Exchange Rate Volatility and the Monetary Policy Conduct: An Emerging Market Perspective

Sumila Tharanga Wanaguru & Anil Perera

Central Bank of Sri Lanka

Outline

- Motivation

- Background and Scope

- Methodological Approach

- Model Specification and Empirical Setup

- Empirical Results and Discussion

- Conclusions and Policy Implications

The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official position of the Central Bank of Sri Lanka

Motivation

EME Central Banks do take the exchange rate into account when setting monetary policy.
## How do we know?

☐ **They say they do**

- ■ "My priority in the short term is to strengthen steps required to immediately stabilize the rupiah exchange rate". Governor Perry Warjiyo, Bank Indonesia

- ■ "At times, we might have to intervene in the foreign exchange market...". Governor Veerathai Santiprabhob, Bank of Thailand

- ■ "The peso continues to be flexible and market-determined,... Nevertheless, we are cognizant that the peso can also be subject to excessive volatility.... We have to take [this] into account." Governor Nestor Espenilla, Bangko Sentral ng Pilipinas

Hans Genberg
Executive Director - The SEACEN Centre
November 2018, Colombo

Motivation

Exchange Rate Movements in Sri Lanka

Sri Lanka: Exchange Rate Movements (2001 - 2018)

Sri Lanka: Exchange Rate Movements (Sep 2015 - Dec 2018)

Sri Lanka: Exchange Rate Movements (2018)
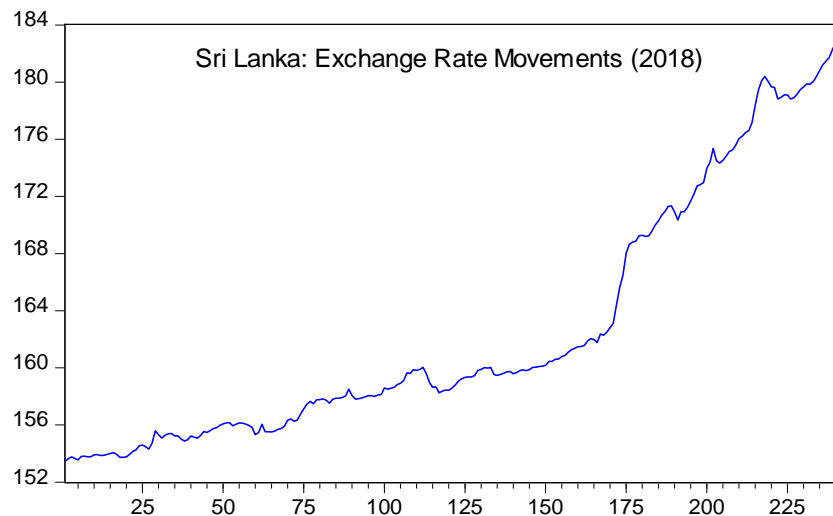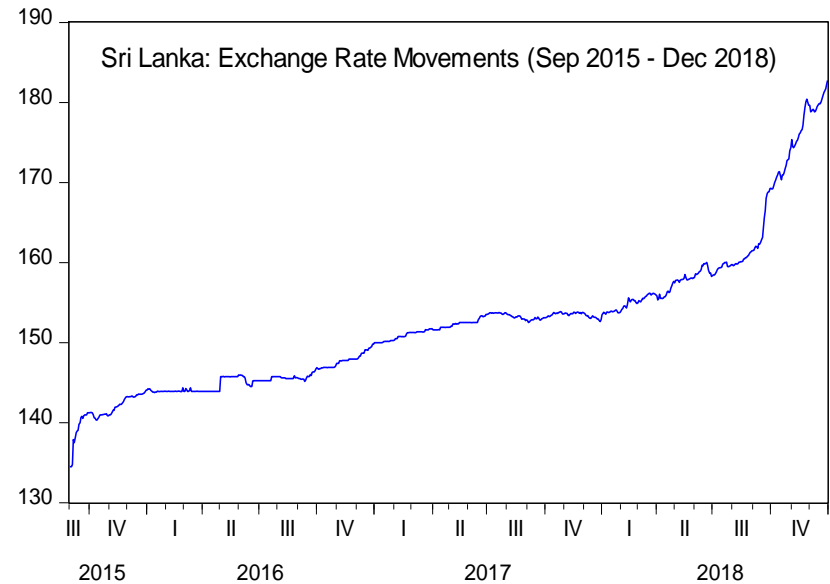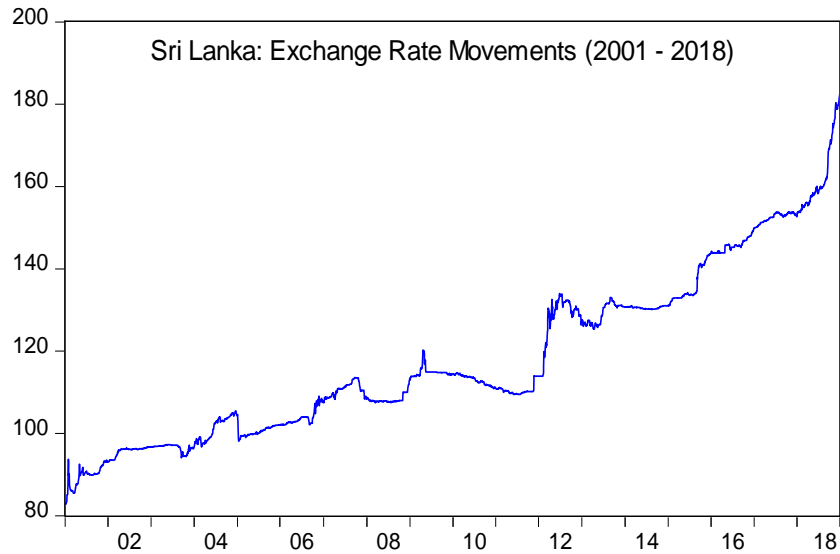
- **Standard Deviations**
  - **2001 – 2008: 20.50**
  - **2015 – 2016: 8.96**
  - **2018 : 8.53**

