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CHANGING FINANCIAL SYSTEMS AND THE RELATIONSHIP BETWEEN MONEY AND INCOME IN TEN ASIAN COUNTRIES

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The objective of this paper is to investigate the long-run relationship between monetary aggregates and income in the era of financial innovations and deregulation in ten Asian developing economies using the cointegration approach. The results of this study suggest that money matters for monetary policy purposes in these countries. Moreover, there is potential role for Divisia monetary aggregates to be used as additional financial indicators for policy actions.

1. Introduction

In the 1980s, there is evidence that financial innovations[1] and deregulation have become more frequent issues in the Asian financial markets. Among the major innovations was the liberalization of interest rates, relaxation of exchange controls, foreign exchange dealings by financial institutions, computerized cheque clearing system, electronic banking, new financial instruments (for example, negotiable certificate of deposits, bankers acceptance and repurchase agreement arrangement [repos]), etc. As a consequence, the financial system has undergone a radical transformation from the relatively simple structure of the early 1960s, comprising the Central Bank and small financial intermediaries, into a more sophisticated

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[1] Ben-Horim and Silber (1977) refer to financial innovation as specific developments or improvements in the financial sector. Miller (1986) defines financial innovations as the unanticipated, unforecastable, the 'surprise' change or improvements in the financial sector.

financial system characterized by the presence of finance companies, merchant banks, commercial banks, discount houses, development finance institutions, capital market institutions, commodity market institutions, new thrift and trust institutions, among others.[2]

However, the aftermath of recent financial liberalization has created new problems for the monetary authorities of the developing countries. The relationship between monetary aggregate, in particular, the narrow money M1, and national income has been questioned more recently. There is evidence that there has been a breakdown in the link between M1 and income in the developing countries. This has led the monetary authorities to focus on broader monetary aggregates as monetary indicators for policy action. Tseng and Corker (1993) have concluded from their study on nine Asian countries[3] that, as a consequence of the changing financial system, the relationship between money, income, and interest rates in those countries has been altered. Tseng and Corker point out that financial liberalization leads to one time or more gradual shifts in the level of money holdings, as well as to changes in the measured income and interest elasticity of money demand.

The objective of the present study is to empirically investigate the long-run relationship between money and income in ten 'deregulated' Asian countries, namely, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Singapore, South Korea, Taiwan, and Thailand. In this study, apart from using the 'traditional' Simple-sum monetary aggregates, we also propose the Divisia aggregates as additional financial indicators for the purpose of monetary policy actions. The reason

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[2] For further discussions on the various financial innovations and deregulation in the Asian countries, see Nasution (1994) on Indonesia; Bank Negara Malaysia (1994) on Malaysia; Shea (1994) on Taiwan; Park (1994) on South Korea; Claasen (1992) on Singapore; Demetriades and Luintel (1996) on Nepal; and Fry (1986) on Philippines and Thailand.

[3] The nine Asian countries were Indonesia, Malaysia, Myanmar, Nepal, Philippines, Singapore, South Korea, Sri Lanka and Thailand.

being that it has been pointed out by Barnett and his colleagues[4] that the instability between money and income was the result of measurement error in measuring the nation's monetary aggregate. Barnett (1980) proposes the use of Divisia aggregate for measuring monetary services. Instead of adding together all the asset components and treating each component with equal weights to form an aggregate, the Divisia aggregate uses the basic monetary components' user costs to calculate their contributions to the consistent monetary aggregates. These user costs measure the marginal money services yielded by each asset component. The share of each component's user cost in total user cost is used to weigh that component's growth rate, and the sum of these weighted growth rates equals the change in the total Divisia aggregate.

Recent study by Chrystal and MacDonald (1994) on the role of Divisia aggregates for the United States, United Kingdom, Australia, Germany, Switzerland, Canada, and Japan, found support for the Divisia aggregates as opposed to the Simple-sum aggregates in these developed countries, even during the financial innovation era. They question the conclusion derived from previous influential studies that financial innovation causes the breakdown of the relationship between money and income. Instead, they argue that inappropriate measurement of money as being the main reason for instability in the link between money and income.

As a matter of fact, recent studies discovered that using Divisia as opposed to Simple-sum aggregate, alters significantly the conclusions that should have been reached by previous influential studies.[5] Chrystal and MacDonald (1994, p. 76) further conclude that 'the problems with tests of money in the economy in recent

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[4] See, for example, Barnett (1980) and Barnett, et al. (1984). Judd and Scadding (1982) and Stone and Thornton (1987) have also highlighted the potential problems using Simple sum aggregate as opposed to the Divisia aggregate.

[5] Barnett, et al. (1992) provide evidence from other developed countries which support the superiority of Divisia aggregate compared to the Simple-sum aggregate.

years may be more due to bad measurement theory rather than to an instability in the link between the true money and the economy. Rather than a problem associated with the Lucas Critique, it could instead be a problem stemming from the Barnett Critique.

2. Methodology

The cointegration analysis

The empirical performance of monetary aggregates and their usefulness as targets for monetary policy might be evaluated in a number of ways, for example, the use of St. Louis-type model or using money demand functions with tests of coefficient stability over time. However, these approaches are sensitive to several problems that arise from the sample period chosen, lag length used in the analysis, specification of the type of functional form and also the type and number of explanatory variables to be included in the model. Thus, one way to circumvent those problems is to investigate the long-run relationship between the monetary aggregates and national income using the cointegration analysis suggested by Granger (1986).

According to Granger (1986), the cointegration methodology provides a way in which the long-run information of the integrated series in level is conserved into equations that comprise stationary components called the error correction model that gives valid statistical inferences. For any $I(1)$ series (say, money, M and income, Y), it is always true that the linear combination of the two series will also result in an $I(1)$.[6] However, if there exists a constant

[6] Series M_t and Y_t are integrated of the same order, denoted by $M_t \sim I(d)$ and $Y_t \sim I(d)$, if the two time series require to be differenced d times to achieve stationarity. A series $M_t \sim I(1)$, that is, integrated of order one, needs to be differenced only once to achieve stationarity, that is, to become $I(0)$. According to Granger (1986), an $I(0)$ series has a mean and there is a tendency for the series to return to the mean, so that it tends to fluctuate around the mean, crossing the value frequently and with rare extensive excursions.

A, such that $z_t = Y_t - AM_t$ is stationary or $I(0)$, then Y_t and M_t will be said to be cointegrated, with A called the cointegrating parameter. If this were not the case, then the variables assumed to be generating the equilibrium could drift apart without bound, which is contrary to the equilibrium concept. If Y_t and M_t are $I(1)$ but cointegrated, then the relationship $Y_t = AM_t$ is considered a long-run or 'equilibrium' relationship, and z_t given above measures the extent to which the system Y_t, M_t are out of equilibrium. Hence, the existence of a linear combination of two $I(1)$ series that is $I(0)$ suggests that the series generally move together over time, such that the relationship holds in the long-run. Accordingly, for a monetary aggregate and income to exhibit a long-run relationship, its velocity should be stationary, also both money and income should be cointegrated.

