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Financial reforms and money demand: Evidence from 20 developing countries

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ABSTRACT

The effects of financial reforms on money demand (*M1*) are analysed with estimates for two sets of sub-samples and two break dates for twenty developing Asian and African countries. In all cases, the magnitude of income elasticity does not change significantly when compared with sub-samples and whole sample periods. Using *CUSUM* and *CUSUMSQ* tests, we find that the demand for money functions in our selected countries are temporally stable and therefore the respective monetary authorities may target money supply as the conduct of monetary policy.

1. Introduction

A stable demand for money function is a necessary condition for the money supply to be an instrument of monetary policy. Due to the financial deregulation and reforms since the 1980s, it is vital to examine the stability of the demand for money function. In a classic paper, Poole (1970) detailed the optimal choice of monetary policy instruments within a standard *ISLM* model. He assumed that the monetary authority can control one of the two instruments (tools) of monetary policy exactly, that is, either money supply or interest rate. If the aim is to minimize the squared deviation of real output from its target value, Poole showed that the choice of the optimal instrument depends on the variance of the error term in the *LM* function, the covariance of the two error terms, and the size of the parameters. Explicitly, he argued that the rate of interest should be targeted if the *LM* curve is unstable and money supply if the *IS* curve is unstable. Since the instability in the demand for money is a major factor causing instability in the *LM*, it is therefore vital to test the stability of the

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money demand function. Based on Poole's analysis, it is interesting to examine whether the use of the rate of interest as a monetary policy instrument by the developing countries can be justified.

A financial system's input to the economy depends upon the quantity and quality of its services and the efficiency with which it presents them. Financial reforms have been the major priority since the 1980s in developed and developing countries. Many studies have argued that financial reforms have made the demand for money functions unstable in both developed and developing countries; see, for example, Nell (1999), Wesso (2002), Bahmani-Oskooee and Rehman (2005), James (2005) and Narayan (2007). We argue that such conclusions are only viable if appropriate stability tests show instability in the demand for money functions and these financial reforms had significant effects.[1] If reforms are not strong enough and weakly implemented, they may not have any significant effects or they may take a long time to be effective. The inherent efficiencies which are expected of a financial sector may not yet manifest in a developing country for these reasons. Few studies in the money demand literature show that the financial reforms did have significant effects on money demand in advanced countries; see, for example, McPhail (1991), Haug (1999), Caporale and Gil-Alana (2005) and Maki and Kitasaka (2006). However, this still needs to be investigated for the developing countries.

If the financial reforms were effective, there would be a structural break in the cointegrating equation. If financial reforms have significant effects on money demand, then the income elasticity should show a decline and the rate of interest elasticity in its absolute value will increase. Also, if financial innovations are observed in the economy, this will have similar effects as above. We argue that if the long-run demand for money has become unstable due to financial reforms, estimates of the cointegrating parameters after the structural break may yield implausible estimates or there may simply be no cointegration between the variables. For this purpose it is necessary to estimate the demand for money for the sub-samples with observations before and after the reforms. However, it is difficult to select a date for the structural break.[2] We have selected the break dates as 1989 and 1995. This is because financial reforms were introduced by most developing countries in the late 1980s and some during the 1990s.

To examine the effects of financial reforms on the demand for money, this study employs annual data to estimate demand for narrow money (*M1*) for sub-samples ((1975–1988), (1989–2005) (1975–1994) and (1995–2005)) and whole sample (1975–2005) periods for twenty developing Asian and African countries, viz., South Africa, Cameroon, Jamaica, Rwanda, Kenya, Ethiopia, Egypt, Nigeria, India, Indonesia, Thailand, China, Philippines, South Korea, Taiwan, Bangladesh, Sri Lanka, Nepal, Malaysia and Singapore.[3] Our results show that there is a well-defined and stable demand for money in all these countries. This implies that the respective central banks may consider money supply instead of the rate of interest as an appropriate instrument of monetary policy. Our estimates based on the time series approach of London School of Economics-Hendry's General to Specific (GETS) show that the income elasticity ranges between 0.9 and 1.4 and the semi-interest rate elasticity ranges between −0.01 and −0.13.

Our paper is organised as follows: in Section 2, we briefly survey some recent works on the demand for money. Section 3 provides the specification and methodology. Section 4 details our empirical results and policy implications. Section 5 concludes.

2. Overview of empirical studies

There is a vast amount of literature on the demand for money in developing countries.[4] However, we only review some key studies related to the developing Asian and African countries. For convenience, we tabulated the major findings of some of these studies in Table 1. James (2005)

[1] A similar view was taken by Bahmani-Oskooee and Bohl (2000) and Rao and Kumar (2009b).

[2] A referee has pointed out that Perron's (1997) structural break tests could be utilised for this purpose. However, it is well known that the Perron tests determine breaks in the context of unit roots. What may be preferred is the Gregory and Hansen (1996) type test. The latter technique is useful; however, a long sample is required to attain better results. Therefore, if the sub-samples based on arbitrary selected break dates give meaningful results, there is no point in applying structural break tests.

[3] Our sample comprises these 20 countries for which data is available from 1975 to 2005 in the International Financial Statistics (2005).

[4] For good literature reviews on the demand for money, see, for instance, Hafer and Kutan (1994), Ericsson (1998), Lütkepohl et al. (1999), Bahmani-Oskooee and Tanku (2006), Bahmani (2008), Hamori and Hamori (2008), Baharumshah et al. (2009), Bahmani and Kutan (2010) and Korhonen and Mehrotra (2010).

Table 1
A few recent studies on money demand in developing countries.

