Conducting Monetary Policy in South Asian Economies: An Investigation

MUHAMMAD ARSHAD KHAN and ATHER MAQSOOD AHMED

Monetary policy which until recently aimed at targeting monetary aggregates has quietly given way to adjusting interest rates. Most of the Central Banks now focus on money reaction function that directly targets inflation or price level. This paper examines the way monetary policy is being conducted in the four major South Asian economies, namely, Bangladesh, India, Pakistan and Sri Lanka. The analysis is based on a variant of the Taylor rule framework. Using quarterly data over the period 1990Q1 to 2012Q4, the study finds that the monetary authorities in India, Pakistan and Sri Lanka have accommodated some degree of inflationary pressure, whereas Bangladesh has continuously smoothened interest rate while setting its monetary policy. Besides pursuing a mild monetary policy stance against inflation, India, Pakistan and Sri Lanka are also giving importance to foreign interest rate and real exchange rate movements to justify their relevance in monetary policy setting. However, the same has not been found to be true for Bangladesh.

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1. INTRODUCTION

It is now well established in the literature that the ultimate goal of monetary policy is to maximise social welfare by maintaining low inflation rates and a stable output gap [Blanchard (2006) and Ahmed and Malik (2011)]. Besides pursuing price stability and economic growth objectives, the monetary authority has to ensure stability of exchange rate and management of foreign exchange reserves in an effective manner to circumvent fiscal distractions.[1] Notwithstanding the clarity of these objectives, the entire effort of conducting an effective monetary policy is delicately poised as has been highlighted by Kydland and Prescott (1977). According to them, a purely discretionary policy setting leads to higher long run inflation—a clear evidence of time inconsistency problem

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[1]For example, "maintaining price stability while supporting the highest sustainable growth" is the stated objective of monetary policy pursued by the Bangladesh Bank [Bangladesh Bank (2006, p.1)]. The State Bank of Pakistan outlines its objective as "(to) regulate the monetary and credit system in Pakistan and to foster its growth in the best national interest with a view to securing monetary stability and fuller utilization of the country's productive resources" [Anwar (2012), pp. 2-3]. Similarly, the Reserve Bank of India also sets the objective of monetary policy as "maintain price stability and ensuring adequate flow of credit to the productive sector of the economy" [Bicchal (2011), p. 230].

[Mohanty and Klau (2004)]. In such a situation rule-based policy is advocated as an alternative strategy to avoid high inflation on the one hand and to lower variations in inflation and output gaps on the other [Islam and Uddin (2011)]. According to Wimanda, *et al.* (2012), such a policy also allows to assess the past behaviour of monetary policy, recommend current policy actions, and predict the future direction of monetary policy. In case of rule-based monetary policy, the Central Bank plays an active role to offset adverse shocks and stabilise the economy.

Following the seminal contribution of Taylor (1993), a large body of empirical literature concerning the optimal monetary policy has focused on the Taylor-type monetary policy rule using a variety of specifications. In simple terms, the monetary policy rule requires the Central Bank to adjust its short term nominal interest rate in response to changes in inflation rate and output gap [Molodtsova, *et al.* (2008)]. The Taylor rule predicts that Central Banks raise interest rate when inflation forecast exceeds its target level and when output gap is positive and vice versa [Bunzel and Enders (2010)]. These changes in the interest rate are expected to destabilise the financial markets through adverse impacts on consumption, domestic and foreign direct investments, exchange rates and foreign exchange reserves.

Going beyond the Taylor rule, the Central Banks also experiment with additional nominal targets assuming that they also influence inflation and output, either directly or indirectly [Jha (2006)]. For instance, the exchange rate target fixes the inflation rate for internationally traded goods and thus directly helps in controlling inflation. However, the main drawback is that this approach leads to a loss of independent monetary policy stance [Obsfeld and Rogoff (1996)]. On the other hand, while monetary targeting enables Central Banks to adjust their monetary policy to cope inflation with the domestic considerations, its effectiveness depends on uncertainties, lag structure and the stability of money demand function which usually remains unstable due to instability of velocity of money [Jha and Rath (2003); Islam and Uddin (2011)].[2] Finally, inflation targeting enables monetary authorities to directly respond to the shocks to the domestic economy. Inflation targeting is, therefore, more flexible strategy as short term deviations of inflation from its target level are acceptable and they do not necessarily translate into loss in credibility either. The inflation targeting is believed to improve accountability, Central Bank's credibility, and enhance transparency.

The empirical verification of monetary policy rule has been a favourite topic among researchers [see for example, Clarida, *et al.* (2000); Taylor (1993); Judd and Rudebusch (1998), among others]. For developing countries, particularly for the South Asian Association for Regional Cooperation (SAARC) countries, the empirical literature is relatively scarce. The reason could be that these economies have switched over to fully flexible exchange rate system only recently after a prolonged use of fixed/managed

[2]The presence of interest rate instrument primarily reflects velocity uncertainty—a major concern in many transition economies when money demand functions are unstable during a period of structural change and transformation of the economies. It can be argued that if velocity shocks are big, then the interest rate is a more suited instrument. However, if there is too much uncertainty in measuring the real interest rate owing to big shocks to investment or net exports, then monetary aggregate is the preferred instrument [Ghatak and Moore (2011)]. For example, a big fall in exports may lead to large depreciation in exchange rate and could necessitate a large rise in interest rate. Therefore, in the presence of interest rate volatility it is very difficult to measure equilibrium real interest rate. Hence, under interest rate rule uncertainty about the equilibrium real interest rate can translate in to policy errors [Ghatak and Moore (2011)].

floating exchange rate regimes [Yazgan and Yilmazkuday (2007)]. However, once these economies opted for the flexible exchange rate system, the only sound monetary policy option available to them for inflation targeting was the monetary policy rule [Taylor (1993, 2000)].[3] As a result, one finds adherence to inflation targeting regime along with the monetary policy rule.

Against this backdrop, the present paper is an attempt to assess the role of the Central Banks in conducting monetary policy by estimating a variant of the Taylor rule for four major SAARC countries, that is, Bangladesh, India, Pakistan and Sri Lanka using quarterly data over the period 1990Q1 to 2012Q4. The region has been selected for the simple reason that like many other developing countries, the South Asian economies have also introduced far-reaching financial sector reforms since 1990 onwards. We believe that the analysis of monetary policy has attained new importance after these reforms as the dependence of 'local' Central Banks on 'leading' Central Banks of the world has greatly increased. The evidence also suggests that due to external constraints, especially emanating from integration of international financial markets, the Central Banks of developing countries need to stabilise exchange rate movements in addition to inflation and output gap [Aleem and Lahiani (2011)]. In this scenario, a simple Taylor-type rule may not fully explain the optimal monetary policy because it not only ignores the dynamic feedback process but also assumes away policymakers' ability to react to the more fundamental causes behind the output gap and inflation [Choi and Wen (2010)]. It is argued that a model specification different from that of the developed economies may be needed to analyse the monetary policy response in the South Asian region.

The rest of the paper is organised as follows: Section 2 specifies a variant of the Taylor rule. Data and methodology are discussed in Section 3. Section 4 discusses empirical findings, while concluding remarks along with policy implications are given in final section.

2. SPECIFICATION OF MONETARY POLICY RULE

Incorporating recent theoretical developments, especially those related to propagation mechanism, we setup an augmented monetary policy reaction function. It incorporates foreign interest rate and real exchange rate movements in addition to inflation and output gap in the model specification. We start with the simple monetary policy reaction function, similar to one suggested by Taylor (1993). It assumes that the Central Bank set the target of short term nominal interest rate (i_t^*) during each period. In the baseline model, this target rate is assumed to depend on the inflation rate and real output gap. It is also assumed that short term nominal interest rate is the main operating policy instrument and the inflation rate and real output are the policy goals based on the implicit assumption that the Central Bank retains autonomy to conduct monetary policy. Following Taylor (1993), the baseline monetary policy reaction function can be written as follows:

$$i_t^* = \bar{i} + \beta(\pi_t - \pi_t^*) + \gamma y_t \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad (1)$$

[3]According to the IMF behavioural classification as of April 2011, information related to de jure exchange rate regime in the South Asia include: Bangladesh (Soft peg-crawl arrangements), India (floating), Pakistan (soft peg-stabilized arrangements), and Sri Lanka (soft peg-crawl arrangements). For further details [see Cavoli and Rajan (2013), p. 2; Rajan (2012), p. 55].

where $\bar{i}$ is the long run equilibrium nominal interest rate, π_t is the actual inflation rate, π^* is the target rate of inflation and y_t is the real output gap or percentage deviation of aggregate real output (y_t^d) from potential output (y_t^p) at time *t*. The parameters β and γ measure the sensitivity of interest rate to variations in inflation and the real output gap respectively.

This rule indicates that when actual inflation exceeds the target rate of inflation, the Central Bank would try to calm the future inflation down by raising the target interest rate until inflation returns to the target level.[4] For stability of this rule the reaction coefficient on inflation (β) has to be above unity. Then the aggregate demand function is negatively sloped with respect to the inflation rate. The coefficient of output gap (γ) in the reaction function depends on the slope of the aggregate supply curve and weight attached to the variability of output in the loss function [Mohanty and Klau (2004)].[5] The basic intuition of equation (1) is that the interest rate rule characterised by $\beta > 1$ implies aggressive responses of the monetary authorities to combat inflationary pressures. On the other hand, if $0 < \beta < 1$, the Central Bank raises the target interest rate if the increment is not enough to keep the real interest rate from falling. This policy rule accommodates inflationary shocks in which more attention is paid to the short term trade-off between inflation and real output gap. A similar logic can be applied to the output gap coefficient, that is, an aggressive response to the output gap is implied if $\gamma > 0$ and an accommodative response will be there otherwise. Since the target rate of inflation is assumed to be constant, denoting the equilibrium level of the real interest rate as $\bar{r}$ leads to $\bar{i} = \bar{r} + \pi^*$.[6] The underlying assumption is that the Central Bank may not adjust the interest rate to the target level instantaneously because a sudden policy reversal may undermine the market confidence. It usually takes some time to change the policy rate [Umezaki (2007)]. Therefore, we consider that actual observed interest rate (i_t) is partially adjusted to its target rate (i^*) as follows:[7]

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + v_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

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[4]Similarly, when output is above its target level the Central Banks also raise interest rate till the rate of inflation is no longer above target.