The test for the order of integration

An integrated series needs to be differenced in order to achieve stationarity. A time series Y_t, that requires no such differencing to obtain stationarity is denoted as $Y_t \sim I(0)$. Therefore, an integrated series such as $Y_t \sim I(2)$ is said to be growing at an increasing rate, $Y_t \sim I(1)$ series appear to grow at a constant rate while $Y_t \sim I(0)$ series appear to be trendless. Thus, if two time series Y_t and M_t are integrated of different order, say $Y_t \sim I(2)$ and $M_t \sim I(1)$, respectively, then they must be drifting apart over time. Therefore, a regression of Y_t on M_t would encounter a spurious regression problem, as the residual would also be $I(2)$ which violates the underlying assumptions of ordinary least squares (OLS). Thus, it is important to determine that the time series of interest have the same order of integration before we proceed into further estimation.

If on the other hand, the two time series Y_t and M_t are both $I(1)$ then it is normally the case that a linear combination between the two will also be $I(1)$ so that a regression of Y_t on M_t would produce spurious results. This is because the residual is also $I(1)$, which violates the assumptions of OLS. However, in a special case, a linear combination of two $I(1)$ variables will result in a variable (residual) which is $I(0)$ and in this special case, the two series are said to be cointegrated. This regression is permissible since the residual is $I(0)$ or stationary, which satisfies the underlying assumption of OLS.

Nelson and Plosser (1982) have demonstrated that most economic time series appear to be difference-stationary processes. Thus, in numerous studies, the augmented Dickey and Fuller (1981) unit root test was employed to determine the order of integration of the individual series. This is because only variables that are of the same order of integration may constitute a potential cointegrating relationship. The test is the *t*-statistic on the parameter α from the following equation

$$(2) \qquad \Delta Y_t = \delta_0 + \alpha Y_{t-1} + \sum_{i=1}^{L} \delta_i \Delta Y_{t-i} + \nu_t$$

where ν_t is the disturbance term. The role of the lagged dependent variable in the augmented Dickey-Fuller (ADF) regression equation (2) is to ensure that ν_t is white noise. The null hypothesis, H_0: Y_t is $I(1)$, is rejected (in favor of $I(0)$) if α is found to be negative and statistically significantly different from zero. The computed *t*-statistic on parameter α is compared to the critical value tabulated in MacKinnon (1991). The unit root tests were also carried out for first-difference of the variables, that is, the following regression equation is estimated

$$(3) \qquad \Delta^2 Y_t = \delta_0 + \alpha \Delta Y_{t-1} + \sum_{i=1}^{L} \delta_i \Delta^2 Y_{t-i} + \omega_t$$

where the null hypothesis is H_0: Y_t is $I(2)$, which is rejected (in favor of $I(1)$) if α is found to be negative and statistically significantly different from zero.

The cointegration tests

After determining that the series are of the same order of integration, the linear combination of the series that are nonstationary in levels are cointegrated is then tested. To conduct the cointegration test, Engle and Granger (1987) propose a two-step procedure for testing the null of no cointegration. In the first step, the following cointegrating regression is estimated

(4) $$Y_t = \gamma_0 + \gamma_1 M_t + \eta_t$$

and in the second step, the ADF unit root test is conducted on the residual η_t as follows:

(5) $$\Delta\eta_t = \beta\eta_{t-1} + \sum_{i=1}^{L} \varphi_i \eta_{t-i} + \varepsilon_t$$

The null hypothesis is H_o: $\beta = 0$, that is, Y_t and M_t are not cointegrated. This is tested by means of t-statistic of parameter β. The critical value is tabulated in MacKinnon (1991). If t_β is smaller than the critical value then Y_t and M_t is said to be cointegrated. Engle and Granger (1987) have also recommended the use of the following cointegrating regression Durbin-Watson (CRDW) statistic computed as follows:

(6) $$\text{CRDW} = [\sum_{t=2}^{N} (\eta_t - \eta_{t-1})^2]/[\sum_{t=1}^{N} \eta t^2]$$

The null hypothesis of no cointegration is rejected for values of CRDW which are significantly different from zero. The critical values for CRDW are tabulated in Engle and Yoo (1987).

However, more recently, Banerjee, et al. (1986) and Kremers, et al. (1992) have shown that the ADF and CRDW tests for cointegration have low power and are sensitive to the choice of lag length and therefore, have recommended the estimation of an error correction model (ECM) as the starting point for modelling and testing. Kremers, et al. (1992) demonstrate that the t-ratio of the coefficient on the error correction term in a dynamic error correction model (ECM), denoted as the ECM stastistic (t_{ECM}), is a more powerful statistic for testing cointegration as compared to the augmented Dickey-Fuller (t_{ADF}) type tests.[7] Kremers, et al. (1992)

[7] See Mokhtari (1994) for a recent application of the ECM statistic, t_{ECM}.

pointed out that the Dickey-Fuller statistic ignores potentially valuable information and a loss of information can occur from assuming error dynamics rather than structural dynamics.

Therefore, as an alternative test for testing cointegration, the error correction model is the appropriate approach. The ECM approach is derived from an important theorem presented by Engle and Granger (1987) that if a set of variables are cointegrated then there always exists an error correcting formulation of the dynamic model and vice versa. Using this approach, following Banerjee, et al. (1986) and Kremers, et al. (1992), the following regression is then estimated using OLS:

$$(7) \qquad \Delta Y_t = \phi_0 + \lambda \mathrm{ECM}_{t-1} + \sum_{i=1}^{H} \Delta Y_{it} + \sum_{j=0}^{N} \Delta M_{jt} + \mu_t$$

where the variable ECM_{t-1} is the lagged one-period residual from the cointegrating regression equation (3). Parameter λ is then evaluated and a test is carried out to check if it is significantly different from zero. The significance of the error correction term (ECM_{t-1}) is sufficient to infer cointegration among the variables in question. The third and fourth terms on the right hand side of equation (7) are to ensure white noise in μ_t.

3. Discussions of Empirical Results

This study covers the period 1981:1 to 1994:4. The four monetary aggregates included in the study were Simple-sum M1 and M2, and Divisia M1 and M2. Nominal income is proxy by gross national product. The sources and detailed description on the computation of Divisia aggregates and the interpolation of quarterly GNP for the Asian countries other than Singapore, South Korea and Taiwan are referred to Habibullah and Smith (1997) and Habibullah (1998).

Table 1 presents the results of the unit root tests on the levels, first-differences and second-differences of the series. In order to choose the appropriate lag length, we started with one lagged regressor, and proceeded by adding an extra lagged term to the regression whenever the LM statistic for fourth-order autoregression exceeded the 5 percent critical value, until the test signalled white noise residuals.[8] Results in Table 1 clearly indicate that most time series are stationary after they have been first-differenced. However, several series, in particular, the Simple-sum M1 for Malaysia and Nepal; Divisia M1 for Malaysia, Nepal and Thailand; Simple-sum M2 for Philippines, Singapore, Taiwan and Thailand; Divisia M2 for Singapore, Sri Lanka, Taiwan and Thailand; and income for Singapore need to be differenced twice to achieve stationarity.

The results of the error correction models estimated for each of the monetary aggregates for all countries are presented in Table 2. For completeness, we have also presented the estimated cointegrating regression equations and the results of the Engle-Granger (1987) two-step procedure for cointegration tests in Table 2. The last column in Table 2 suggests that there is no serial correlation present in the ECM auxiliary regression equations estimated. The lag length, H and N, are chosen according to the procedure outlined earlier. Our main interest is the t-statistic of the ECM term in equation (6) as shown by t_{ECM} in Table 2. We observe in Table 2 that, unlike for Malaysia, South Korea and Thailand,[9] the evidence that monetary aggregates and national income are cointegrated is supported by the Indonesian and Myanmar monetary data. In both countries, the results indicate that all four money measure exhibit long-run relationships with income during the period under study. The results indicate that both Simple-sum and Divisia M1 and M2 are good monetary indicators for policy purposes in these countries.