Study	Money	Country/period	Method	ln *Y*	*R*	Other findings
Siddiki (2000)	*M2*	Bangladesh 1975–1995	ARDL	3.260	0.088	*M2* demand is stable in Bangladesh.
Nachega (2001)	*M2*	Cameroon 1963–1993	ECM	1.100	7.700	*M2* demand is stable in Cameroon.
Anoruo (2002)	*M1*	Nigeria 1986(Q2)–2000(Q1)	JML	5.700	−5.440	*M1* demand is stable in Nigeria.
Wesso (2002)	*M3*	South Africa 1971 (Q1)–2000(Q4)	JML	1.840	−2.760	*M3* demand is unstable in South Africa.
Hafer and Kutan (2003)	*M0*	Philippines	JML	0.58	0.17	*M1* demand is stable and could be used for monetary policy in Philippines.
	M1	1980(Q1)–1998(Q1)		1.54	−0.10	
	M3			1.40	−0.08	
James (2005)		Indonesia				*M2* demand is stable in Indonesia.
	M2	1983(Q1)–2000(Q4)	ARDL	1.526	−0.160	
Atkins (2005)		Jamaica				*M2* demand is stable in Jamaica.
	M2	1962–2000	JML	1.560	1.460	
Owoye and Onafowora (2007)		Nigeria				*M2* demand is stable in Nigeria.
	M2	1986(Q1)–2001(Q4)	JML	2.067	0.306	
Nair et al. (2008)		Malaysia				*M1*, *M2* and *M3* demand functions are stable in Malaysia.
	M1	1970–2004	ARDL	1.733	−0.032	
	M2			2.784	0.031	
	M2			3.244	0.089	
Rao and Kumar (2009a)		Bangladesh				*M1* demand is stable in Bangladesh.
	M1	1973–2003	GH	1.261	−0.030	

Notes: *M0* is reserve money, *M1* is narrow money and *M2* and *M3* are broad measures of money. ARDL, JML, ECM and GH are time series techniques that denotes autoregressive distributed lag, Johansen maximum likelihood, error correction method and Gregory–Hansen, respectively. ln *Y* is the income elasticity and semi-interest rate elasticity is denoted by *R*.

extended the conventional long-run theoretical money demand model (see, for instance, Goldfeld, 1992) to analyse the effects of financial reforms on Indonesia. He found that the proxies for financial liberalization and deterministic trend play a vital role in *M2* demand. However, the *M2* demand function is stable in Indonesia. Similar findings were also attained by Dekle and Pradhan (1997) and Anglingkusumo (2005) for Indonesia.

Using Philippine data for *M0*, *M1* and *M3* over the period 1980–1998, Hafer and Kutan (2003) found no cointegration between *M1* and *M3*, real income and interest rates. However, when they allowed for the impact of financial innovations, this finding is reversed for *M1*. Their findings imply that a nominal money aggregate could be used as a policy measure to reduce inflation in the Philippines. Nair et al. (2008) utilised the Autoregressive Distributed Lag (*ARDL*) bound test technique and find that the demand for *M1*, *M2*, and *M3* is cointegrated with its determinants. In all cases, the monetary aggregates are structurally stable, which implies that monetary targeting could be an option in monetary policy decisions. Recently, Rao and Kumar (2009a) have used the Gregory and Hansen (*GH*) technique for structural breaks to estimate the *M1* demand for Bangladesh. Their income elasticity of the demand for *M1* is around 1.26. An important finding of their study is that the demand for *M1* function is stable in Bangladesh and therefore the central bank should continue to use money supply as an instrument of monetary policy. This finding is also supported by Siddiki (2000), Hossain (2006) and Kumar (2007).[5] Other studies on Asian countries (for instance, see Valadkhani and Alauddin,

[5] While Hossain and Kumar found income elasticities around unity, Siddiki's estimate of income elasticity is implausibly high at 3.26 (see Table 1).

2003; Bahmani-Oskooee and Rehman, 2005; Rao and Kumar, 2009b) also support stability in money demand functions in the Asian countries.[6]

The African countries have received relatively less attention in the money demand literature. Anoruo (2002) tested the stability of the demand for *M2* function for Nigeria in the Structural Adjustment Program (*SAP*) period using quarterly data from 1986(Q2) to 2000(Q1). With the Johansen maximum likelihood (*JML*) technique, the elasticity with respect to industrial production was 5.70, implausibly high for Nigeria. The major finding was that the Nigerian *M2* demand function is stable in the *SAP* period. Atkins (2005) used the *JML* technique to estimate demand for *M2* for Jamaica. The income elasticity of *M2* demand was 1.56. Using *CUSUM* and *CUSUM SQUARES* stability tests, he found that there exists a stable demand for *M2* in Jamaica. Recently, Owoye and Onafowora (2007) also employed the *JML* technique to examine the demand for *M2* in Nigeria. They obtained an implausible income elasticity of approximately 2.1. The stability tests revealed that the demand for *M2* is stable in Nigeria.

Nachega (2001) applied the error correction model to investigate the stability of demand for *M2* in Cameroon from 1963 to 1993. The income elasticity was unity and the demand for *M2* was found to be stable. Nachega claims that monetary targeting by the central bank is appropriate. Wesso (2002) used the *JML* technique to estimate demand for *M3* for South Africa using quarterly data from 1971(Q1) to 2000(Q4).[7] Note that the long-run income elasticity is implausibly high at 1.84. Wesso found that the demand for *M3* is structurally unstable in South Africa.[8] Fielding (1994) and Arize et al. (1990) also examined the demand for money for a group of African countries; however, the stability findings are limited in these two studies.[9]