[5]For example, a flat aggregate supply curve implies that a policy shock to reduce inflation will significantly increase output variability, suggesting relatively small coefficient [Mohanty and Klau (2004)].

[6]It assumed that equilibrium real interest rate ($\bar{r}$) is stationary and is determined by the non-monetary factors in the long run. Equilibrium real interest rate is also assumed to be constant and independent of monetary policy in the short run. Equilibrium real interest rate is the average real interest rate over the observed period, excluding the financial crisis period. In the original version, the intercept of the Taylor rule represents the sum of the equilibrium real interest rate and the inflation target and takes the value of 4, the inflation gap has the value 1.5, while the reaction coefficient on the output gap has the value of 0.5 [Pinkwart (2013); Osterholm (2005)].

[7]Lagged interest rate is introduced to capture inertia in optimal monetary policy [Hutchison, *et al.* (2010)]. One reason of partial adjustment could be high uncertainty about the model parameters and, therefore, the policymakers have to act upon partial information. Another reason could be that if markets have limited capacity to hedge against interest rate risk, sudden and large changes in interest rate could expose market participants to capital losses which might raise systemic financial risks. The other reasons could be avoiding reputation risks to the Central Banks from sudden reversals of interest rate directions [see Mohanty and Klau (2004); Goodhart (1999)]. Pinkwart (2013) noted that the inclusion of the lagged policy rate on the right hand side is often found to improve the fit to the data.

The partial adjustment parameter ρ lies in the interval [0;1] and v_t is independently and identically distributed (*iid*) random shock to the policy rate [Pinkwart (2013)]. The magnitude of the parameter ρ measures the degree of interest rate smoothing behaviour by modern Central Banks [Wimanda, *et al.* (2012); Pinkwart (2013)].[8] Equation (2) implies that the Central Bank adjusts its policy rate by a fraction $(1-\rho)$ of its current target level. The gap between the current interest rate and the current target level can be represented by some linear combination of the one period lagged realised actual interest rate and its current target level. Combining Equation (1) and Equation (2) yields the following dynamic version of the monetary policy reaction function.

$$i_t = (1-\rho)\bar{i} + (1-\rho)\beta(\pi_t - \pi_t^*) + (1-\rho)\gamma y_t + \rho i_{t-1} + v_t \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Equation (3) can be written as:

$$i_t = (1-\rho)\alpha + (1-\rho)\beta\pi_t + (1-\rho)\gamma y_t + \rho i_{t-1} + v_t \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Where $\alpha \cong \bar{r} - \beta\pi^*$, and $\bar{r}$ equilibrium real interest rate, i_t is the short run nominal interest rate which is used as monetary policy instrument Equation (4) implies that the interest rate (i_t) depends on the inflation rate and the output gap and plus its own lags. The target rate of inflation can be expressed as follows:

$$\pi^* = \frac{\bar{r} - \alpha}{\beta - 1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4a)$$

The value of β indicates the Central Bank's stance against inflation. Equation (4) describes the interest rate setting behaviour of the monetary authority in the developed countries. However, it is inappropriate to assume that the monetary policy is largely determined by the domestic factors only. According to Ahmed and Malik (2011) and Aleem and Lahaini (2011) the simple Taylor rule is not enough to explain interest rate setting behaviour of the monetary authority. In fact, as indicated, the interest rate setting behaviour of the Central Banks in developing countries is heavily influenced by the monetary policy stance of the major Central Banks of the world due to greater integration of financial markets and high degree of capital mobility [Umezaki (2007)]. Frankel (1992) argued that many barriers to the international capital movement across countries have been dismantled following the deregulation of the domestic financial markets. South Asian countries have taken a number of measures to liberalise their financial system in the early 1990s. These liberalisation measures are expected to enhance the efficiency of domestic financial markets and to make it international competitive. Moosa and Bhatti (1997) argued that financial integration greatly affects the behaviour of exchange rate and interest rate across countries, which in turn have crucial implications for the domestic monetary authority to pursue independent monetary policy. They argued that the more integrated financial markets the limited will be the scope for pursuing independent monetary policy. Khan and Sajid (2007) found that SAARC interest rates are cointegrated with the United States interest rates in the long-run. However, they found

[8]Rudebusch (2002) notes that interest rate smoothing could be due to existence of persistent shocks in the economy or due to unobserved variables which are incorrectly omitted from the monetary policy reaction function.

low degree of financial market integration across countries within the SAARC region. In the wake of financial sector liberalisation, Chow, *et al.* (2014) acknowledged the role of foreign interest rates in domestic monetary policy setting. They argued that under free capital mobility domestic interest rates are determined by foreign interest rates. We believe that the Central Banks in the South Asian region give high priority to exchange rate stabilisation in addition to price stability.[9] The possibility of default risks increases manifold when exchange rate determination is left on the market forces. This is true because foreign trade in these countries is 'generally' invoiced in such currencies as the US dollar, the British Pound, and the Euro, therefore, abrupt fluctuations in real exchange rates hurt the confidence of exporters and importers, which in turn accelerates the inflationary pressure. The pass-through effect of exchange rate on inflation through import prices is the fastest channel from monetary policy to inflation. Since, SAARC countries are heavily dependent on international trade and domestic consumption has high import content and these economies are susceptible to imported inflation. It appears from the literature that in the process of inflation targeting, management of exchange rate play fundamental role in monetary policy framework, therefore its role cannot be ignored [Chow, *et al.* (2014)]. The Central Banks may also respond to real exchange rate movements because exchange rate shocks affect their ability in achieving inflation target. Minimising exchange rate volatility enhances credibility of the Central Banks and affects inflationary expectations [Chami, *et al.* (2007)]. Shrestha and Semmler (2015) and Chow, *et al.* (2014) noted that emerging market economies seem to suffer from fear of floating in case of exchange rate appreciation and fear of loss in case of decline in foreign exchange reserves due to lack of credibility of the monetary authority. Therefore, emerging market countries have adopting a Taylor rule.[10] Ball (1999) finds that inclusion of exchange rate in the monetary policy reaction function could improve macroeconomic

[9]This could be due to the fact that when exchange rate pass-through into domestic price is high then monetary authorities give special importance to exchange rate management through capital controls (intervention), debt swaps and other exchange rate linked instruments to stabilize exchange rate expectations. Ball (1999) points out that if adverse exchange rate shocks cause sudden withdrawal of foreign investment from the country, then increase in the interest rate may be an appropriate response to stabilize inflation and output. Furthermore, exchange rate depreciation will increases external demand and prices, a tight monetary policy will reduce domestic demand and stabilize inflation [Mohanty and Klau (2004)]. In case of emerging economies, exchange rate shocks tend to be large and persistent which creates risk of overshooting the inflation target and losses credibility of the Central Banks. Therefore, defending the domestic currency requires raising the interest rate which causes large output losses. On the other hand, to overcome the negative effects of exchange rate depreciation, many countries try to minimize exchange rate movements. In this situation, monetary policy is constraint and plays an accommodating role to achieve exchange rate stability. The main reason of negative effect could be due to the "origin sin hypothesis" which suggests that exchange rate depreciation are costly in countries where economic agents are unable to borrow long-term domestically and cannot borrow abroad in domestic currency and are forced to borrow in terms of foreign currency. In this case, currency exposures restrict the ability of monetary policy to accommodate negative terms-of-trade shocks through nominal depreciation and thus derive up interest rate [Baqueiro, *et al.* (2001)].

[10]Under the flexible exchange rate regime, monetary policy is independent of exchange rate policy because interest rate could set to achieve price stability, while at the same time nominal exchange rate could adjust to attain equilibrium in the external account. However, for small open economy like Pakistan which faces difficulties in letting the nominal exchange rate to adjust freely, an independent monetary policy may not be a feasible option. In this context, Calvo and Reinhart (2002) proposed the "fear of floating" and Eichengreen and Hausmann (1999) developed the "original sin" hypotheses. They argued that the advantages of a pure float are not attainable in emerging economies due to lack of institutional credibility. Therefore, these countries should adopt "hard peg" to solve the problem of credibility.

performance of monetary policy rule. He further argues that in pure inflation targeting regime ignoring the role of exchange rate is dangerous for open economy because it captures large fluctuations in inflation rate and real output.

In the light of the above, we redefine the monetary policy reaction function for the SAARC Countries which simultaneously incorporates both foreign interest rates (i^f) and real exchange rate movements (Δq_t) as follows:

$$i_t = (1-\rho)\alpha + (1-\rho)\beta\pi_t + (1-\rho)\gamma y_t + (1-\rho)\delta i_t^f + (1-\rho)\eta\Delta q_t + \rho i_{t-1} + v_t \quad \dots \quad (5)$$

The real exchange rate movement is defined following the short-run variant of purchasing power parity (PPP) condition:

$$\Delta q_t = \Delta e_t + \pi_t^f + \pi_t^d \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \qquad \dots \quad (5a)$$

Where e_t is the logarithmic value of nominal exchange rate and π^f and π^d represent foreign and domestic inflation, respectively. Using customary notation of Δ for first difference operator, an increase in Δq_t indicates depreciation of domestic currency. The Central Bank increases policy rate in response to a rise in the foreign interest rate if $\delta > 0$ and is assumed to cut down the policy rate in response to an appreciation of real exchange rate according to the Uncovered Interest rate Parity (UIP) condition. Furthermore, the Central Bank stabilises real exchange rate if $\eta > 0$.