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[8] Schlitzer (1996) also uses this approach, but instead of using Breusch-Godfrey LM test for serial correlation, he uses the Box-Ljiung Portmanteau statistic to detect for serial correlation.

[9] If one allows the significance level of the ECM test statistic to be at 10 percent level, however, with the critical value of –3.12, would indicate that Simple-sum is cointegrated with income in Thailand.

Table 1 - Results of Integration Tests

Money series	Levels			First-Differences			Second-Differences		
	t_α	Lags	LM(4)	t_α	Lags	LM(4)	t_α	Lags	LM(4)
INDONESIA									
Simple sum M1	1.27	0	1.90	–8.13*	0	1.82	–	–	–
Divisia M1	1.37	1	1.43	–10.76*	0	1.37	–	–	–
Simple sum M2	0.10	0	1.32	–7.66*	0	1.41	–	–	–
Divisia M2	0.83	0	6.66	–9.73*	0	1.86	–	–	–
Income	0.80	3	3.69	–7.23*	2	3.58	–	–	–
MALAYSIA									
Simple sum M1	2.10	3	4.19	–2.79	5	6.58	–3.70*	6	6.66
Divisia M1	1.23	4	2.44	–1.64	3	3.57	–13.62*	2	2.44
Simple sum M2	1.31	0	4.08	–6.66*	0	4.18	–	–	–
Divisia M2	1.24	0	6.10	–7.99*	0	6.25	–	–	–
Income	1.43	3	4.71	–7.01*	3	6.46	–	–	–
MYANMAR									
Simple sum M1	0.38	0	1.44	–7.97*	0	0.81	–	–	–
Divisia M1	0.22	0	1.17	–7.95*	0	0.12	–	–	–
Simple sum M2	0.85	0	4.09	–8.52*	0	1.49	–	–	–
Divisia M2	0.84	0	4.95	–8.92*	0	1.02	–	–	–
Income	0.04	5	7.07	–10.65*	2	4.79	–	–	–
NEPAL									
Simple sum M1	1.81	8	6.09	–2.08	7	6.00	–4.24*	10	1.58
Divisia M1	1.88	10	7.00	–2.48	8	6.70	–4.06*	10	2.77

Table 1 (continued)

Money series	Levels			First-Differences			Second-Differences		
	t_α	Lags	LM(4)	t_α	Lags	LM(4)	t_α	Lags	LM(4)
Simple sum M2	1.34	4	6.69	–3.38*	3	5.36	–	–	–
Divisia M2	3.31	6	6.62	–4.53*	3	5.85	–	–	–
Income	0.00	3	4.58	–8.67*	2	4.35	–	–	–
PHILIPPINES									
Simple sum M1	0.71	7	5.42	–5.43*	6	5.05	–	–	–
Divisia M1	–2.00	11	4.83	–4.41*	10	3.85	–	–	–
Simple sum M2	0.57	8	6.57	–1.75	7	4.94	–3.66*	6	3.05
Divisia M2	–0.38	7	7.56	–3.93*	6	7.72	–	–	–
Income	–0.76	2	2.26	–8.42*	1	2.17	–	–	–
SINGAPORE									
Simple sum M1	1.73	3	2.34	–6.28*	2	4.80	–	–	–
Divisia M1	1.37	8	5.80	–3.57*	6	6.79	–	–	–
Simple sum M2	–0.12	4	7.99	–2.35	5	1.19	–11.49*	2	7.73
Divisia M2	0.33	6	2.38	–2.54	5	2.15	–4.19*	4	3.63
Income	1.42	8	3.50	–2.21	7	1.44	–3.69*	6	1.64
SOUTH KOREA									
Simple sum M1	–0.04	3	3.56	–9.52*	1	7.79	–	–	–
Divisia M1	0.14	3	3.19	–9.71*	1	7.68	–	–	–
Simple sum M2	0.29	4	6.69	–3.55*	5	2.91	–	–	–
Divisia M2	–0.20	4	4.00	–6.87*	2	7.19	–	–	–
Income	0.75	4	7.02	–3.27*	3	6.94	–	–	–

Table 1 (continued)

Money series	Levels			First-Differences			Second-Differences		
	t_α	Lags	LM(4)	t_α	Lags	LM(4)	t_α	Lags	LM(4)
SRI LANKA									
Simple sum M1	–0.11	4	5.67	–3.57*	3	5.28	–	–	–
Divisia M1	–1.13	4	7.64	–2.92*	3	7.81	–	–	–
Simple sum M2	1.58	4	4.41	–2.91*	3	2.51	–	–	–
Divisia M2	1.86	8	6.74	–2.07	7	6.23	–5.45*	6	5.67
Income	–0.13	3	3.45	–6.19*	3	6.82	–	–	–
TAIWAN									
Simple sum M1	–1.23	5	7.17	–2.99*	6	3.71	–	–	–
Divisia M1	–1.17	5	7.32	–2.97*	6	3.34	–	–	–
Simple sum M2	–2.28	4	5.26	–1.45	3	0.62	–8.86*	2	0.74
Divisia M2	–0.90	6	6.16	–2.00	5	6.06	–11.30*	2	6.37
Income	0.30	3	6.81	–7.87*	2	6.85	–	–	–
THAILAND									
Simple sum M1	1.20	6	5.27	–3.02*	5	6.33	–	–	–
Divisia M1	1.64	10	2.95	–1.57	9	4.70	–4.81*	7	9.02
Simple sum M2	–0.22	7	1.44	–1.77	6	1.44	–13.01*	2	9.40
Divisia M2	0.06	8	6.46	–2.05	7	6.34	–5.63*	6	4.85
Income	1.53	3	5.04	–8.16*	2	7.98	–	–	–

Notes: Following MacKinnon (1991), for 56 observations, the critical value at 5 percent level of significance is -2.91. The Chi-square for LM statistics for fourth order autoregression is 9.48 (5 %).

Table 2 - Results of Cointegration Tests

Money series	Cointegrating regression				ADF auxiliary regression			ECM auxiliary regression				
	Coefficient on regressor											
	γ_0	γ_1	R^2	CRDW	t_{ADF}	L	LM(4)	t_{ECM}	H	N	R^2	LM(4)
INDONESIA												
Simple sum M1	1.453	0.918	0.963	1.40*	-5.38*	0	5.52	-5.34*	-	0	0.383	2.80
Divisia M1	0.889	0.972	0.967	1.65*	-6.32*	0	1.98	-6.36*	-	0	0.461	1.27
Simple sum M2	3.933	0.610	0.973	1.62*	-6.17*	0	2.23	-6.17*	-	0	0.426	2.09
Divisia M2	3.640	0.649	0.970	1.54*	-5.82*	0	4.01	-5.80*	-	0	0.399	2.60
MALAYSIA												
Simple sum M1	9.830	6.514	0.280	0.76	0.07	3	2.87	0.58	3	0	0.927	3.93
Divisia M1	9.853	6.827	0.184	0.96*	0.21	3	5.62	1.09	3	0	0.939	4.87
Simple sum M2	1.157	0.798	0.724	2.76*	-1.98	3	4.34	-1.56	3	0	0.932	4.41
Divisia M2	0.685	0.847	0.715	2.67*	-1.57	3	3.72	-1.64	3	0	0.935	3.61
MYANMAR												
Simple sum M1	0.035	1.013	0.863	1.65*	-6.00*	0	5.20	-5.72*	-	1	0.510	7.12
Divisia M1	0.096	1.008	0.856	1.60*	-5.85*	0	4.59	-5.62	-	0	0.426	5.51
Simple sum M2	-0.958	1.076	0.869	1.69*	-6.27*	0	7.32	-6.50*	-	0	0.500	6.73
Divisia M2	0.054	0.971	0.880	1.85*	-6.77*	0	7.18	-6.91*	-	0	0.529	7.02
NEPAL												
Simple sum M1	9.732	1.906	0.033	0.10	0.34	3	1.46	1.47	3	2	0.929	5.80
Divisia M1	9.821	0.353	0.003	0.08	0.31	3	2.14	1.43	3	2	0.931	8.30