3. Specification and methodology

3.1. Specification

The demand for real narrow money (*M1*) is expressed as a function of real income and the nominal rate of interest. Our basic specification is as follows:

$$\left(\frac{M}{P}\right)_t = f\left(\left(\frac{Y}{P}\right), R_t\right)_t \tag{1}$$

where M is the narrow money, P is the GDP deflator, Y is the nominal GDP measured at factor cost, and R is the nominal weighted average interest rate on short-term time deposits. Alternative variables such as real effective exchange rate and inflation rate could also be used to proxy the cost of holding money; however, we have selected only the nominal rate of interest due to the availability of data. In our short-run dynamic adjustment equations, we shall analyse the impact of growth of expected

[6] Bahmani-Oskooee and Rehman (2005) used quarterly data from 1973 to 2000 to estimate the demand for money (*M1* and *M2*) for seven Asian countries: India, Indonesia, Malaysia, Pakistan, Philippines, Singapore and Thailand. Using the *CUSUM* stability tests showed that the demand for *M1* is stable in all the selected countries. Valadkhani and Alauddin (2003) utilised the panel cointegration technique (Seemingly Unrelated Regression) to examine the major determinants of the demand for *M2* for eight developing countries, viz., Malaysia, Chile, Thailand, Papua New Guinea (PNG), Bangladesh, Sri Lanka, Sierra Leone and Philippines. While their findings support stability in money demand functions, we argue that they should have used a Pedroni (2004) type of method because their unit root tests showed that the variables are $I(1)$ in levels. Recently, Rao and Kumar (2009b) used alternative panel data techniques to estimate the cointegrating equations for the demand for *M1* for a panel of 14 Asian countries from 1970 to 2005. Their results show that the money demand function has been stable in all these economies.

[7] After using 1971(Q1)–2000(Q4) as the estimation sub-sample, a forecast was generated from 2001(Q1) to 2002(Q2) using a varying parameter regression model, which was then compared to that of the simpler money demand function. Allowing some coefficients to vary over time also improved the forecasting performance of the money demand equation significantly over the forecasting period.

[8] Nell (1999) also supported instability in money demand (particularly *M1* and *M2*) in South Africa over the period 1965–1997. However, Nell found that there exists a stable long-run demand for *M3* in South Africa.

[9] Fielding (1994) examined the *M2* demand for four African countries, viz., Cameroon, Nigeria, Ivory Coast and Kenya. The *JML* technique revealed the income elasticities for Cameroon, Nigeria and Ivory Coast as 1.5, 0.72 and 1.58, respectively. For Kenya, three cointegrating vectors were obtained and income elasticity was insignificant. Arize et al. (1990) used Two Stage Least Squares (*TSLS*) technique to estimate demand for *M1* for seven African countries for the period 1960–1987. The main limitation of their work is that they ignored the implications of the time series methods of estimation.

inflation on money demand. We expect that income elasticity is around unity and the interest rate elasticity is significant with the correct negative sign. Such income elasticity would imply underdeveloped financial markets where most transactions involve the use of narrow money as opposed to other forms of monetary aggregates. However, in developed countries, income elasticities are expected to be much lower than unity. This is due to a better financial system which lowers the cost of transactions and reduces the use of liquid assets such as *M1*. For an empirical survey of income elasticities for developed and developing countries, see Sriram (1999). Our sample period is from 1975 to 2005. Microfit 4.1 is used for all estimations. Definitions of the variables and sources of data are in Appendix A.

3.2. Methodology

The London School of Economics (*LSE*) Hendry's *GETS* approach was developed because econometricians at *LSE* were concerned with the methodological conflict between the static nature of equilibrium relationships and the data. It is argued that the data is collected from the world, which is seldom in equilibrium. *GETS* is an alternative approach to the Partial Adjustment method (*PAM*) and a better method for dynamic specification. The economic theory provides no guidance on how the dynamic adjustments take place. Thus, it is difficult to establish an equilibrium relationship with dis-equilibrium data. In the past, this gap was reconciled by arbitrary lag specifications like *PAM* and Almond lags.

The main advantage of the *GETS* method is that it includes an efficient dynamic adjustment process. We take a methodological view that alternative estimation techniques are observationally equivalent but *GETS* based on the classical methods is simpler to use and well suited for the purpose of testing theories. Advantages of the *GETS* method are explicitly stated in Rao et al. (2010). Although the Johansen (1991) method (*JML*) is widely used in empirical works, it offers biased estimates if the sample size is small. Consequently, we apply the *GETS* method to estimate money demand for the sub-sample periods. *GETS* can be easily conducted with ordinary least squares (*OLS*) or non-linear least squares (*NLLS*).[10] There is no doubt that it is a single equation approach because it assumes that there is a single cointegrating vector. There are three vital steps in the *GETS* approach. First, specify an underlying error-correction model (*ECM*). Second, specify a general *ARDL* dynamic scheme. Third, search for a parsimonious equation. The long-run specification of the real narrow money demand is[11]:

$$\ln\left(\frac{M}{P}\right)_t = \beta_0 + \beta_1 \ln\left(\frac{Y}{P}\right)_t - \beta_2 R_t + \varepsilon_t \tag{2}$$

The above equation in its partial adjustment form can be written as

$$\Delta\ln\left(\frac{M}{P}\right)_t = \beta_0 + \beta_1 \ln\left(\frac{M}{P}\right)_{t-1} + \beta_2 \ln\left(\frac{Y}{P}\right)_{t-1} - \beta_3 R_{t-1} + \beta_4 \Delta\ln\left(\frac{M}{P}\right)_{t-1} + \varepsilon_t \tag{3}$$

The general dynamic specification will have more lagged values of $\Delta\ln(M/P)$, $\Delta\ln(Y/P)$ and ΔR. The general dynamic equation can be specified as:

$$\Delta\ln\left(\frac{M}{P}\right)_t = \beta_0 + \beta_1 \ln\left(\frac{M}{P}\right)_{t-1} + \beta_2 \ln\left(\frac{Y}{P}\right)_{t-1} - \beta_3 R_{t-1} + \sum_{i=0}^{n} \lambda_i \Delta\ln\left(\frac{Y}{P}\right)_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta R_{t-i} + \sum_{i=1}^{j} T_i \Delta\ln\left(\frac{M}{P}\right)_{t-i} + \varepsilon_t \tag{4}$$

The crucial long-run coefficients are β_1, β_2 and β_3. Thus, in the following section we shall apply the *GETS* technique to estimate the long-run and short-run dynamic estimates. The stability of the demand for money functions is examined with the *CUSUM* and *CUSUMSQ* tests.