With necessary substitutions in the monetary policy function (Equation 5) and inclusion of levels dummy (D_{08}) which takes the value one for 2007Q4 to 2008Q4 and zero otherwise to account for the effect of global financial crisis of 2007-08 on the monetary policy, Equation (5) can be rewritten as:

$$i_t = c_0 + c_1\pi_t + c_2 y_t + c_3 i_t^f + c_4\Delta q_t + c_5 i_{t-1} + c_6 D_{08} + v_t \quad \dots \qquad \dots \qquad \dots \quad (6)$$

Where c_5 measures short-run effects and $c_i/(1-c_5)$ measures the long-run response of the Central Banks. The coefficients of inflation (c_1), output gap (c_2), and foreign interest rate (c_3) are expected to be positive, while the coefficient of lagged policy rate (c_5) is expected to take positive value and vary between zero and one because it would take more than one period for the actual policy rate to adjust to its desired level. The sign of c_4 is ambiguous because Central Banks may raise the policy rate in response to depreciation of the real exchange rate and lower the policy rate in response to appreciation of the real exchange rate [Hsing (2009)]. The policy rule given in Equation (6) differs from the standard Taylor rule because it incorporates variables including the real exchange rate movement and foreign interest rate besides the inflation rate and output gap.

We contend that the inclusion of foreign interest rate and real exchange rate in the policy reaction function will allow us to determine the degree of the monetary policy autonomy. If domestic factors remain significant even after the inclusion of foreign factors it would suggest that the Central Banks retain their autonomy in the conduct of monetary policy. If the foreign factors are insignificant, the Central Banks conducts its monetary policy based only on the domestic factors without any regard for foreign factors. If both domestic and foreign factors are significant in the monetary policy reaction function, then autonomous monetary policy based on domestic factors is not compatible, unless exchange rate depreciation and foreign interest rate are not taken into

account. In this case a hybrid monetary policy reaction function could be useful to pursue sustainability of the domestic currency together with price stability and output growth.[11]

3. DATA AND METHODOLOGY

3.1. The Data

Quarterly data for Bangladesh, India, Pakistan and Sri Lanka over the period 1990Q1 to 2012Q4 has been used for empirical analysis.[12] Even though the standard practice is to use of discount rate as monetary policy instrument but due to changed monetary policy stance over the years in the SAARC region, alternative proxies have been used in the present study. The justification is as follows.[13] There has been a shift from direct to indirect instruments of monetary policy in the region. Before 1990, SAARC countries have used cash-reserve ratio (CRR), directed credit programmes and statutory liquidity ratio (SLR) as instruments of monetary policy. However, after 1990 many countries in the region have started to float several interest rates in the financial markets and there is no consensus on the best measure of the monetary policy stance among these various interest rates. Given this lack of uniformity, we have used the 6-month Treasury bill rate as proxy for monetary policy stance for Pakistan and Sri Lanka.[14] It is considered as benchmark rate in the money market because majority of the Treasury bills have a maturity of 6-months. The same has not been used for Bangladesh and India due to non-availability of data on 6-month Treasury bill rate. Instead the deposit rate has been used for Bangladesh and the overnight call money rate is used as proxy of monetary policy instrument for India. Finally, the quarterly values of US Federal Funds rate are taken as proxy of foreign interest rate. The four-quarter inflation rate (π_t) is calculated as:

$$\pi_t = [\log(p_t) - \log(p_{t-4})] \times 100$$

Where p_t is consumer price index (CPI with 2000=100 as base year). Since quarterly data on real GDP were not available for all countries, we followed Goldstein and Khan (1976) methodology to construct these data. We have used the Hodrick-Prescott (HP) filter for the real GDP data to obtain potential output (y_t^p) which was then used to construct the output gap (y_t).[15] Real exchange rate (q_t) has been calculated as logarithmic values of bilateral nominal exchange rates plus logarithms of foreign prices minus logarithms of domestic price level for each country. Increase in q_t means depreciation. The US consumer price index (CPI with base year 2000=100) is taken as proxy of foreign price

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[11]Clarida, *et al.* (1997, p. 21) argued that in such situation the monetary policy rate determined by the weighted average of the domestic and foreign factors.

[12]For Bangladesh data are available only from 1993Q3 to 2012Q4.

[13]Two reasons for using market interest rate as the dependent variable. First, the standard regression analysis requires a continuous variable, but the policy rate (discount rate) changes in discretionary steps. Secondly, policy rate is not always the appropriate variable to correctly signal the stance of the monetary policy [Pinkwart (2013)].

[14]For India some observations on Call Money rate are missing that were replaced by the values of discount rate because of insignificant difference between the two.

[15]One important characteristics of HP filter is that it is two sided and uses future information to compute the potential output.

level.[16] The real exchange rate depreciation is calculated as $\Delta q_t = (q_t = q_{t-4})$. All data series have been retrieved from the International Monetary Fund's international Financial Statistics (IFS) CD-ROM-2013.

3.2. Data Analysis

To understand the pattern of quarterly domestic interest rates, output gap, foreign interest rate and inflation rates in SAARC region, we plot data of each country in Figures 1. We observe that SAARC interest rates are volatile with respect to Federal Funds rate except for Bangladesh. This shows that financial markets in the SAARC region are dependent on the FED's monetary policy, particularly after 2000. An evidence of pro-cyclical co-movements between output gap and inflation rate is observed for all countries, which confirms that inflation increases with positive output gap. This could be due to demand pressure. Furthermore, output gap also remains negative during recession.[17] Except for Bangladesh, inflation seems to be positive with respect to policy interest rate for other countries. After 2004 Pakistan and Sri Lanka appeared to have adopted contractionary monetary policy measures, whereas India adopted contractionary monetary measures between 2006 and 2008. However, Indian and Bangladesh interest rate show a declining trend in post-2008 period.

Fig. 1. Trends of Domestic and Foreign Interest Rates, Output Gap and Inflation Rates
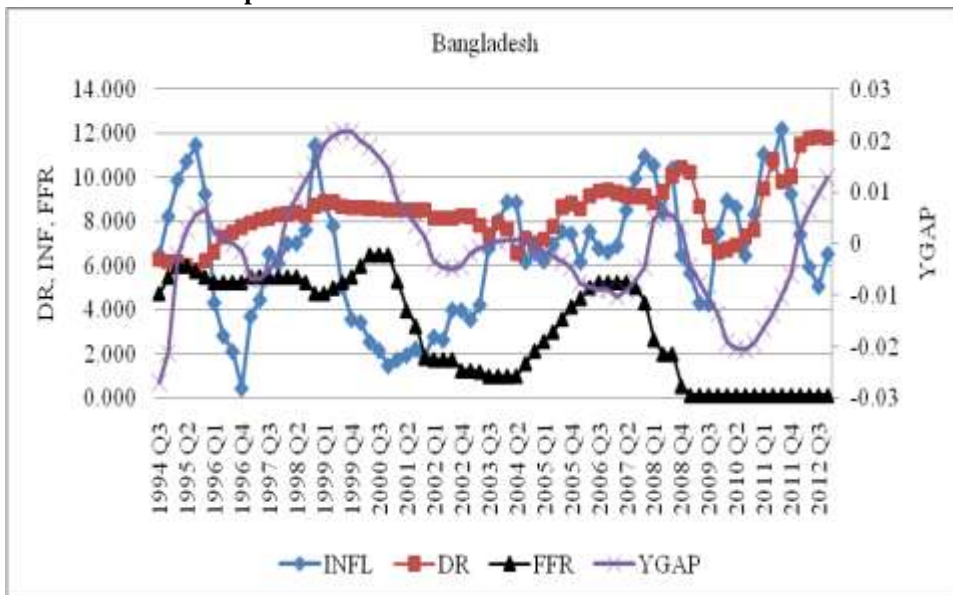
[16]A bilateral nominal exchange rate is the spot exchange rates of each country with respect to US dollar.

[17]According to the Taylor rule, monetary policy does not responds directly to inflation, and it also responds to the output gap which can be viewed as a measure of inflationary pressures. If actual real output falls below its natural level, the output gap is positive and the real interest rate falls, whereas if real output rises above its natural level, the output gap is negative and the real interest rate rises accordingly [Mankiw and Scarth (2008)].