Table 2 (continued)

Money series	Cointegrating regression				ADF auxiliary regression			ECM auxiliary regression				
	Coefficient on regressor											
	γ_0	γ_1	R^2	CRDW	t_{ADF}	L	LM(4)	t_{ECM}	H	N	R^2	LM(4)
Simple sum M2	1.400	0.846	0.955	1.95*	–7.64*	1	2.43	–7.69*	1	0	0.647	2.14
Divisia M2	1.475	0.842	0.958	2.01*	–7.73*	1	2.43	–7.34*	1	0	0.637	2.31
PHILIPPINES												
Simple sum M1	1.911	0.942	0.966	0.83*	–2.55	2	7.05	–3.78*	–	3	0.595	5.48
Divisia M1	2.651	0.852	0.978	1.56*	–6.01*	1	6.25	–5.47*	–	3	0.693	4.55
Simple sum M2	12.078	1.265	0.015	0.03	–1.52	2	0.12	–0.89	2	0	0.388	6.85
Divisia M2	3.192	0.727	0.978	0.99*	–4.08*	0	6.59	–3.70*	–	3	0.546	6.46
SINGAPORE												
Simple sum M1	–0.036	0.001	0.005	2.10*	–2.55	7	1.82	–5.51*	2	3	0.806	3.12
Divisia M1	–0.024	0.005	0.002	2.09*	–2.47	7	1.66	–5.16*	2	3	0.844	2.69
Simple sum M2	6.956	0.678	0.980	0.41	–2.99	4	7.12	–2.97	4	1	0.914	7.53
Divisia M2	6.703	0.703	0.982	0.50	–0.44	6	5.98	–2.82	4	4	0.928	5.09
SOUTH KOREA												
Simple sum M1	0.021	0.871	0.949	1.69*	–2.42	4	7.44	0.77	4	0	0.980	7.90
Divisia M1	0.518	0.811	0.950	1.73*	–2.16	4	7.57	0.75	4	0	0.980	7.92
Simple sum M2	–0.732	0.827	0.959	2.53*	–4.25*	4	5.71	–2.59	4	3	0.982	6.96
Divisia M2	–0.111	0.763	0.960	2.48*	–3.91*	4	6.77	–1.91	4	3	0.981	5.78

Table 2 (continued)

Money series	Cointegrating regression				ADF auxiliary regression			ECM auxiliary regression				
	Coefficient on regressor											
	γ_0	γ_1	R^2	CRDW	t_{ADF}	L	LM(4)	t_{ECM}	H	N	R^2	LM(4)
SRI LANKA												
Simple sum M1	0.958	0.980	0.942	1.76*	–1.75	3	5.95	–4.24*	1	2	0.669	6.62
Divisia M1	1.458	0.917	0.930	1.62*	–1.32	3	6.17	–0.99	3	3	0.773	4.08
Simple sum M2	–0.001	0.987	0.953	2.14*	–2.57	3	7.81	–7.08*	1	2	0.730	4.08
Divisia M2	10.843	2.027	0.011	0.11	–0.04	3	5.59	0.26	4	4	0.802	6.13
TAIWAN												
Simple sum M1	2.177	0.638	0.959	0.37	–1.74	4	5.51	–5.25*	11	0	0.742	5.32
Divisia M1	2.114	0.651	0.964	0.41	–1.73	4	5.70	–5.16*	11	0	0.737	4.97
Simple sum M2	7.087	–8.041	0.137	0.38	–0.77	3	2.97	0.05	1	2	0.351	7.68
Divisia M2	6.765	–1.066	0.013	0.04	–0.54	7	0.95	0.20	1	2	0.392	4.09
THAILAND												
Simple sum M1	0.817	1.019	0.970	1.34*	–2.42	6	3.39	–3.13	2	2	0.598	7.48
Divisia M1	12.828	1.286	0.030	0.06	–0.33	6	5.99	1.51	4	0	0.555	4.28
Simple sum M2	12.850	0.349	0.000	0.01	2.10	3	6.34	1.46	4	0	0.532	2.70
Divisia M2	12.858	0.189	0.000	0.01	2.22	3	5.52	1.51	4	0	0.526	3.02

Notes: At 5 percent significance level, the critical value for CRDW is 0.78 (see Engle and Yoo, 1987), and cointegration test is -3.45 (see MacKinnon, 1991). The Chi-square for LM statistics for fourth order autoregression is 9.48 (5 %).

The results for Philippines suggest that Divisia aggregates dominate the Simple-sum aggregate, where both Divisia M1 and M2 are cointegrated with national income. Furthermore, Simple-sum M1 also show an apparent long-run relationship with income. In Nepal, the broad monetary aggregates, Simple-sum and Divisia M2 show a long-run relationship with national income, but, in Singapore and Taiwan, only narrow monetary aggregates, both Simple-sum and Divisia are cointegrated with national income. On the other hand, the results for Sri Lanka show that, both Simple-sum M1 and M2 exhibit long-run relationship with national income.

Comparing the results of the ECM with the ADF and CRDW, we find some interesting features. The t_{ADF} values of the ADF auxiliary regressions show that the results for Indonesia, Malaysia, Myanmar, Nepal, Thailand and the Philippines (except for Simple-sum M1) are not different from those derived from the ECM auxiliary regression. However, contrasting results are shown by Singapore, South Korea, Sri Lanka, and Taiwan. In the ECM model, 19 out of 40 cases show evidence of cointegration between monetary aggregates and national income, but, in the ADF regressions, only 14 out of 40 cases exhibit cointegration. However, in general, the results of the ADF are at odds with the results derived from ECM in 10 out of 40 cases. On the other hand, results from the CRDW indicate that 26 out of 40 cases show that monetary aggregates are cointegrated with national income. As a whole, 13 out of 40 cases of CRDW results are different from the ECM. In fact 12 out of 40 cases of CRDW results are in contrast with the results from the ADF regression.

The above results which indicate the discrepancies between CRDW, ADF and ECM thus provide support for Banerjee, et al. (1986) and Kremers, et al. (1992) conclusion that one has to be more wary and cautious in interpreting the results of CRDW and t_{ADF} as these statistics have low power compared to t_{ECM}. As a matter of fact, earlier, Engle and Yoo (1987) have warned against using CRDW as a test for cointegration. Engle and Yoo (1987, p. 157-158) note that

> "we have examined the behavior of the Durbin-Watson statistic from the co-integrating regression. Unfortunately, the discrepancy between the critical values for different systems remains significant even for the sample of size two hundred. This is not surprising since the statistic is not asymptotically similar to the preceding tests. Hence this statistic does not appear to be too useful for testing co-integration."