[10] A good applicability of this technique can be found in Rao (2007), Kumar and Manoka (2008), Singh and Kumar (2010), Kumar (2009), Kumar et al. (in press-a,b) and Rao et al. (2010).

[11] See Eq. (1) for a definition of the variables. ε_t is the *iid* error term.

4. Empirical results and policy implications

4.1. Empirical results

We initially tested for the presence of unit root in our variables. The Augmented Dicky-Fuller tests (*ADF*) are used for testing for the order of the variables. In all cases, the *ADF* tests have been applied for both levels and their first differences with an intercept and trend. The time trend is incorporated because it is significant in the levels and first differences of the variables, see Rao (2007) for details. The computed test statistics for the levels and first differences of the variables are given in Table B1. The null hypothesis of unit root cannot be rejected at the 5% level for the level variables, i.e. $\ln(M/P)$, $\ln(Y/P)$ and R. Alternatively, the null that their first differences have unit roots is evidently rejected. The time series properties of the variables are satisfactory and therefore there is no use in applying more complicated unit root tests because, compared to the *ADF* test, alternative unit root tests like the Phillips Perron test, generalized least squares *ADF* test, and the Elliott, Rothenburg and Stock test have more power against the unit root null.

We shall use the *GETS* approach to estimate demand for money for our selected twenty developing countries. Our selected break dates are 1989 and 1995. We first estimated the money demand function for sub-samples (1975–1988), (1989–2005) (1975–1994) and (1995–2005) with a lag length of 3 periods. These were later reduced to manageable parsimonious versions as reported in Table 2. We only report the long-run income and semi-interest rate elasticity.[12] It is worth noting that the income and interest rate elasticities are not significantly different when compared to other sub-sample periods. In other words, the long-run elasticities did not change significantly and therefore it is unlikely that the scale economies of the demand for money have increased. Perhaps an important implication of this result is that financial reforms did not have any significant effects on the money demand in these countries.

We also estimated the money demand functions for the whole sample period 1975–2005 with a lag length of 4 periods. The results are reported in Tables 3–6. The implied income elasticity of money demand in all cases is close to unity and the interest rate elasticity is also significant with the expected sign.[13] These two estimated values imply that the long-run elasticities for income and the rate of interest are significant with expected signs and expected magnitudes.[14] The variable $\Delta^2 \ln P$ captures the effects of growth in expected inflation and has the expected negative coefficient. In all equations the X^2 summary statistics indicate that there is no serial correlation, functional form misspecification, non-normality and heteroscedasticity in the residuals. Our parsimonious equations in Tables 3–6 were tested for temporal stability. This study applies structural stability tests including the *CUSUM* and the *CUSUMSQ* procedures developed by Brown et al. (1975). The *CUSUM* procedure is based on the cumulative recursive sum of recursive residuals. However, the *CUSUMSQ* framework is based on the cumulative sum of squares of recursive residuals. To draw inferences relative to the stability of the parameters and the model in particular, the *CUSUM* and the *CUSUMSQ* procedures are updated recursively and are plotted against the break points. The null hypothesis of instability is rejected when the plots of the *CUSUM* and the *CUSUMSQ* stay within the 5% significance level. However, the model is unstable when the plots of the *CUSUM* and the *CUSUMSQ* move outside the 5% critical lines. In all cases, the plots for both the *CUSUM* and the *CUSUMSQ* remained within the 5% critical bounds. This finding suggests that the demand for money in our selected countries is stable.[15]

[12] The sub-sample based dynamic adjustment coefficients are not reported to conserve space. However, these can be obtained from the author upon request.

[13] We used the Wald test to examine whether the income elasticity is unity in all cases. The Wald test computed $X^2(1)$ test statistics are insignificant and therefore the restrictions could not be rejected.

[14] High values of λ imply that departures from equilibrium will be corrected quickly in the subsequent period. This may be the case for Jamaica, Kenya, Egypt, Philippines and Singapore.

[15] We did not report *CUSUM* and *CUSUMSQ* test results to conserve space. Further, the advanced parameter stability tests by Bruggeman et al. (2003) also suggested that in all cases the money demand functions are stable. These results can be obtained from the author upon request.

Table 2
Income and interest rate elasticities from sub-sample periods.