Bangladesh

India

India

Pakistan

Pakistan

Sri Lanka
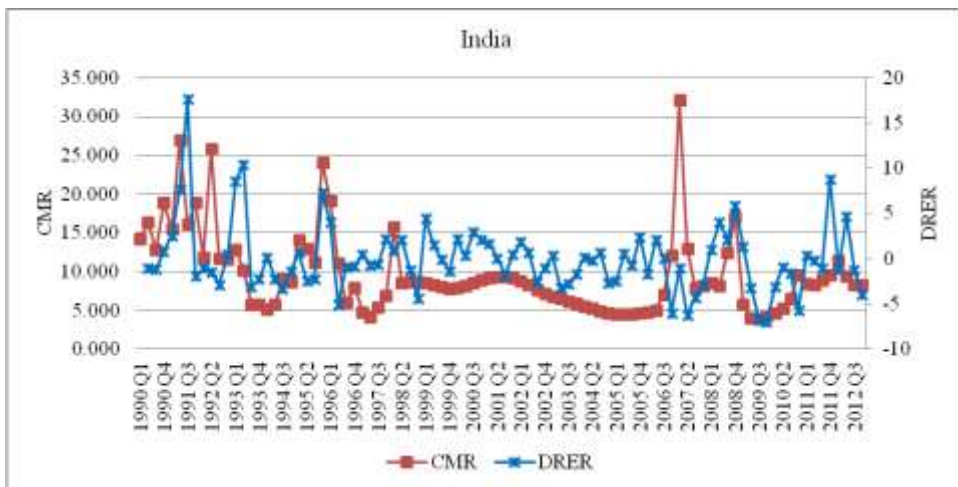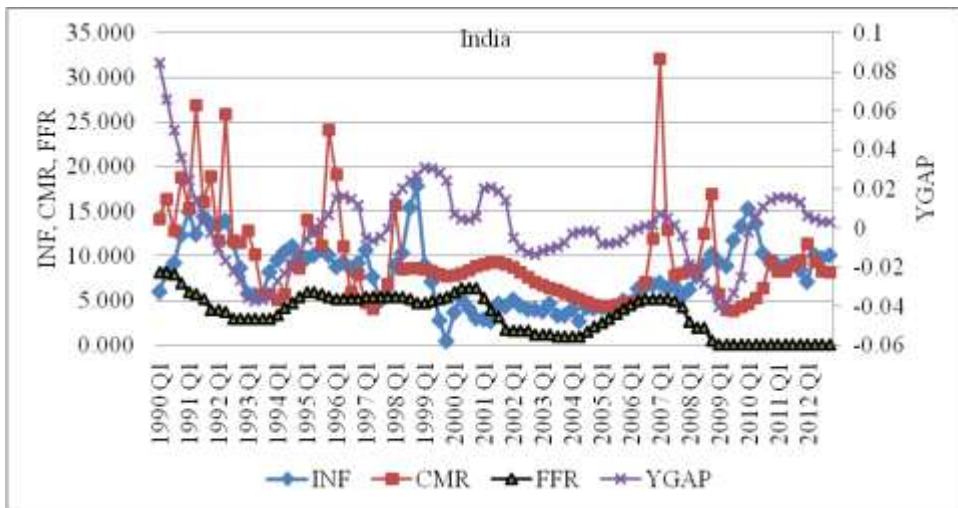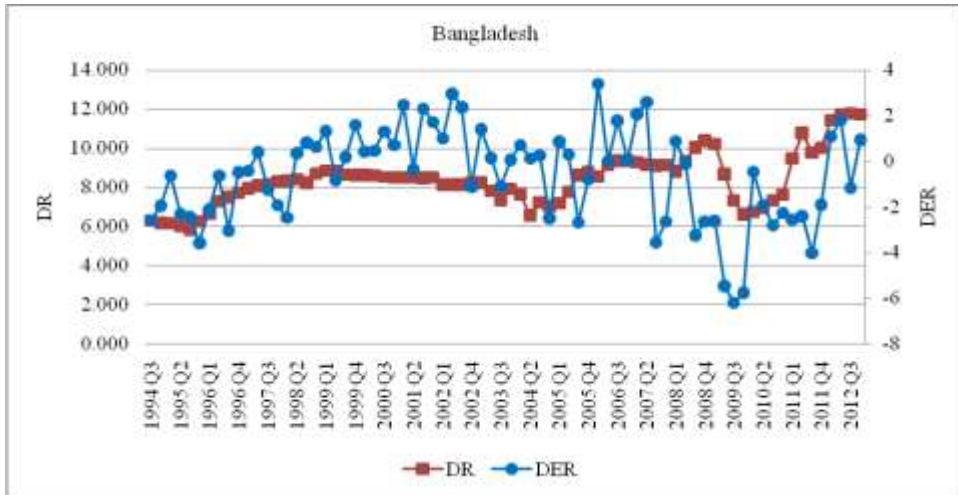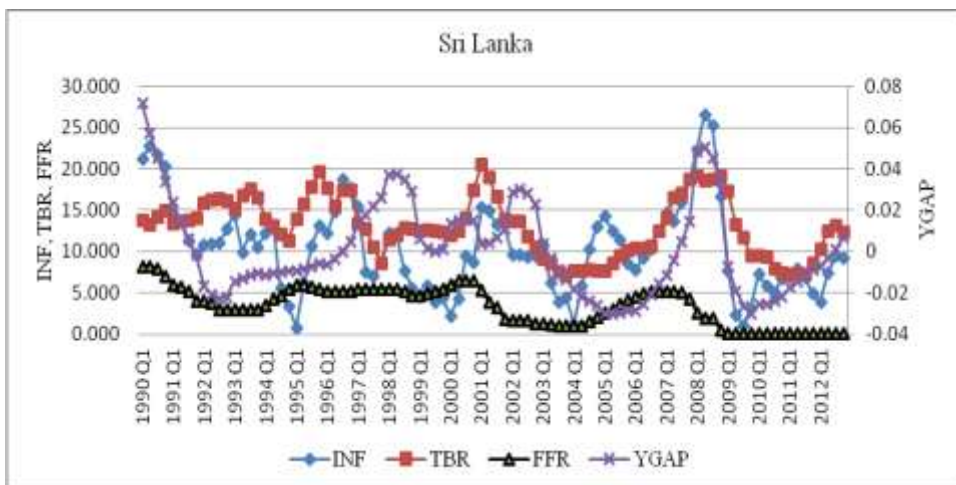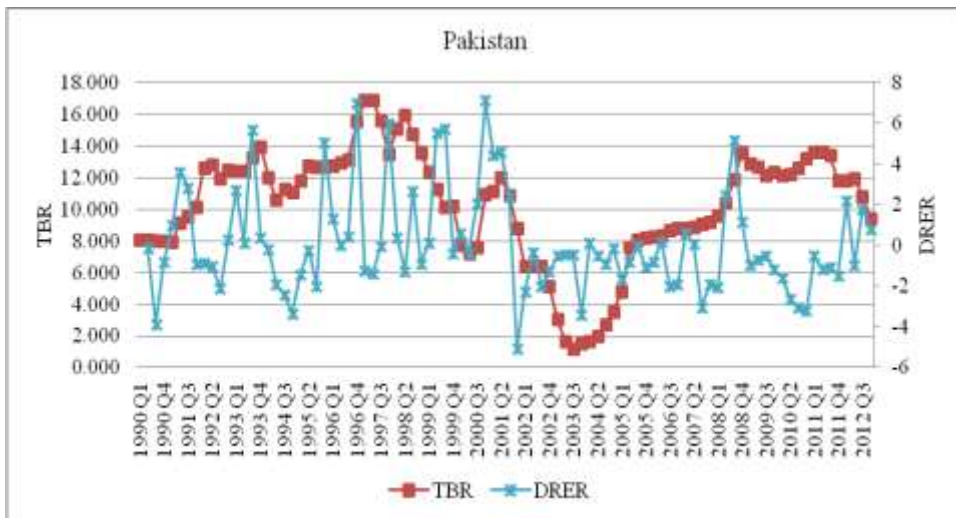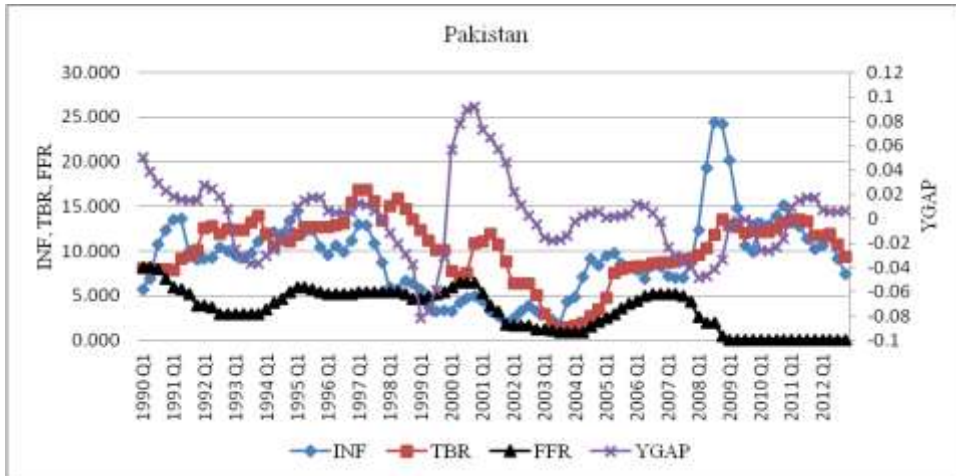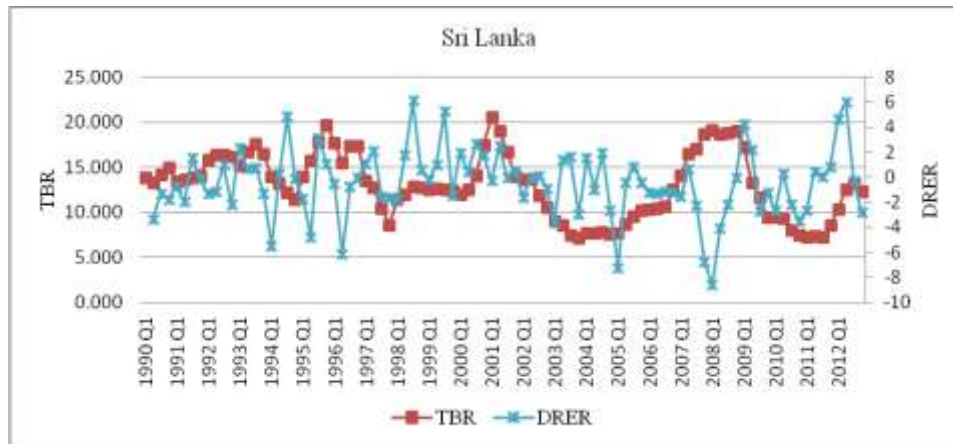
The real exchange rate movements suggest that exchange rates in South Asian region remain volatile during 1990-2012. However, Pakistani rupee exchange rate seems more volatile than the other South Asian exchange rates. Therefore, Bangladesh, India, Pakistan and Sri Lanka may target exchange rate together with the interest rate as an instrument of monetary policy to achieve output and price stability.

3.3. Correlation Analysis

The correlation between policy interest rate, inflation rate, output gap, foreign interest rate and exchange rate movements are depicted in Table 1.