Although there is evidence that some monetary aggregates and national income are cointegrated in Indonesia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka and Taiwan, the question now is, how stable are these relationships? Therefore, in this study we endeavor to test for structural stability for the period 1981:1 to 1994:4, in which, as mentioned earlier, financial innovations were most prevalent. To test for stability we used the CUSUM and CUSUM-squared tests as well as the standard Chow and predictive failure tests (see Table 3). The results of the CUSUM and CUSUM-squared test are presented in Figures 1 to 7. In general, except for Sri Lanka, these plots provide increasing indication of evidence of instability during the financial innovation era of 1980s. In some cases, the graph (either CUSUM or CUSUM-squared) touches the upper 5 percent line, and in other cases it exceeds the upper 5 percent limit. Nevertheless, there are indications that the relationship between these monetary aggregates and national income stabilized in the 1990s. On the other hand, the Chow and predictive failure tests also suggest that the relationship has been unstable during the period under study, in particular, for Myanmar, Philippines, Singapore, and Sri Lanka. In summary, despite cointegration between some monetary aggregates and national income in seven (7) out of ten (10) Asian countries studied, there are indications that these relationships are not stable. However, the instability in the link between money and income subsides towards 1994.

Table 3 - Results of Structural Stability Tests

Country	Series	Break Point	Chow	Predictive Failure
Indonesia	Simple sum M1	1985:2	0.935	0.524
			(0.430)	(0.939)
		1989:2	0.615	0.519
			(0.608)	(0.944)
	Divisia M1	1985:2	0.568	0.676
			(0.638)	(0.830)
		1989:2	1.113	0.469
			(0.352)	(0.966)
	Simple sum M2	1985:2	0.288	0.650
			(0.833)	(0.852)
		1989:2	0.759	0.668
			(0.522)	(0.837)
	Divisia M2	1985:2	1.325	0.713
			(0.276)	(0.797)
		1989:2	0.431	0.494
			(0.731)	(0.956)
Myanmar	Simple sum M1	1985:2	0.426	5.474**
			(0.788)	(0.002)
		1989:2	0.747	0.455
			(0.565)	(0.965)
	Divisia M1	1985:2	0.719	7.293**
			(0.545)	(0.000)
		1989:2	0.353	0.367
			(0.786)	(0.989)
	Simple sum M2	1985:2	0.606	5.719**
			(0.614)	(0.000)
		1989:2	0.369	0.387
			(0.775)	(0.986)
	Divisia M2	1985:2	0.711	5.396**
			(0.540)	(0.001)
		1989:2	0.513	0.434
			(0.675)	(0.974)

Table 3 (continued)

Country	Series	Break Point	Chow	Predictive Failure
Nepal	Simple sum M2	1985:2	1.075	0.370
			(0.379)	(0.989)
		1989:2	1.004	0.809
			(0.414)	(0.694)
	Divisia M2	1985:2	0.968	0.393
			(0.433)	(0.984)
		1989:2	0.938	0.753
			(0.450)	(0.752)
Philippines	Simple sum M1	1986:2	1.584	0.759
			(0.176)	(0.743)
		1989:4	2.458**	1.469
			(0.040)	(0.177)
	Divisia M1	1986:2	0.703	0.350
			(0.648)	(0.990)
		1989:4	0.571	0.814
			(0.750)	(0.680)
	Divisia M2	1986:2	2.190*	0.447
			(0.063)	(0.965)
		1989:4	1.489	0.787
			(0.206)	(0.709)
Singapore	Simple sum M1	1986:2	2.669**	1.548
			(0.020)	(0.249)
		1989:4	0.846	0.499
			(0.568)	(0.942)
	Divisia M1	1986:2	3.132**	1.369
			(0.008)	(0.321)
		1989:4	0.510	0.359
			(0.840)	(0.989)
Sri Lanka	Simple sum M1	1986:2	1.162	1.549
			(0.344)	(0.210)
		1989:4	0.876	0.737
			(0.520)	(0.759)

Table 3 (continued)

Country	Series	Break Point	Chow	Predictive Failure
	Simple sum M2	1986:2	0.773	1.161
			(0.595)	(0.408)
		1989:4	2.021*	1.009
			(0.084)	(0.489)
Taiwan	Simple sum M1	1989:2	0.919	0.267
			(0.558)	(0.992)
		1991:2	0.352	0.308
			(0.971)	(0.985)
	Divisia M1	1989:2	0.887	0.257
			(0.585)	(0.993)
		1991:2	0.308	0.271
			(0.983)	(0.991)

Notes: Figures in parentheses are p-values. ** and * denote statistically significant at 5 percent and 10 percent level, respectively.