Country	1975–1988		1989–2005		1975–1994		1995–2005	
	$\ln(Y/P)_{t-1}$	R_{t-1}	$\ln(Y/P)_{t-1}$	R_{t-1}	$\ln(Y/P)_{t-1}$	R_{t-1}	$\ln(Y/P)_{t-1}$	R_{t-1}
South Africa	1.056 (2.34)*	−0.021 (3.78)*	1.168 (3.82)*	−0.024 (1.88)**	1.109 (5.78)*	−0.042 (2.58)*	0.989 (1.86)**	−0.023 (2.37)*
Cameroon	1.245 (3.21)*	−0.006 (1.79)**	1.067 (1.94)**	−0.052 (2.37)*	1.321 (2.30)*	−0.029 (1.69)**	1.167 (1.80)**	−0.097 (2.12)*
Jamaica	1.156 (3.52)*	−0.011 (3.26)*	1.142 (2.36)*	−0.067 (3.79)*	1.027 (4.27)*	−0.034 (2.71)*	0.969 (1.87)**	−0.089 (2.01)*
Rwanda	1.345 (2.73)*	−0.076 (1.93)**	1.407 (2.76)*	−0.089 (2.12)*	1.312 (3.67)*	−0.052 (3.89)*	1.260 (2.24)*	−0.024 (2.85)*
Kenya	1.178 (3.72)*	−0.102 (1.69)**	1.273 (3.28)*	−0.089 (1.99)*	1.172 (2.83)*	−0.137 (2.37)*	1.287 (2.12)*	−0.089 (1.82)**
Ethiopia	1.323 (2.36)*	−0.034 (2.73)*	1.267 (2.39)*	−0.039 (3.89)*	1.299 (1.78)**	−0.087 (1.85)**	1.378 (1.95)**	−0.038 (2.08)*
Egypt	1.288 (4.27)*	−0.031 (2.89)*	1.387 (3.28)*	−0.078 (2.12)*	1.199 (1.98)*	−0.032 (2.37)*	1.278 (2.39)*	−0.082 (2.92)*
Nigeria	1.322 (2.27)*	−0.072 (3.17)*	1.241 (2.37)*	−0.062 (2.37)*	1.239 (2.19)*	−0.027 (2.38)*	1.365 (2.30)*	−0.037 (2.66)*
India	1.124 (3.21)*	−0.023 (2.77)*	1.028 (2.63)*	−0.028 (3.38)*	0.927 (3.47)*	−0.034 (4.27)*	0.967 (2.16)*	−0.067 (3.17)*
Indonesia	1.277 (3.22)*	−0.033 (2.76)*	1.342 (2.38)*	−0.037 (4.58)*	1.267 (8.72)*	−0.028 (3.47)*	1.027 (1.91)**	−0.026 (2.72)*
Thailand	1.036 (3.37)*	−0.072 (2.12)*	1.078 (3.23)*	−0.039 (3.37)*	0.956 (2.35)*	−0.078 (3.12)*	1.023 (2.88)*	−0.063 (2.36)*
China	1.128 (3.24)*	−0.026 (2.37)*	0.965 (2.37)*	−0.088 (2.36)*	0.977 (2.34)*	−0.056 (3.46)*	1.098 (3.28)*	−0.065 (2.43)*
Philippines	1.426 (3.28)*	−0.089 (3.74)*	1.356 (2.37)*	−0.036 (3.47)*	1.449 (3.28)*	−0.067 (2.37)*	1.236 (2.38)*	−0.063 (2.34)*
South Korea	1.028 (2.37)*	−0.032 (3.38)*	1.236 (1.87)**	−0.078 (3.46)*	1.128 (2.36)*	−0.102 (3.27)*	0.956 (2.12)*	−0.063 (2.55)*
Taiwan	1.127 (4.37)*	−0.033 (2.43)*	1.236 (4.57)*	−0.068 (3.26)*	1.156 (3.28)*	−0.035 (2.36)*	1.268 (2.76)*	−0.073 (3.27)*
Bangladesh	1.174 (3.48)*	−0.016 (3.28)*	1.284 (3.47)*	−0.078 (2.12)*	1.072 (2.36)*	−0.063 (3.87)*	1.123 (4.23)*	−0.026 (2.83)*
Sri Lanka	1.027 (5.37)*	−0.085 (3.78)*	1.328 (3.14)*	−0.045 (2.26)*	1.256 (2.36)*	−0.035 (3.27)*	1.126 (1.78)**	−0.099 (2.64)*
Nepal	1.235 (2.63)*	−0.036 (3.36)*	1.136 (4.35)*	−0.078 (2.12)*	1.217 (2.34)*	−0.035 (2.36)*	1.266 (2.11)*	−0.056 (3.56)*
Malaysia	1.028 (2.36)*	−0.099 (2.35)*	1.213 (2.47)*	−0.053 (2.37)*	1.127 (3.26)*	−0.069 (3.25)*	1.165 (2.27)*	−0.067 (2.36)*
Singapore	1.036 (4.66)*	−0.026 (2.36)*	0.932 (2.35)*	−0.033 (2.37)*	0.955 (3.45)*	−0.064 (3.46)*	1.037 (3.44)*	−0.035 (1.69)**

Notes: (1) $\ln(Y/P)_{t-1}$ and R_{t-1} represent income elasticity and semi-interest rate elasticity, respectively. (2) The absolute t-ratios are reported in parentheses below the estimated coefficients. (4) The sample period is from 1975 to 2005 in all cases.

* Significance at 5% level.

** Significance at 10% level.

Table 3
Dynamic adjustment equations 1975–2005.