Table 1

Correlation Analysis, 1990Q1-2012Q4

Variable	Bangladesh	India	Pakistan	Sri Lanka
Interest Rate-Inflation Rate	−0.11(−0.86)	0.33 (3.05)*	0.51(5.16)*	0.58 (6.17)*
Interest Rate-Output Gap	0.008 (0.006)	0.12 (1.02)	0.04 (0.32)	0.03 (0.29)
Interest Rate-Foreign Interest Rate	−0.06 (−0.44)	0.36 (3.35)*	0.30(2.74)*	0.33 (3.02)*
Interest Rate-Real Exchange Rate Depreciation	0.14(1.07)	0.34(3.17)*	0.31(2.89)*	−0.06(−0.50)

Note: Figure in brackets is the t-values. * indicate significant at the 1percent level of significance.

It is evident from the correlation results that there is no significant correlation observed between policy interest rate, inflation rate, output gap, foreign interest rate and real exchange rate depreciation for Bangladesh. However, in India and Pakistan except for output gap, there exists a significant correlation between interest rate, inflation rate, foreign interest rate and real exchange rate depreciation. Similarly, for Sri Lanka inflation and foreign interest rates are significantly correlated with reference to policy interest rate. However, output gap and real exchange rate depreciation remains insignificant. These results suggest that except for Bangladesh other countries might be following some form of the Taylor principle.

3.4. Methodology

The presence of lag dependent variable on the right hand side of the Equation (6) may create endogeneity problem, hence the Ordinary Least Squares (OLS) method remains inconsistent. This problem is mitigated by applying the Generalised Method of Moments (GMM) technique which uses instruments that are uncorrelated with the error term. These instruments isolate the components of the regressors that are correlated with error term. To explain further, let Z be the vector of instruments with $T \times l$ order of matrix and $l = 7$ are the number of regressors including constant. The orthogonal moment conditions for estimation of the parameters of Equation (6) using GMM is as follow:

$$E(Z'v) = 0 \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (7)$$

The GMM coefficients can be obtained by minimising the following GMM criterion function:

$$Q(\theta, y) = (y - X\theta)'Z(Z'\Omega Z)^{-1}Z'(y - X\theta) \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (8)$$

Where Ω is variance-covariance matrix defined by $E(v'v) = \Omega$. The GMM criteria function is directly used to test for over-identifying restrictions. The two step GMM estimators are obtained as:

$$\hat{\theta} = (X'Z(Z'\hat{\Omega}Z)^{-1}Z'^{-1}X'Z(Z'\hat{\Omega}Z)^{-1}Z'y \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (9)$$

For time series data, the matrix Ω may contain non-zero off-diagonal elements to capture serial correlation. The GMM estimator then takes the following form:

$$\hat{\theta} = (X'Z\hat{\Sigma}^{-1}Z'^{-1})X'Z\hat{\Sigma}^{-1}Z'y \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (10)$$

We used lagged value of the regressors as instruments in GMM estimation and the validity of instruments, which we evaluate by computing the Sargan-Hansen J – test of over-identifying restrictions proposed by Newey and West (1987).[18] The rejection of the null hypothesis that instruments are orthogonal to errors would indicate that the estimates are inconsistent.

4. THE MONETARY POLICY RULE: EMPIRICAL ANALYSIS

4.1. Results of the Baseline Model

Initially we have estimated a variant of the baseline Taylor rule to examine whether or not Central Banks of SAARC countries follows the Taylor rule. Table 3 reports the results.[19]

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[18] Lagged policy rate are not included in the list of instruments because they all are correlated with the residuals [Pinkwart (2013)].

[19] It is worth mentioning here that in order to apply OLS or GMM the variable must be stationary [see Pinkwart (2013)]. The results of extended variant of Taylor rule based on the OLS are reported in Tables 2A, 2B and 2C (see Appendix).

Table 3

Empirical Verification of Baseline Taylor Rule
Dependent Variable: i_t

Variables	Bangladesh	India	Pakistan	Sri Lanka
Constant	1.70	3.09	–0.29	0.24
	(1.64)	(2.16)*	(–0.62)	(0.38)
π_t	–0.004	0.12	0.09	0.12
	(–0.24)	(1.02)	(2.04)**	(2.05)*
y_t	–0.002	–0.08	0.11	0.19
	(–0.05)	(–0.47)	(2.28)**	(2.75)*
i_{t-1}	0.80	0.49	0.95	0.90
	(6.26)*	(2. 63)*	(20.77)*	(10.49)*
R^2	0.81	0.27	0.72	0.86
$\overline{R}^2$	0.80	0.24	0.71	0.85
J – statistic	3.24 [0.778]	8.09 [0.232]	1.89 [0.930]	8.56 [0.200]
Instrument rank		10	10	10

Note: Figures in parentheses are the t-values. *, ** and *** indicate significant at the 1 percent, 5 percent and 10 percent level of significance. Number in [.] are the p-values. Instruments are: $\pi_{t-1,\ t2\ and\ t-3}$, $y_{t-1,\ t-2\ and\ t-3}$, and $Lrm_{t-1,\ t-2\ and\ t-3}$.

It is evident from the results that explanatory power of the estimated monetary policy rule seems to be reasonably good for Bangladesh, Pakistan and Sri Lanka, whereas the value of adjusted R^2 is relatively low for India. However, the estimated model does not suffer from misspecification. The Sargan-Hansen J-statistic confirms the validity of over-identifying instruments used in estimation.

It is observed from the results that the short-run coefficients of the estimated model are not in accordance with the values hypothesised by the Taylor rule.[20] The results clearly indicate that Central Banks of SAARC countries are not following the Taylor rule principle in conducting the monetary policy in the short-run, although the coefficients of inflation rate and output gap have the expected signs and statistically significant in the case of Pakistan and Sri Lanka. Thus, we conclude that the standard Taylor rule does not apply to the major SAARC countries in the short-run. On the other hand, the estimate indicates that the coefficients of the lagged interest rate are positive and statistically significant with high magnitudes and vary between 0.49 (India) and 0.95 (Pakistan). The coefficients on the lagged interest rate are 0.95 in Pakistan followed by Sri Lanka (0.90), Bangladesh (0.80) and India (0.49), implying that initial adjustment in the interest rate is only 5 percent in Pakistan, 10 percent in Sri Lanka, 20 percent in Bangladesh and 51 percent in India within one quarter. The degree of interest rate smoothing is high in Pakistan, Sri Lanka and Bangladesh. The main reason of high degree of interest rate smoothing could be the presence of financial crises, credit crunches and developments in commodity prices [Pinkwart (2013)]. This finding implies that standard Taylor rule may be useful only for interest rate smoothing rather than stabilising inflation rate and supply of output. This suggests that pursuance of interest rate

[20]Taylor (1993) predicted the monetary policy rule as: $i_t = \pi_t + 0.5y_t + 0.5(\pi_t - 2) + 2$. This rule assumed a constant real interest rate and long-run inflation target at 2 percent. However, as we set the real interest rate and inflation target equal to 2, the interest rate setting rule becomes: $i_t = 1 + 1.5\pi_t + 0.5y_t$.

smoothing is an important objective of the monetary policy in these countries. Another important finding with respect to Pakistan and Sri Lanka is that the response of monetary policy to inflation exceeds than unity. The long-run coefficients of inflation in Pakistan and Sri Lanka are respectively 1.8 and 1.2, indicating that Central banks in these countries do not accommodating inflationary pressures.[21] The response coefficient of inflation is significantly greater than one in Pakistan and Sri Lanka which confirms stability condition for the Taylor rule. The long-run response of inflation to policy rate appears to be very weak and insignificant in India and Bangladesh, indicating perhaps their relatively higher inflation rates. The reason of this finding could be that the monetary authorities in India and Bangladesh may face some non-monetary policy price pressures in order to reduce the output costs [Mohanty and Klau (2004)]. The low and insignificance response of inflation rate to policy rate violates the stability condition for the Taylor rule. The response of output gap is negative and insignificant in the case of Bangladesh and India. One reason of this finding could be that a large chunk of real sector activities are not under the domain of monetary policy in these countries. The other reason could be that negative and insignificant output gap implies future declines in the inflation rate, which could destabilise the economy where the interest rate approaches to lower bound. Therefore, negative output gap generate a more rigorous response than the case when the gap exceeds the assumed target [Caglayan, *et al.* (2016)]. On the other hand, output gap seems to be positive and significant in the case of Pakistan and Sri Lanka which suggests that output exceeds the set target and demand pressure calls for the tight monetary policy in these countries, although the coefficient of output gap is less than 0.5. The long-run coefficients of output gap are respectively 2.2 and 1.9 in Pakistan and Sri Lanka suggesting that monetary authority also stabilises output besides in inflation in these countries in the long-run. Finally, in case of Pakistan the intercept term is negative but statistically insignificant. The negative sign of intercept term implies that either the real interest rate is negative or level of inflation target is high, that is, more than double of the real interest rate [Malik and Ahmed (2007)].

4.2. Results of Extended Taylor Rule

The results depicted in Table 3 suggest that simple monetary policy rule due to the Taylor (1993) is not appropriate to conduct monetary policy by major South Asian Central banks. It is now well established that in the era of globalisation with greater financial markets integration, the variants of the Taylor rule based on a closed economy framework perform poorly in an open economy unless they are modified to account for the movements in the exchange rates [Ball (1999); Caglyan, *et al.* (2016)]. Svensson (2000) argued that in an open economy setting there are various direct and indirect channels through which exchange rates can affect monetary policy and show that domestic inflation responds to foreign variables such as foreign inflation rate, exchange rate, foreign interest rate and shocks from the rest of the world [Caglyan, *et al.* (2016)]. In such circumstances, monetary policy in emerging economies may need to pursue multiple objectives such as economic growth, price stability, financial and exchange rate stability and had to pay more attention to the external constraint. Accordingly, Taylor (2001) and

[21]The long-run coefficient of inflation in Pakistan is equal to 0.09/1-0.95 and for Sri Lanka is 0.12/1-0.90.