Figure 1a
Indonesia - Simple sum M1

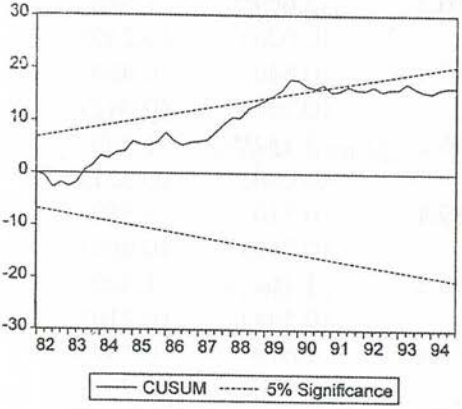


Figure 1b
Indonesia - Simple sum M1

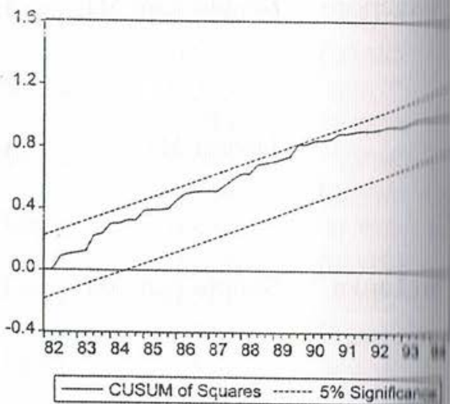


Figure 1c
Indonesia - Divisia M1

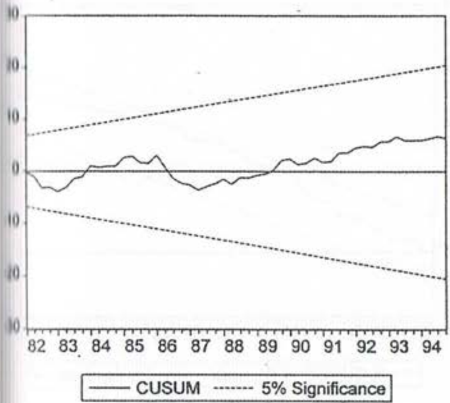


Figure 1d
Indonesia - Divisia M1

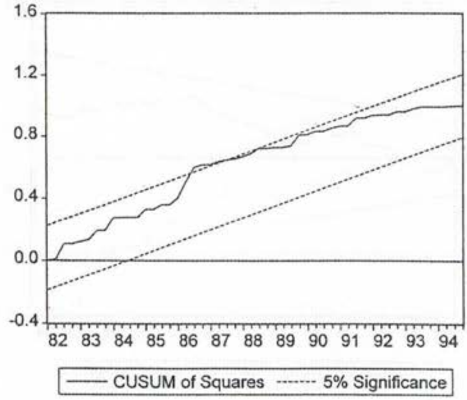


Figure 1e
Indonesia - Simple sum M2

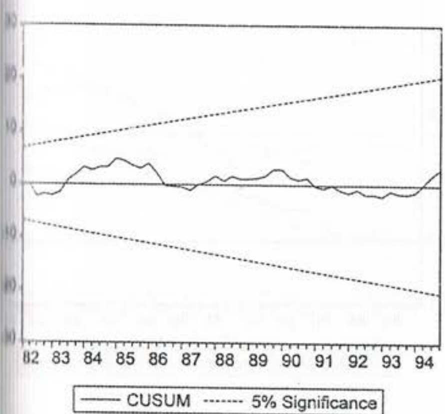


Figure 1f
Indonesia - Simple sum M2

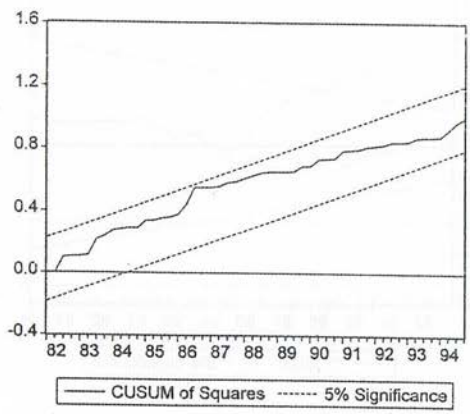


Figure 1g
Indonesia - Divisia M2

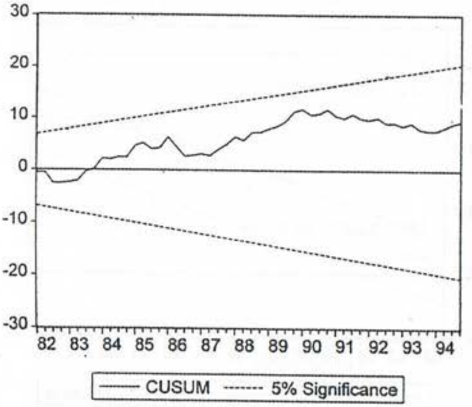


Figure 1h
Indonesia - Divisia M2

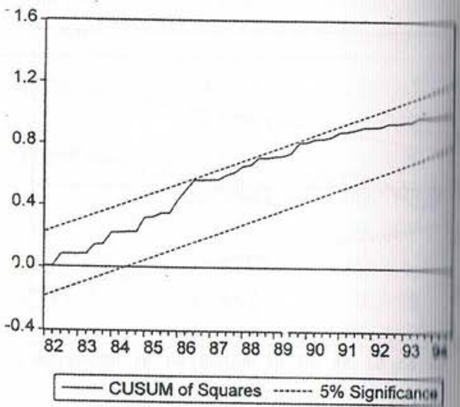


Figure 2a
Myanmar - Simple sum M1

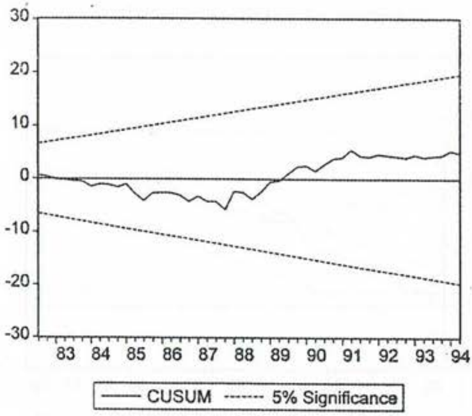


Figure 2b
Myanmar - Simple sum M1

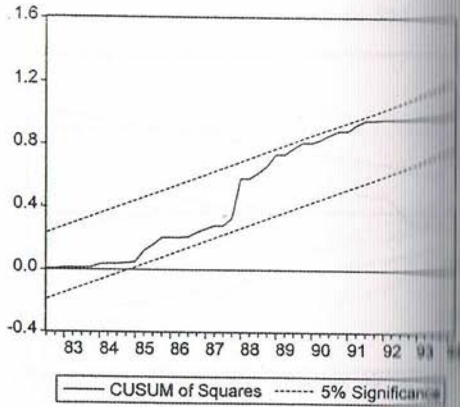
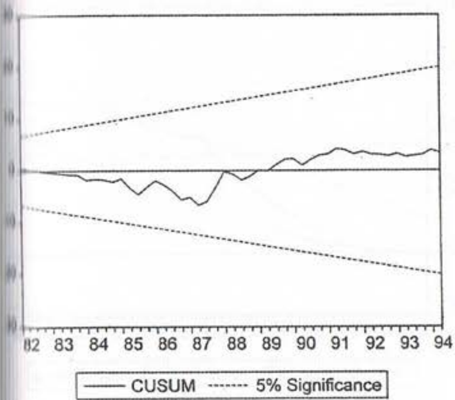


Figure 2c
Myanmar Divisia M1



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Myanmar - Divisia M1

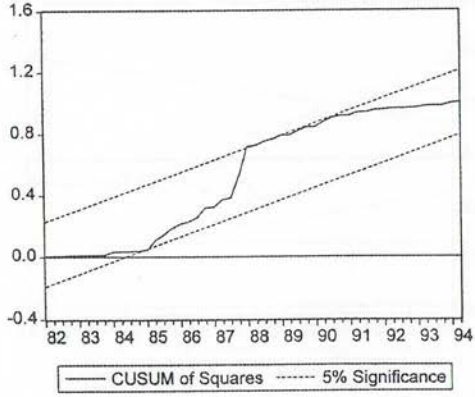
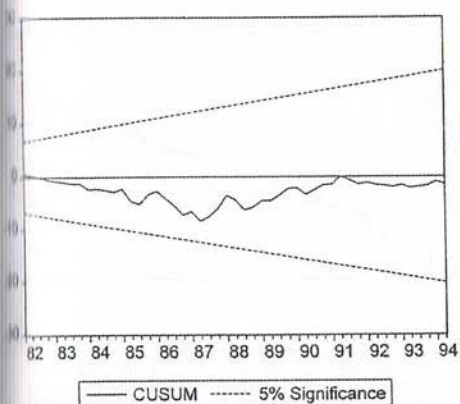