	South Africa	Cameroon	Jamaica	Rwanda	Kenya
Intercept	1.278 (2.35)*	0.287 (10.37)*	1.493 (5.34)*	1.278 (4.31)*	0.837 (7.36)*
λ	−0.337 (6.78)*	−0.036 (4.35)*	−1.278 (3.46)*	−0.347 (3.33)*	−1.372 (4.38)*
$\ln(Y/P)_{t-1}$	1.126 (5.67)*	1.255 (3.88)*	1.155 (3.47)*	1.278 (2.36)*	1.266 (3.46)*
R_{t-1}	−0.054 (3.46)*	−0.088 (6.89)*	−0.074 (6.72)*	−0.088 (3.47)*	−0.058 (2.44)*
$\Delta\ln(M/P)_{t-1}$		−0.288 (2.36)*		0.273 (4.58)*	
$\Delta\ln(Y/P)_{t-1}$	0.035 (6.77)*		1.722 (2.36)*	3.478 (4.89)*	
$\Delta\ln(Y/P)_{t-2}$		7.238 (4.38)*	3.470 (1.72)**		1.278 (2.38)*
ΔR_t	−1.378 (8.39)*	2.378 (2.33)*		−0.363 (4.23)*	−1.266 (8.92)*
$\Delta^2\ln P_{t-1}$		−1.266 (1.88)**	−0.126 (2.37)*		−0.045 (1.92)**
$\Delta^2\ln P_{t-2}$	−0.223 (3.47)*		−0.035 (1.85)**	−0.374 (2.37)*	
Adjusted R^2	0.756	0.633	0.721	0.689	0.711
SEE	0.023	0.110	0.066	0.976	0.078
X^2_{sc1}	0.170 (0.68)	0.004 (0.99)	0.191 (0.66)	0.786 (0.38)	0.672 (0.41)
X^2_{ff}	1.816 (0.18)	2.661 (0.26)	2.294 (0.13)	1.685 (0.19)	1.692 (0.19)
X^2_n	3.724 (0.16)	0.307 (0.86)	0.390 (0.82)	0.182 (0.91)	0.362 (0.83)
X^2_{hs}	0.410 (0.52)	2.710 (0.10)	0.206 (0.65)	0.405 (0.52)	0.487 (0.49)

Notes: (1) $\ln(Y/P)_{t-1}$ and R_{t-1} represent income elasticity and semi-interest rate elasticity, respectively. (2) λ is the speed of adjustment. (3) The absolute t-ratios for the variables and the p-values for the chi-square tests are in parentheses. (4) The sample period is from 1975 to 2005 in all cases.

* Significance at 5% level.

** Significance at 10% level.

Table 4
Dynamic adjustment equations 1975–2005.

	Ethiopia	Egypt	Nigeria	India	Indonesia
Intercept	0.726 (9.73)*	7.289 (3.47)*	0.005 (7.34)*	0.368 (6.47)*	1.389 (2.37)*
λ	−0.689 (5.38)*	−2.369 (8.26)*	−0.034 (5.51)*	−0.056 (6.47)*	−0.452 (4.33)*
$\ln(Y/P)_{t-1}$	1.255 (3.27)*	1.150 (3.26)*	1.253 (2.28)*	1.027 (3.46)*	1.058 (3.48)*
R_{t-1}	−0.072 (2.11)*	−0.102 (4.63)*	−0.027 (5.37)*	−0.035 (6.74)*	−0.069 (4.37)*
$\Delta\ln(M/P)_{t-1}$		3.289 (1.80)**		0.783 (3.23)*	
$\Delta\ln(M/P)_{t-2}$	−0.528 (2.56)*		−0.038 (4.27)*		7.829 (4.28)*
$\Delta\ln(Y/P)_{t-1}$	8.572 (1.85)**	1.278 (2.36)*		2.783 (3.64)*	1.376 (3.46)*
ΔR_t		−0.004 (8.63)*	0.367 (2.35)*	−0.387 (2.65)*	
ΔR_{t-1}	−0.268 (3.46)*		−0.075 (2.81)*	−0.679 (3.41)*	−0.788 (3.48)*
$\Delta^2\ln P_{t-1}$	−0.025 (1.69)**	−0.001 (1.74)**	−0.648 (3.48)*	−0.388 (2.35)*	−0.035 (2.45)*
Adjusted R^2	0.664	0.755	0.782	0.858	0.699
SEE	0.097	0.068	0.053	0.074	0.095
X^2_{sc1}	0.893 (0.35)	0.001 (0.99)	0.002 (0.97)	1.296 (0.26)	0.952 (0.33)
X^2_{ff}	0.259 (0.61)	0.092 (0.76)	2.515 (0.11)	1.380 (0.24)	0.324 (0.57)
X^2_n	1.085 (0.58)	0.591 (0.74)	1.414 (0.49)	0.631 (0.43)	0.155 (0.93)
X^2_{hs}	0.006 (0.94)	0.643 (0.42)	0.115 (0.74)	0.165 (0.69)	0.998 (0.32)

Notes: (1) $\ln(Y/P)_{t-1}$ and R_{t-1} represent income elasticity and semi-interest rate elasticity, respectively. (2) λ is the speed of adjustment. (3) The absolute t-ratios for the variables and the p-values for the chi-square tests are in parentheses. (4) The sample period is from 1975 to 2005 in all cases.

* Significance at 5% level.

** Significance at 10% level.

4.2. Financial reforms and policy implications

Following the financial reforms, money demand functions may have become unstable in the advanced countries. Advanced countries offer the opportunity for more and diversified financial instruments by their central banks and there are more opportunities for increased savings, improved efficiency with which resources are allocated among alternative investment projects, improved payments technology and creation of more near monies. There are also more non-bank financial institutions with established track record. Such diversification in the financial system of an economy ensures that capital is mobilised from several avenues rather than from the traditional banking

Table 5
Dynamic adjustment equations 1975–2005.