Hsing (2009) have incorporating the exchange rate and foreign interest rate in the monetary policy reaction function. Filosa (2001) finds that most Central Banks in emerging market economies react strongly to exchange rates. Mohanty and Klau (2004) reported that Central Banks in emerging markets tend to look beyond inflation and output, and focus on other objectives such as exchange rate changes. Similarly, Lubik and Schorfheide (2007) and Adolfson, *et al.* (2008) show that exchange rate movements affect Central Bank behaviour. Furthermore, Umezaki (2007) demonstrated that international capital mobility also affect domestic monetary policy. It is appropriate to assume that foreign interest rate affect SAARC interest rates through interest rate arbitrage. Therefore, we have estimated the extended version of the Taylor rule specified by Equation (6). The empirical analysis in the ensuing paragraph is on GMM results reported in Tables 4 to 5.[22] It is evident from the results that the explanatory power of the extended model has been reasonably good for Bangladesh, Pakistan and Sri Lanka, whereas for India the value of adjusted R^2 is relatively low. The estimated equations do not show any evidence of misspecification. The Sargan-Hansen J-test accepts the null hypothesis of over-identifying instruments. This implies that the instruments are appropriately selected. We start with the outcome for Bangladesh (Table 4).

Table 4

Empirical Verification of an Extended Taylor Rule
Dependent Variable: i_t

Variables	Bangladesh			India		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	0.83	0.48	–0.66	6.86	0.80	2.37
	(0.62)	(0.55)	(–0.55)	(3.54)*	(0.82)	(3.49)*
π_t	0.05	0.03	0.04	0.36	0.07	0.43
	(0.43)	(0.90)	(0.42)	(1.89)***	(0.82)	(9.54)*
y_t	–0.03	0.06	0.05	0.24	–0.44	0.18
	(–0.24)	(1.24)	(0.58)	(0.78)	(–2.77)*	(2.02)*
Δq_t	3.15	–	–1.32	22.45	–	8.78
	(0.29)		(–0.17)	(2.73)*		(5.97)*
i_t^f	–	0.07	0.06	–	0.74	0.25
		(2.72)*	(1.00)		(3.16)*	(2.23)*
i_{t-1}	0.88	0.89	1.03	–0.08	0.48	0.27
	(5.13)*	(9.47)*	(7.63)*	(–0.31)	(3.78)*	(8.38)*
D_{08}	–0.55	0.36	–0.24	–0.96	4.43	–1.54
	(–0.35)	(0.87)	(–0.35)	(–0.22)	(2.11)*	(–2.04)*
R^2	0.75	0.85	0.80	0.09	0.33	0.28
$\overline{R}^2$	0.72	0.84	0.78	0.02	0.29	0.22
J–statistic	3.45	5.84	13.37	4.61	8.54	98.37
	[0.841]	[0.558]	[0.147]	[0.707]	[0.287]	[0.000]
Instrument Rank	13	13	16	13	13	17

See note below Table 3. Instruments are: $\pi_{t-1,t-2\,and\,t-3}, y_{t-1,t-2\,and\,t-3}, i_{t-1,t-2\,and\,t-3}^f, \Delta q_{t-1,t-2\,and\,t-3}$ and

$Lrm_{t-1,t-2\,and\,t-3}$

[22] Since we are interested to determine the impact of exchange rate depreciation and foreign interest rate on monetary policy, therefore, we are much concentrated on model 3 in Tables 4 and 5.

The results reveal that for Bangladesh the coefficients of inflation and output gap possess expected positive signs but they are statistically insignificant in all specifications. This is not surprising because the Bangladesh Bank does not follow the Taylor rule principle in setting interest rate. Since its independence, the Bangladesh Bank has been conducting monetary policy with significant discretion. Islam and Uddin (2011) have argued that the Bangladesh Bank is still using broad money as intermediate target and reserve money as the operating target. Unstable broad money supply growth and inflation instability undermine the credibility of the monetary authorities and dilute the impact of monetary policy. Furthermore, the Bangladesh Bank did not gain much independence in terms of monetary policy formulation and implementation due to fiscal dominance. The Bangladesh Bank maintains that inflation targeting is not yet appropriate because the interest rate channel of monetary policy transmission mechanism is not well developed [Hossain (2010)].

Real exchange rate depreciation is also insignificant in the monetary policy reaction function. This implies that Bangladesh monetary authority do not react to real exchange rate movements. In model 2 (Table 4), foreign interest rate appears to be statistically significant, implying the Bangladesh monetary authority reacts to foreign monetary policy although the response is too weak. However, it turns out to be insignificant when both real exchange rate depreciation and foreign interest rate are added in the estimation (model 3). The coefficient of interest rate lagged by one quarter exerts significant effect on monetary policy instrument in all specifications. However, the coefficient on the lagged interest rate is 1.03 (model 3), which implies that the initial adjustment in interest rate is only –0.03 percent and the degree of interest rate smoothing is 1.03 percent. Finally, it is argued that Bangladesh follow lax monetary policy with short-run and long-run coefficients of inflation rate, real output gap and real exchange rate movements are not significantly different from zero. In this context, Hossain (2010, p. 576) argued that "there is lack of transparency of the design and conduct of monetary policy in Bangladesh. Inflation targeting does not necessarily achieve credibility in an uncertain inflationary environment when a Central Bank claim bad luck, adverse shocks and extenuating circumstances in missing the inflation target, which can ultimately undermine a Central Bank's credibility". Finally, to capture the response of Bangladesh Bank to global financial crisis, a dummy variable that takes value one for 2007Q3 to 2008Q4 and zero otherwise has been introduced. The result suggests that global financial crisis has transmitted no significant impact on Bangladesh monetary policy.

The results obtained for India suggest that inflation rate; foreign interest rate and exchange rate depreciation produces significant positive effect on monetary policy rate in all specifications. However, the size of the coefficients changes significantly when real exchange rate depreciation and foreign interest rate included in estimation. The positive and statistically significant coefficient of inflation implies that the Reserve Bank of India (RBI) has consistently strived to stabilise inflationary movements over the sample period 1990-2012. The less than unitary coefficient of inflation suggests that RBI increased the policy interest rate by 0.43 basis points in response to a 1percent rise in the inflation. However, less than unity coefficient of inflation violates the stability condition for the Taylor rule in the short-run. Similarly, real output gap is positive and statistically significant. This suggests that the monetary authority in India increased the policy

interest rate by 0.18 basis points in response to a one unit rise in output gap.[23] However, the coefficient with respect to output gap is smaller than the coefficient of inflation rate which suggests that the aggregate supply curve in India is inelastic. This may indicate that inflation in India is governed by the cost push factor. This may also be due to inadequacy of the measure of output gap as Mohanty and Klau (2004) have rightly noted that estimating potential output is difficult as supply side shocks in emerging economies are relatively larger than that of developed economies. Despite these concerns, the results of present study are, nonetheless, consistent with the earlier findings of Hutchison, *et al.* (2010), Hutchison, *et al.* (2013) and Singh (2010).

The coefficient of real exchange rate depreciation is although greater than unity for all cases, it turns out to be significant in the monetary policy reaction function. This implies that exchange rate plays a dominant role in the monetary policy setting in India. Ball (1999) argued that inflation targeting without explicit attention to the exchange rate is dangerous in an open economy, because large fluctuations in exchange rate affect output as well as inflation through import price channel. Large movements in capital flows and exchange rates force the RBI to intervene in the foreign exchange market to ensure orderly conditions in the foreign exchange market and prevent excessive exchange rate volatility that can induce further spirals [Gokran (2012); Patra and Kapur (2012)].[24] The main instrument of the RBI to smooth excessive exchange rate volatility has been active capital account management along with interventions in the foreign exchange markets [Mohan and Kapur (2009); Patra and Kapur (2012)].[25] However, large and significant coefficient of exchange rate signals the effectiveness of exchange rate channel of monetary policy. Mohanty and Klau (2004) find that central banks in emerging economies tend to focus on exchange rate stabilising besides inflation and output gap.[26] Jha (2008) noted that even though price stability, output growth, reduction of exchange rate volatility, and financial stability are the monetary policy goals of the RBI, but none of these are fully under its direct control. The dominance of exchange rate changes in the monetary policy reaction function does indicate that exchange rate stabilisation in inflation targeting is a preferred policy choice for India. Mishra and Mishra (2012) have also hinted towards this based on similar results for India.

Regarding foreign interest rate, the result reveals that an increase in the foreign interest rate will generate depreciation of the real exchange rate, which in turn putting upward pressure on inflation rate and hence on the domestic interest rates [Caglayan, *et al.*

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[23] Positive increases in the output gap represent a rise in actual output relative to potential output.

[24] In 2006 committee on full convertibility of capital account firmly recommended to the RBI that RBI should maintain a monitoring band of +/- 5 percent around the real effective exchange rate and should intervene as and when the real effective exchange rate moved outside this band [RBI (2006)].

[25] The RBI adopted multiple indicator approach in 1998 to maintain (i) a stable inflation environment, (ii) appropriate liquidity conditions to accelerate economic growth, (iii) maintain orderly conditions in the foreign exchange market to avoid excessive volatility in the exchange rate, and (iv) stable interest rate [RBI (2002); Jha (2008)].

[26]It is important to note that reaction of the exchange rate to an interest rate shocks depend on the nature of exchange rate regime and the degree of trade openness of an economy. In a flexible exchange rate regime, the exchange rate reacts more pronouncedly to an interest rate shocks. However, if exchange rate is pegged and heavily managed, it will not respond to an interest rate shocks [Aleem (2010)]. However, India still placed many qualitative restrictions on the trade and capital flows.

(2016)].[27] The result suggests that an increase of 100 basis points in the US Federal Funds rate is associated with an increase of 25 basis points in the policy rate per quarter in India.[28] This suggests that Indian monetary policy is significantly influenced by international events, especially from the US monetary policy actions. Though, this result confirms relatively weak degree of financial markets integration between India and the rest of the world.