Figure 2e
Myanmar - Simple sum M2



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Myanmar - Simple sum M2

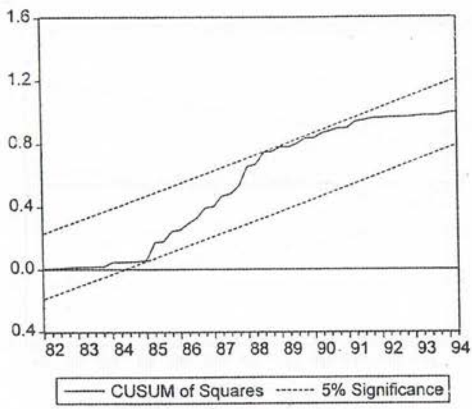


Figure 2g
Myanmar - Divisia M2

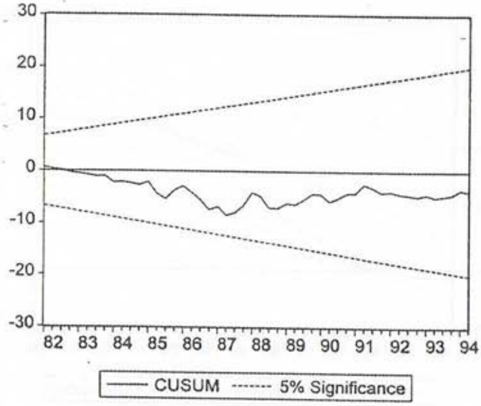


Figure 2h
Myanmar - Divisia M2

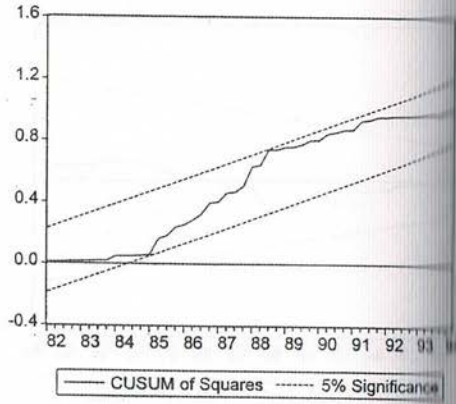


Figure 3a
Nepal - Simple sum M2

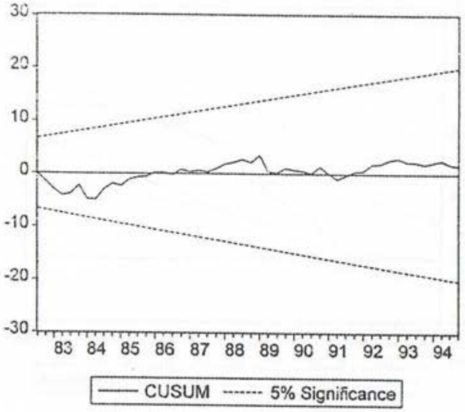


Figure 3b
Nepal - Simple sum M2

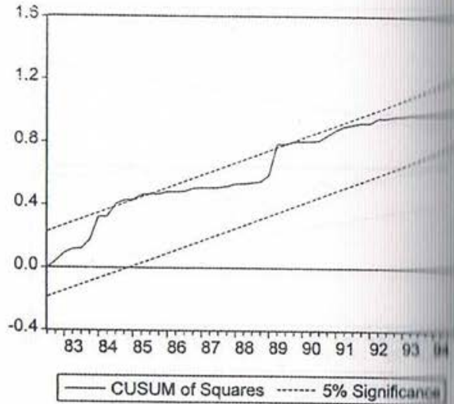


Figure 3c
Nepal - Divisia M2

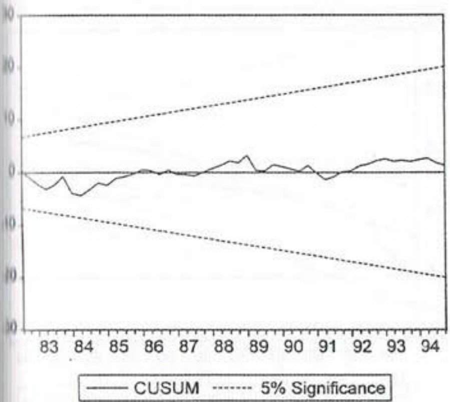


Figure 3d
Nepal - Divisia M2

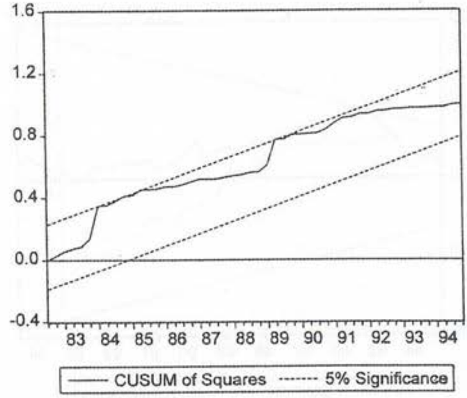


Figure 4a
Philippines - Simple sum M1

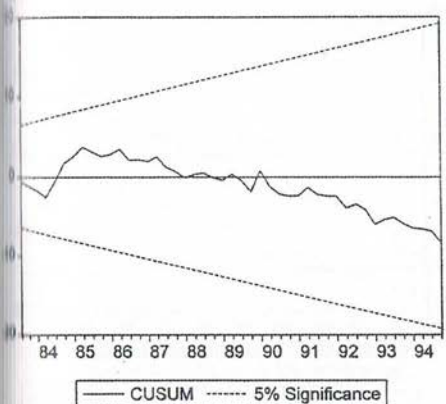


Figure 4b
Philippines - Simple sum M1

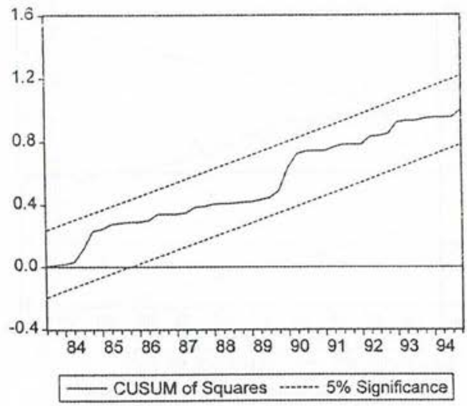


Figure 4c
Philippines - Divisia M1

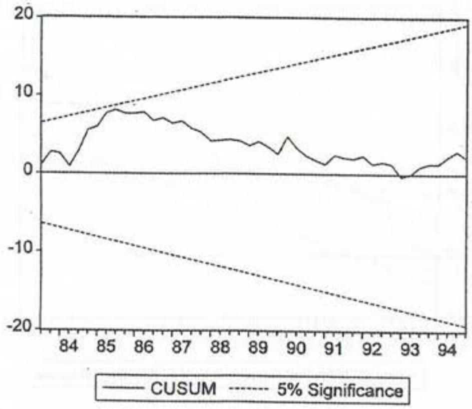


Figure 4d
Philippines - Divisia M1

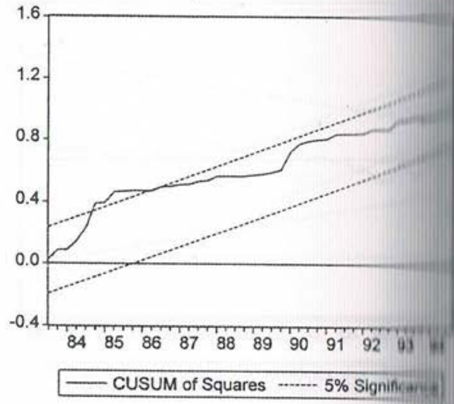


Figure 4e
Philippines - Divisia M2

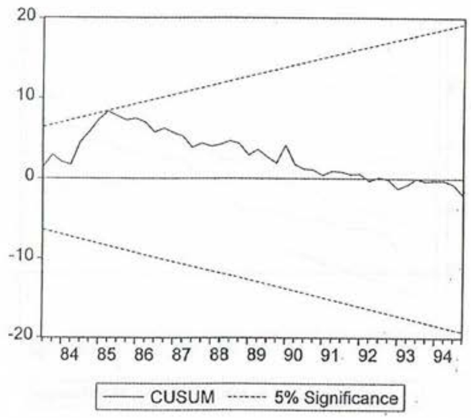


Figure 4f
Philippines - Divisia M2

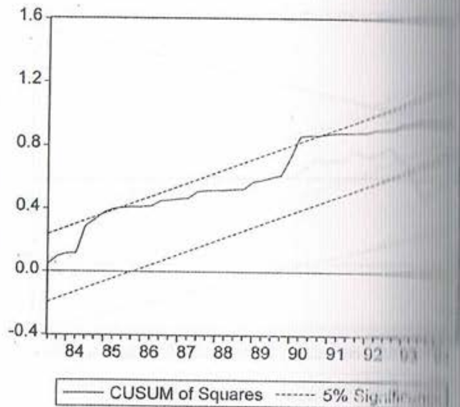


Figure 5a
Singapore - Simple sum M1

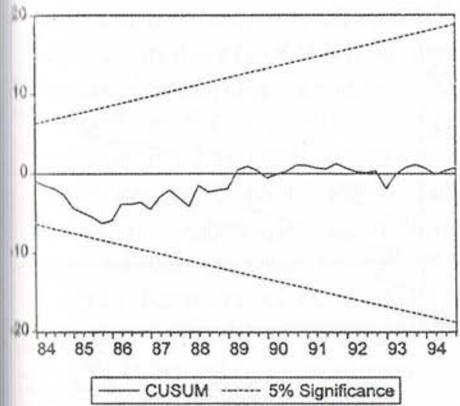


Figure 5b
Singapore - Simple sum M1

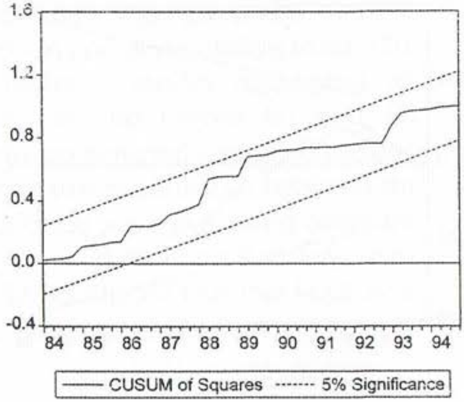


Figure 5c
Singapore - Divisia M1

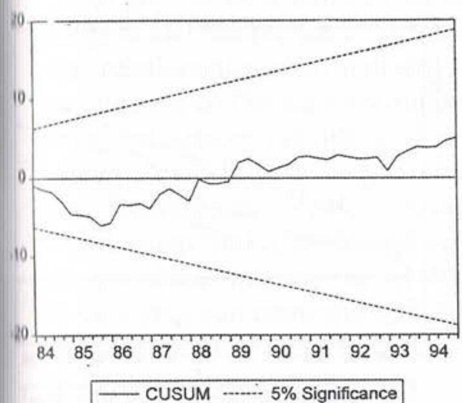


Figure 5d
Singapore - Divisia M1

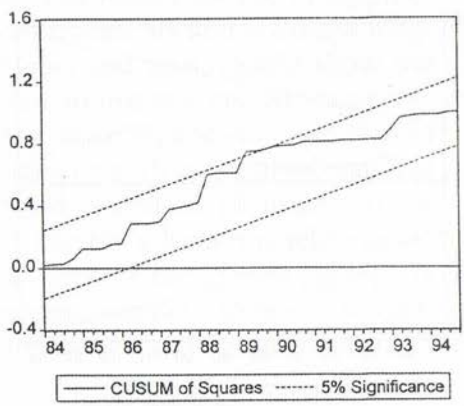


Figure 6a
Sri Lanka - Simple sum M1

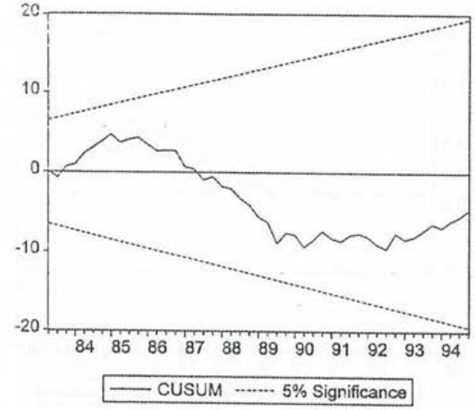


Figure 6b
Sri Lanka - Simple sum M1

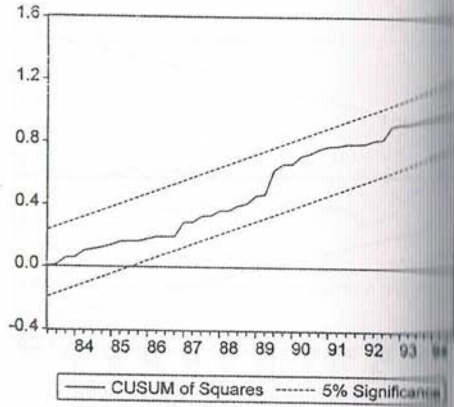


Figure 6c
Sri Lanka - Simple sum M2

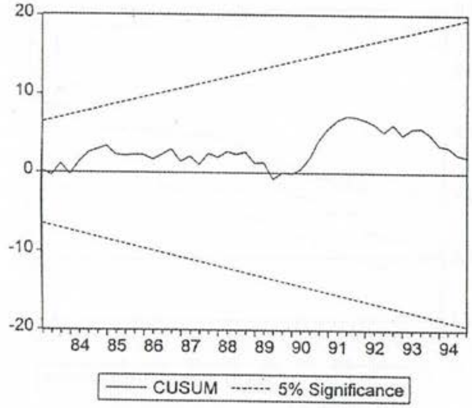
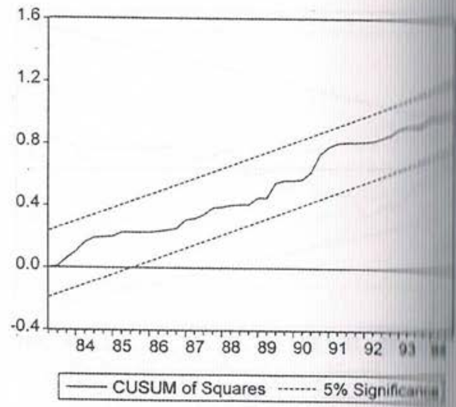


Figure 6d
Sri Lanka - Simple sum M2



4. Conclusions