	Thailand	China	Philippines	South Korea	Taiwan
Intercept	1.287 (3.77)*	0.067 (2.69)*	0.377 (2.37)*	1.630 (8.99)*	10.373 (8.76)*
λ	−0.635 (8.94)*	−0.382 (3.27)*	−1.283 (7.39)*	−0.052 (4.58)*	−0.393 (7.74)*
$\ln(Y/P)_{t-1}$	0.945 (4.52)*	0.911 (2.16)*	1.377 (2.36)*	0.966 (5.69)*	1.073 (4.85)*
R_{t-1}	−0.069 (7.81)*	−0.089 (6.55)*	−0.082 (4.35)*	−0.021 (3.45)*	−0.084 (2.89)*
Trend	2.450 (2.37)*	1.378 (9.72)*	8.293 (10.36)*	0.006 (12.37)*	2.364 (18.37)*
$\Delta\ln(Y/P)_{t-1}$	1.276 (1.89)**		1.365 (2.46)*	3.464 (5.52)*	
$\Delta\ln(Y/P)_{t-2}$		1.378 (5.38)*	0.036 (3.46)*		1.374 (6.38)*
ΔR_{t-1}	−0.368 (3.46)*	0.263 (6.24)*		−0.063 (3.64)*	
ΔR_{t-2}	−3.468 (2.37)*	−4.473 (2.35)*	−0.368 (7.54)*	−9.923 (3.74)*	1.473 (3.46)*
$\Delta^2\ln P_{t-2}$	−1.687 (2.36)*	−0.037 (2.53)*	−0.482 (1.79)**	−3.474 (2.14)*	−0.366 (2.67)*
Adjusted R^2	0.866	0.761	0.578	0.689	0.723
SEE	0.042	0.094	0.076	0.085	0.099
X^2_{sc1}	1.509 (0.22)	0.104 (0.75)	0.417 (0.52)	1.424 (0.23)	1.509 (0.22)
X^2_{ff}	0.562 (0.45)	2.239 (0.14)	1.214 (0.55)	0.111 (0.95)	0.562 (0.45)
X^2_n	0.445 (0.51)	0.631 (0.43)	1.019 (0.60)	0.681 (0.41)	0.445 (0.51)
X^2_{hs}	0.165 (0.69)	0.069 (0.79)	2.548 (0.11)	2.221 (0.14)	0.165 (0.69)

Notes: (1) $\ln(Y/P)_{t-1}$ and R_{t-1} represent income elasticity and semi-interest rate elasticity, respectively. (2) λ is the speed of adjustment. (3) The absolute *t*-ratios for the variables and the *p*-values for the chi-square tests are in parentheses. (4) The sample period is from 1975 to 2005 in all cases.

* Significance at 5% level.

** Significance at 10% level.

Table 6
Dynamic adjustment equations 1975–2005.

	Bangladesh	Sri Lanka	Nepal	Malaysia	Singapore
Intercept	2.367 (8.04)*	19.782 (14.66)*	0.007 (4.57)*	0.278 (2.36)*	4.378 (3.87)*
λ	−0.382 (6.77)*	−0.742 (4.36)*	−0.083 (5.67)*	−0.262 (3.46)*	−1.278 (4.56)*
$\ln(Y/P)_{t-1}$	1.162 (6.76)*	1.288 (3.46)*	1.077 (4.32)*	0.911 (2.35)*	1.024 (3.75)*
R_{t-1}	−0.010 (2.53)*	−0.059 (4.53)*	−0.018 (4.60)*	−0.110 (3.27)*	−0.063 (2.64)*
$\Delta\ln(Y/P)_{t-1}$		3.467 (7.89)*	−3.468 (4.37)*		0.683 (2.37)*
$\Delta\ln(Y/P)_{t-2}$	0.007 (4.02)*			3.278 (4.37)*	
$\Delta\ln(Y/P)_{t-3}$	−8.923 (3.49)*	0.063 (7.11)*	9.637 (2.53)*	0.378 (4.72)*	0.006 (5.73)*
ΔR_{t-1}	−0.035 (3.46)*				−1.732 (3.47)*
ΔR_{t-3}		−4.621 (1.79)**	1.263 (3.45)*	−0.372 (4.39)*	−0.062 (1.87)**
$\Delta^2\ln P_{t-1}$	−1.378 (4.55)*	−0.055 (1.84)**	−0.367 (2.76)*	−0.472 (1.94)**	−0.282 (1.97)**
Adjusted R^2	0.761	0.633	0.753	0.679	0.673
SEE	0.088	0.092	0.063	0.082	0.095
X^2_{sc1}	0.542 (0.41)	1.509 (0.22)	1.367 (0.53)	0.155 (0.93)	1.627 (0.20)
X^2_{ff}	1.593 (0.19)	0.445 (0.51)	−0.136 (0.72)	0.998 (0.32)	0.420 (0.81)
X^2_n	1.296 (0.26)	0.165 (0.69)	0.145 (0.70)	0.050 (0.82)	1.445 (0.23)
X^2_{hs}	0.983 (0.33)	0.145 (0.70)	0.347 (0.21)	0.640 (0.73)	0.024 (0.88)

Notes: (1) $\ln(Y/P)_{t-1}$ and R_{t-1} represent income elasticity and semi-interest rate elasticity, respectively. (2) λ is the speed of adjustment. (3) The absolute *t*-ratios for the variables and the *p*-values for the chi-square tests are in parentheses. (4) The sample period is from 1975 to 2005 in all cases.

* Significance at 5% level.

** Significance at 10% level.

sector. The underdeveloped financial markets in most developing countries generally lack these features.

Many Asian countries have liberalized their financial markets from the early 1980s. For instance, initiatives to reform the financial sector in Bangladesh started in the 1980s with the denationalisation of the *Uttara Bank* and *Pubali Bank*. Also, a few new private commercial banks were given licences. Similarly, the Philippine economy commenced their reforms since the mid-1980s with the rehabilitation of the financial system and the liberalization of the foreign exchange market. Consequently, in most Asian countries, for instance Thailand, Singapore, China, Indonesia, Philippines and India, the central banks are using bank rates and inflation rates as the tools of monetary policy. Alternatively, the African countries were late starters and delayed reforms until the early 1990s. For

example, the privatisation of state-owned banks in Nigeria commenced in 1992. In 1993, Kenya began a major program of economic liberalization. As part of this program, the government eliminated price controls and import licensing, removed foreign exchange controls and advanced the banking systems. Other African countries also implemented financial reforms during the 1990s but the effects have been minimal. Therefore it is unlikely that the money demand functions in the African countries have become unstable.