The response coefficient of lagged policy rate is positive and significant in model 2 and model 3. However, the lagged coefficient of policy rate is 0.27 in model 3 indicating a relatively low degree of interest rate smoothing with initial adjustment in interest rate is 73 percent per quarter. The long-run coefficients on inflation rate and output gap respectively are 0.59 and 0.25, which suggests that in long-run a unit increases in inflation rate lead to raise interest rate by 0.59 basis points and output gap by 0.25. These finding are inconsistent and violates long-run stability condition for the Taylor principle. Finally, our finding reveals that the effect of global financial crisis of 2007-08 is negative and statistically significant which suggest that the RBI reacts to global financial crisis passively by loosening of domestic monetary policy.

In case of Pakistan, the results are generally consistent with economic theory (Table 5). The coefficient of inflation rate is positive and larger than output gap in all cases which implies that the State Bank of Pakistan (SBP) has given more weight to inflation stabilisation than output. However, the coefficient of inflation rate is less than unity (0.19) which suggests that the SBP has accommodated inflationary pressures by increasing nominal interest rate by 0.19 basis points in response to 1 percent increase in inflation rate in the short-run. The coefficient of output gap suggests that a one percent deviation of actual output from its long run sustainable level would raise policy rate by 0.12 percent. This variable is significant at the 5 percent level. The result pertaining to real exchange rate implies that a one percent depreciation of real exchange rate increases monetary policy rate by more than 3 percent. This result confirms strong integration of domestic financial markets in Pakistan. Khan and Ahmed (2011) found that real exchange rate seemed to be a dominant source of variation in output and inflation in Pakistan. Foreign interest rate enters in the monetary policy reaction function with positive sign and it is statistically significant which confirms that the domestic financial markets are now relatively more integrated with the rest of the world due to a series of financial sector reforms since early 1990s. The coefficient of lagged policy rate is 0.86 which confirms a high degree of interest rate smoothing with adjustment in interest rate is only 14 percent per quarter. The long-run coefficient of inflation and output gap are 1.36 and 0.86 which confirms the stability of the Taylor rule in the long-run.

On the whole, the results of present study are consistent with the earlier findings of Ahmed and Malik (2011) and Aleem and Lahiani (2011). The coefficient of D_{08} which corresponds to global financial crisis of 2007-08 is negative and significant which is quite odd given that the domestic financial sector was not seriously influenced by the global financial crisis and as such did not require loosening of the monetary policy stance.

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[27]The real UIP condition implies that a rise in the foreign interest rate will lead to an appreciation in the real exchange rate ($q_{t+1}^e - q_t < 0$). Given expected foreign inflation rate (π_{t+1}^{e*}), an expected appreciation will be generated by an increase in domestic inflation (π_{t+1}^e) and exerting an upward pressure on domestic interest rate. Hence, through this channel an increase in foreign interest rate will have a positive impact on domestic interest rate [Caglayan, *et al.* (2016)].

[28] In model 2, the coefficient of foreign interest rate is 0.74.

Table 5

Empirical Verification of an Extended Taylor Rule
Dependent Variable: i_t

Variables	Pakistan			Sri Lanka		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	–0.001	–0.70	–0.55	–1.27	–0.64	0.58
	(–0.002)	(–2.07)**	(–2.86)*	(–1.25)	(–0.66)	(3.94)*
π_t	0.17	0.14	0.19	0.40	0.18	0.28
	(2.14)*	(2.74)*	(9.15)*	(4.81)*	(0.56)	(13.16)*
y_t	0.11	0.10	0.12	0.28	0.10	0.25
	(2.18)*	(2.03)*	(12.85)*	(2.55)*	(0.86)	(6.99)*
Δq_t	3.79	–	3.45	0.39	–	3.45
	(1.48)		(2.73)*	(0.26)		(6.36)*
i_t^f	–	0.13	0.10	–	0.29	0.11
		(1.84)*	(3.32)*		(1.82)*	(2.93)*
i_{t-1}	0.86	0.90	0.86	0.84	0.85	0.75
	(10.53)*	(16.42)*	(47.20)*	(12.09)*	(11.78)*	(48.65)*
D_{08}	–1.05	0.21	–0.94	–4.51	–1.10	–1.34
	(–0.66)	(0.29)	(–1.80)**	(–2.16)*	(–0.42)	(–3.38)*
R^2	0.75	0.74	0.75	0.79	0.86	0.86
$\overline{R}^2$	0.73	0.72	0.73	0.78	0.85	0.85
$J-$statistic	2.55	4.61	11.77	6.46	4.71	17.32
	[0.923]	[0.707]	[0.227]	[0.488]	[0.695]	[0.185]
Instrument Rank	13	13	16	13	13	20

See note below Table 4. Instruments are: $\pi_{t-1,t-2 \text{ and } t-3}$, $y_{t-1,t-2 \text{ and } t-3}$, $i^f_{t-1,t-2 \text{ and } t-3}$, $\Delta q_{t-1.t-2 \text{ and } t-3}$ and

$Lrm_{t-1,t-2 \text{ and } t-3}$

The empirical results for Sri Lanka (Table 5) reveal that the coefficient of inflation rate, output gap, foreign interest rate and real exchange rate depreciation and lagged interest rate enter the monetary policy reaction function with expected positive sign in all specifications. It is interesting to note that in case of Sri Lanka the coefficients of inflation rate, output gap, foreign interest rate and real exchange rate depreciation are statistically significant (see model 3). The coefficient of inflation rate is positive but less than unity (i.e. 0.27) suggesting that the Central Bank of Sri Lanka (CBSL) increases policy rate by 0.27 basis points when there is one percent increase in inflation in Sri Lanka. This finding clearly indicates that CBSL does not following the Taylor rule in the short-run. The reason could be that in Sri Lanka formal financial system is dominated by the commercial banks and the monetary authority mainly focuses on the demand for and supply of reserve money [CBSL (2010)]. As a result, monetary policy instruments, such as interest rate and open market operations are used to achieve monetary targets. Bernanke and Gertler (1995) argue that dominance of commercial banks and information asymmetries leads dominance of credit channels in transmission mechanism of monetary policy rather than the interest rate channels. The positive and significant coefficient of output gap implies that the CBSL stabilises real economic activity besides the price

stability. Real exchange rate depreciation enters in the monetary policy reaction function with positive sign and statistically significant which verifies a dominant role of real exchange rate in the monetary policy in Sri Lanka. The positive and significant coefficient of foreign interest rate implies that Sri Lankan financial markets are integrated with the rest of world and its monetary policy is dependent of monetary policies of the developed countries. Therefore, it appears that Sri Lankan monetary authority significantly react to changes in foreign interest rate. The coefficient on lagged dependent variables is 0.75 which show that there is high degree of interest rate smoothing in monetary policy instrument by the CBSL. The variable that represents external shock (D_{08}) remains negative and significant in the monetary policy in Sri Lanka. This implies that domestic policy interest rate depresses in the wake of external shocks. In the long-run, the coefficients of inflation and output gap equals 1.12 and 1.00 which confirms the stability condition for the Taylor rule.

4.3. Discussion of Results

The empirical findings of this study confirm that over the years the Taylor principle has not been pursued in its entirety in India, Pakistan, and Sri Lanka as the Central Banks in these countries have not adequately reacted to inflationary pressures.[29] The reason for this weak support for the Taylor rule may lie in model uncertainty, fear of financial market disruption, and/ or the fear of loss of credibility due to sudden policy reversals [Carare and Tchaidze (2005)]. This weakness in monetary policy response may have encouraged inflation rate to be significantly influenced by large movements of interest rates after the introduction of financial sector reforms in the region. In all probability the regional Central Banks may have accommodated some of the non-monetary price pressures to reduce output costs [Coorey, *et al.* (1998); Pujal and Griffiths (1998)] emanating from factors such as the use of contemporaneous reaction function, ignoring the normal lags associated with the operation of monetary policy, use of call money rate/ treasury bill rate as a proxy of policy rate [Patra and Kapur (2012)], use of industrial output as activity variable rather than overall GNP/ GDP, and finally, the relative fiscal dominance in regional economies due to less than full independence of respective Central Banks.

Earlier studies have confirmed that the stability of monetary policy rule depends on the underlying structure of the economy [Moura and de Carvalho (2010)]. Bullard and Mitra (2001) and Woodford (2003) have stressed upon the importance of output gap coefficient along with the coefficient of inflation. In addition, they also consider firm's intertemporal discount factor and the slope of the new-Keynesian Phillips curve as relevant parameters. Thus, within a broader perspective, the smaller than unity inflation coefficient does not necessarily means failure of Central Banks to apply the Taylor principle [Moura and de Carvalho (2010)]. Viewed holistically, one may therefore argue that the RBI, the SBP, and the CBSL have shown some commitment to stabilise inflation.

It is worth mentioning here that the coefficient on output gap remains positive and significant for India, Pakistan and Sri Lanka, which implies that monetary authorities in these countries are emphasise more on the underlying demand pressure

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[29]Taylor principle predicts that for the stability of macroeconomic system, the coefficient of inflation should be greater than unity.

in setting interest rates. The insignificant coefficient of output gap for the case of Bangladesh implies that monetary policy has no effect on the real output [Jakab, *et al.* (2006); Vonnak (2007)]. Thus, the RBI, SBP and CBSL may focus more on inflation and output stabilisation.

The positive and significant response of monetary policy to foreign interest rate for India, Pakistan and Sri Lanka suggests that monetary policy of major SAARC countries is largely influenced by the leading economies of the world, particularly the US monetary policy. However, the estimates of foreign interest rate are less than unity suggesting that the interest rate arbitrage has not been working fully—an indication of limited international capital mobility to these countries. This result also indicates weak linkages between domestic financial markets of the SAARC countries and the rest of the world because domestic capital markets are not sufficiently developed.

In an effort to understand whether the monetary authority uses interest rate instrument to lean against exchange rate movements, the coefficient of real exchange rate depreciation was introduced in the model specification. The positive and significant coefficient for India, Pakistan and Sri Lanka imply that these economies use interest rate as an instrument to defend the values of their respective currencies. Since the real exchange rate depreciation appears in the monetary policy reaction function with positive and greater than unity coefficient, it is clear that exchange rate is being used as an alternative instrument of monetary policy to control inflation. Finally, the response of SAARC countries to global financial crisis of 2008 seems to be minimal and mixed.