The objective of this paper has been to investigate the long-run relationship between alternative monetary aggregates and national income in the era of financial innovation and deregulation in ten (10) Asian developing countries. Alternative monetary aggregates included in the analysis are Simple-sum and Divisia M1 and M2 aggregates. The Divisia aggregates are constructed using the method porposed by Barnett (1980). The long-run relationship between the monetary aggregates and national income were evaluated using the t_{ECM} statistic proposed by Banerjee, et al. (1986) and Kremers, et al. (1992). Kremers, et al. (1992) had demonstrated that the *t*-test from the error correction model (ECM) is more powerful than the Dickey-Fuller type tests.

Empirical results indicate that the evidence for a long-run relationship between monetary aggregates and national income varies across countries. In Malaysia, South Korea and Thailand, both Simple-sum and Divisia monetary aggregates do not show any stable link with national income. In contrast, in Indonesia, all measures of monetary aggregates exhibit evidence of cointegration with national income. The results for the Philippines suggest that Simple-sum M1 and both Divisia M1 and M2 show long-run relationships with national income, and thus, clearly show the dominance of Divisia over Simple-sum in this country. In Singapore, only the narrow definition of money (both Simple-sum and Divisia aggregate) indicate a long-run relationship with national income. On the contrary, in Nepal, only a broad definition of money (both Simple-sum and Divisia aggregate) exhibit a long-run relationship with national income. In Sri Lanka, none of the Divisia aggregates have a long-run relationship with income, instead, the results suggest that Simple-sum monetary aggregate are useful indicator compared to Divisia aggregate.

Our main conclusion from this study is that money matters for monetary policy purposes despite the occurrence of financial innovations and deregulation in the above selected Asian countries. And in the majority of the above cases analyzed, there is potential role for Divisia aggregates as additional financial indicators for policy actions in the Asian developing countries investigated.

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