Our results show that the demand for money functions in the developing Asian and African countries are largely stable. The respective money demand functions were tested for temporal stability using the *TIMVAR* tests and neither the *CUSUM* nor the *CUSUM SQUARES* showed any instability. An important implication of our findings is that the central banks in these countries should reconsider their choice of using the interest rate as their monetary policy instrument because, according to Poole (1970), money supply should be used as the monetary policy instrument when the demand for money is stable.

5. Conclusions

This paper has used the *GETS* technique to examine the relationship between real narrow money, real income and nominal rate of interest for twenty developing Asian and African countries. The results from the *ADF* unit root tests show that the three variables are first difference stationary. To account for structural breaks, the effects of financial reforms are analysed with estimates for two sets of sub-samples and two break dates. Our selected break dates are 1989 and 1995. We found that in all cases there is a cointegrating relationship between real narrow money, real income and nominal rate of interest. The implied income and interest rate elasticties are significant and with the expected signs in all cases.

Although the selection of break dates are somewhat arbitrary, this is the best way to observe the change in magnitudes of income and interest rate elasticities over time. If financial reforms have significant effects on money demand, the income elasticity should show a decline and the rate of interest elasticity should increase in its absolute value. For all selected countries, the income and interest rate elasticities do not change significantly over the sub-sample periods. Therefore it is unlikely that the scale economies of the demand for money have increased. The stability tests by *CUSUM* and *CUSUMSQ* showed that the demand for money functions in these respective countries are temporally stable over the period 1975–2005.

An important implication of our findings is that financial reforms did not have any significant impact on the demand for money functions for our selected developing countries. There is no evidence that the demand for money in the developing countries has become unstable. Following Poole (1970), we argue that money supply is the optimal instrument of monetary policy if the central banks aim to stabilise the inflation rate and to minimize output fluctuations. Using the rate of interest as an instrument of monetary policy will only accentuate instability in the output.

A few limitations of our work should be noted. First, we have ignored the structural break tests of Gregory and Hansen (1996) and Bai and Perron (2003). There are practical problems in utilizing these tests with a limited number of annual observations relative to the number of such possible breaks. Second, we arbitrarily selected the break dates as 1989 and 1995. However, the main motivation is to examine the change in magnitudes of the long-run elasticities over time. Third, we have used a single equation time series approach (*GETS*) rather than a systems-based approach. We argue that *GETS* is simple to use when estimating the sub-samples and more flexible, so that it captures the dynamic adjustments well. We are hopeful that our work will be useful for further work on the demand for money.

Appendix A. Definition of variables

P = GDP deflator (2000 = 100). Data derived are from International Financial Statistics (IFS-2005).
Y = nominal GDP at factor cost or market prices, whichever is available. Data are from IFS-2005.
R = the average short-term (maximum of 3 years) savings deposit rate. Data derived from the IFS-2005.
M = currency in circulation, including demand deposit and bills payable. Data derived from the IFS-2005.

Note: All variables, except the rate of interest, are deflated with the GDP deflator and are in natural logs.

Appendix B

See Table B1.

Table B1
ADF unit root tests.

	Lags	$\ln M_t$	$\Delta \ln M_t$	$\ln Y_t$	$\Delta \ln Y_t$	R_t	ΔR_t
South Africa	[1,0,1,0,2,0]	1.867	4.895	1.389	6.389	1.378	5.397
Cameroon	[0,1,1,0,1,1]	2.367	5.383	1.038	4.389	1.935	4.890
Jamaica	[0,2,1,0,1,0]	1.479	4.389	2.036	4.992	1.384	4.637
Rwanda	[0,0,1,0,2,0]	1.372	5.228	1.472	4.276	1.933	4.243
Kenya	[0,2,1,0,1,3]	2.118	5.003	0.382	8.836	0.947	6.389
Ethiopia	[0,0,1,1,3,3]	0.782	5.869	2.573	4.378	2.025	4.352
Egypt	[1,1,1,1,2,0]	2.211	4.289	0.053	5.389	1.843	5.583
Nigeria	[0,0,0,1,2,1]	1.388	5.200	1.679	4.913	1.036	4.837
India	[0,1,1,0,0,1]	1.993	6.037	0.372	3.997	1.947	6.389
Indonesia	[1,0,1,2,2,1]	1.519	4.897	2.343	6.836	0.484	4.313
Thailand	[0,1,0,0,1,3]	2.323	5.003	1.742	4.772	0.943	5.036
China	[1,0,0,0,0,1]	1.254	3.886	2.598	7.328	0.482	3.719
Philippines	[1,2,0,0,1,3]	1.379	7.389	0.346	8.914	1.374	3.711
South Korea	[0,0,1,1,3,3]	2.003	3.998	2.788	3.932	2.004	3.638
Taiwan	[2,1,2,1,2,0]	0.378	3.999	0.678	5.779	1.739	4.399
Bangladesh	[0,1,0,1,0,1]	1.378	5.036	1.236	4.618	1.494	4.397
Sri Lanka	[1,0,1,0,1,0]	1.832	6.478	2.492	3.991	1.047	7.945
Nepal	[0,0,1,3,2,1]	1.519	5.382	2.003	6.075	0.638	3.997
Malaysia	[0,1,0,1,3,3]	2.221	4.033	1.858	4.772	0.472	4.893
Singapore	[1,1,0,1,0,0]	0.389	3.995	2.394	6.398	2.046	4.299

Notes: (1) $\ln M_t$ and $\ln Y_t$ represent log of real money and real income, respectively. (2) The respective 1% and 5% critical values for ADF test are 3.685 and 2.970. (3) Lag lengths are for the respective variables selected with AIC and SBC criteria. For example [0,1] indicates that lag 0 and 1 are significant in the 1st and 2nd columns, respectively. (4) The sample period is 1975–2005 in all cases.

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