5. CONCLUSIONS AND POLICY IMPLICATIONS

In recent years there is growing interest for adopting inflation targeting policy in most of the emerging economies. The adoption of alternative monetary policy strategy nonetheless requires necessary understanding as to how monetary policy shocks are absorbed by key macroeconomic variables. In this context, the present study has developed a link between monetary policy rate, real output gap, inflation rate, real exchange rate movements and foreign interest rate to investigate monetary policy stance in Bangladesh, India, Pakistan and Sri Lanka, the leading countries of SAARC using quarterly data for the period 1990Q1-2012Q4. Our results have found a weak support of the Taylor rule in India, Pakistan and Sri Lanka. Bangladesh appears to have adopted interest rate smoothing policy. These finding implies that simple Taylor rule may not be enough to conduct monetary policy in these countries. We augment the simple Taylor rule by foreign interest rate and real exchange rate depreciation and the results reveal that inflation rate, output gap, foreign interest rate and real exchange rate significantly influencing the monetary policy rate. It appears from the results that monetary authorities in India, Pakistan and Sri Lanka have taken accommodating stance of monetary policy towards price shocks. However, in these countries there exists a strong response of the interest rate to exchange rate movements. This reflects that Central Banks in these countries stabilising the exchange rate by the use of monetary policy instruments. The findings of present study have important policy implications. First, there is a need to stabilise real output besides inflation. Second, foreign interest rate is found to be a significant factor in

monetary policy setting in India, Pakistan and Sri Lanka which implies that monetary policy in these countries is partially dependent on the FED's monetary policy actions.[30] Hence, monetary policy in these countries requires the inclusion of Federal Funds rate in the monetary policy reaction function to absorb external shocks. It is well documented that inclusion of the relevant external variables in the monetary policy specification and controlling for external shocks may reduces the biases. Therefore, there is a need to augment monetary policy reaction function by the inclusion of foreign interest rate. Third, exchange rate changes appear to be most significant and dominant factor in the monetary policy function which supports the effectiveness of exchange rate channel in the transmission mechanism. Therefore, it is suggested that India, Pakistan and Sri Lanka may target exchange rate together with the interest rate to stabilise output and inflation. Fourth, sudden shocks, such as global financial crisis do affect domestic economies, therefore, the respective monetary authorities may need to strengthen their shock absorptive capacity. To this end, further regulations may be needed to improve the efficiency of domestic financial markets. Fifthly, besides domestic factor, external factors such as foreign interest rate and exchange rate influences domestic monetary policy in the major SAARC countries. Therefore, these economies may have to specify broader monetary policy reaction functions by considering foreign interest rate and exchange rate movements. Finally, performance of the Taylor rule could be improved by augmenting some other variables in the monetary policy reaction function such as asset prices, private sector credit, foreign exchange reserves, foreign output gap, expectations and oil price volatility. It is worth mentioning here that parameters of the augmented Taylor rule may changes when one employs a different specification. On the whole, this study provides interesting evidence on the historical conduct of monetary policy in the SAARC countries, preparing for the adoption of alternative monetary policy strategy to tackle unanticipated inflationary fluctuations.

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[30] In response of various financial crisis and recession, the FED reduced overnight Federal Funds rate target to a range between zero and 25 basis points in December 2008. The Federal Open Market Operation Committee (FOMC) lowered the interest rate on reserves to 25 basis points and the Federal Funds rate has traded close to, but still below, the rate on excess reserves. Through the FED introduced a corridor system. In such system, the target for the Federal Funds rate would be typically set within the corridor established by the discount rate at the ceiling and the interest rate on excess reserves at the floor. Through this system FED adopted highly accommodative monetary policy stance unit 2015 [Kahn (2010)].

APPENDIX

Table 2A

Empirical Verification of an Extended Taylor Rule (OLS Results)

Bangladesh

$$i_t = 0.853 + 0.004\pi_t + 0.0002y_t + 0.026i_t^f - 1.623\Delta q_t + 1.307i_{t-1} - 0.428i_{t-2}$$

$$(2.235)^* \ (0.225) \quad (0.006) \quad (0.948) \quad (-0.883) \quad (7.411)^* \ (-2.339)^{**}$$

$$R^2 = 0.88 \qquad \overline{R}^2 = 0.87 \quad F = 71.17[0.000] \qquad ADF = -7.777^*$$

India

$$i_t = 1.705 + 0.255\pi_t + 0.046y_t + 0.473i_t^f + 9.512\Delta q_t + 0.402i_{t-1}$$

$$(1.727) \ (1.814)^{**} \ (0.236) \quad (2.143)^{**} \ (1.178) \quad (4.760)^*$$

$$R^2 = 0.36 \qquad \overline{R}^2 = 0.31 \qquad F = 7.83[0.000] \quad ADF = -8.829^*$$

Pakistan

$$i_t = 0.271\pi_t + 0.178y_t + 0.163i_t^f + 0.090\Delta q_t + 0.391i_{t-1} + 0.312i_{t-2}$$

$$(3.493)^* \ (1.546) \quad (1.990)^{**} \ (2.587)^* \quad (2.039)^{**} \ (2.311)^*$$

$$R^2 = 0.80 \qquad \overline{R}^2 = 0.79 \qquad ADF = -9.422^*$$

Sri Lanka

$$i_t = 1.056 + 0.097\pi_t + 0.091y_t + 0.180i_t^f + 1.037\Delta q_t + 1.136i_{t-1} - 0.336i_{t-2}$$

$$(2.120) \ (2.637)^* \ (1.904)^{**} \ (2.406)^* \quad (1.837)^{**} \ (11.160)^* \ (-3.863)^*$$

$$R^2 = 0.89 \qquad \overline{R}^2 = 0.88 \quad F = 95.60[0.000] \qquad ADF = -8.544^*$$

Note: Figures in parentheses are the t-values. *, ** and *** indicate significant at the 1 percent, 5 percent and 10 percent level of significance. ADF is unit root test applied on the residuals obtained from the estimated equations for each country. Critical values are tabulated by Hamilton (1994).

Table 2B

Misspecification Test Statistics

Country	AR 1–5 Test	ARCH 1–4 Test	Normality Test	Hetero Test	Hetero-X Test	RESET Test
Bangladesh	1.611	2.723	8.706	2.681	1.355	0.297
	[0.177]	[0.038]*	[0.013]*	[0.006]*	[0.194]	[0.745]
India	0.300	0.154	96.601	1.075	0.744	4.402
	[0.911]	[0.961]	[0.000]*	[0.395]	[0.769]	[0.016]*
Pakistan	1.155	3.655	28.761	1.193	1.677	0.030
	[0.340]	[0.009]*	[0.000]*	[0.305]	[0.055]	[0.971]
Sri Lanka	1.415	2.954	3.259	1.200	1.139	1.247
	[0.230]	[0.026]*	[0.196]	[0.300]	[0.337]	[0.294]

Note: Residuals diagnostics include AR (error autocorrelation) test, Autoregressive conditional Heteroscedasticity (ARCH), the Normality of the Distribution of the Residuals, Heteroscedasticity (Hetero test and Hetero-X test) and Functional Form (RESET Test). * indicate significant at the 1 percent level and [.] indicates p-values.

Table 2C

Augmented Dickey-Fuller (ADF) Unit Root Test

Country	Specification	Series	ADF at Levels	ADF at First Difference	Decision
Bangladesh	C	i_t	$-3.623\ (1)^*$	$-5.035\ (0)^*$	I (0)
	C	π_t	$-4.110\ (2)^*$	$-5.563\ (3)^*$	I (0)
	C	y_t	$-3.030\ (4)^*$	$-7.971\ (2)^*$	I (0)
	C	i_t^f	$-2.205\ (2)^{***}$	$-3.297\ (3)^*$	I (0)
	C	Δq_t	$-3.164\ (3)^*$	$-11.11\ (1)^*$	I (0)
India	C	i_t	$-4.609\ (0)^*$	$-9.628\ (0)^*$	I (0)
	C	π_t	$-3.124\ (1)^*$	$-7.493\ (3)^*$	I (0)
	C	y_t	$-2.882\ (1)^{***}$	$-9.659\ (1)^*$	I (0)
	C	i_t^f	$-2.205\ (2)^{***}$	$-3.297\ (3)^*$	I (0)
	C	Δq_t	$-7.592\ (0)^*$	$-6.982\ (4)^*$	I (0)
Pakistan	C	i_t	$-2.582\ (0)^{***}$	$-11.82\ (0)^*$	I (0)
	C	π_t	$-2.963\ (1)^{**}$	$-4.692\ (0)^{*\cdot}$	I (0)
	C	y_t	$-5.260\ (1)^*$	$-6.354\ (3)^*$	I (0)
	C	i_t^f	$-2.205\ (2)^{***}$	$-3.297\ (3)^*$	I (0)
	C	Δq_t	$-3.506\ (2)^*$	$-7.175\ (3)^*$	I (0)
Sri Lanka	C	i_t	$-3.040\ (1)^*$	$-5.340\ (0)^*$	I (0)
	C	π_t	$-4.100\ (1)^*$	$-3.770\ (4)^*$	I (0)
	C	y_t	$-4.171\ (1)^*$	$-7.966\ (1)^*$	I (0)
	C	i_t^f	$-2.205\ (2)^{***}$	$-3.297\ (3)^*$	I (0)
	C	Δq_t	$-9.135\ (1)^*$	$-7.762\ (4)^*$	I (0)

Note: C stands for intercept; numbers in brackets are the optimal lags. *, ** and *** indicates significant at the 1 percent, 5 percent and 10 percent level of significance. ADF-test is carried out using OxMatrics-6.0 Software. Critical values for ADF are: –3.52, –2.90 and –2.58 for 1 percent, 5 percent and 10 percent respectively.

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