4

Background

- Foreign exchange markets are essentially volatile, and Sri Lanka is not an exception

- Risk of holding one currency against another is measured by the variation or the volatility of exchange rate

- Foreign exchange rates are extremely difficult to forecast

- Exchange rate regimes also matter for the volatility in the exchange rate

Background

- Accurate understanding and modelling of exchange rate volatility is important

  - **Microeconomic impact:** portfolio choice, pricing of assets and risk management at the level

  - **Macroeconomic significance**: capital mobility, growth, trade flows, direct investments, productivity, welfare, etc.

Background

- The **interaction between exchange rate volatility and the monetary policy** remains one of the focus areas of policy makers:

  - Unprecedented momentum and the changes in global financial integration (Ozcelebi 2018)

  - Debate on inflation targeting and exchange rate volatility (Minella et al. 2003; Pontines 2013; Castillo 2014; Cabral et al. 2018)

Background

- **Monetary policy activism in fighting inflation could act as a destabilizer of the exchange rate**
  - IT causes higher exchange rate instability than the alternative regimes (Berganza and Broto 2012)
  - Optimal monetary policy and the Taylor rule do not prevent exchange rate volatility; pegged exchange rate appears better at stabilising exchange rate volatility (Gali and Monacelli 2005)
  - A rise in the short-term interest rates can lead to volatility in exchange rates and macroeconomic instability (Ozcelebi 2018)
  - Interest rates can be adjusted to smoothen the real exchange rate movements (West 2004)

Background

- **Sri Lanka is in the process of moving towards a Flexible Inflation Targeting (FIT) framework**

- CBSL does not consider exchange rate as an objective/ an explicit target of monetary policy (CBSL 2019)
    - Greater flexibility in the determination of the exchange rate
    - Intervention is limited to correct disorderly adjustments in the exchange rate
    - Volatility has come down across episodes

- **Exploring the relationship between monetary policy and exchange rate remains vital in the Sri Lankan context**

Scope of this Study

- **This study explores the interplay between exchange rate volatility and monetary policy in Sri Lanka:**

  - High frequency-exclusive dataset for the period 2015- 2018

  - Exchange rates and monetary policy variables

  - **Threshold-Generalized Autoregressive Conditional Heteroscedasticity (TGARCH) model:** capturing relationship between exchange rate volatility and monetary policy variables and time varying volatility and persistence of shocks

  - **An unrestricted-VAR model**: to investigate how the exchange rate volatility responds to monetary policy shocks

Methodological Approach

- **Correct model specification is a pre-requisite of efficient econometric inference**

- Any model, which tries to investigate volatility structure of a time series, should be able to capture

  - **Volatility clustering**: large changes tend to be followed by large changes and small changes by small changes (persistence of shocks)

  - **Leptokurtosis**: returns are fatter tailed compares to those of normal distribution

  - **Asymmetric leverage effect**: negative shocks causing higher volatility in the near-term than the positive shocks

Methodological Approach

- Assumption of homoskedasticity (constant variance) becomes inappropriate in the presence of time varying volatility

  - Should apply alternative methodologies to capture conditional volatility (heteroskedasticity)

  - ARCH process and its subsequent extensions such as GARCH, EGARCH, TGACH etc. have provided a good fit for many financial time series

  - Empirical analysis in this study is basically built up on TGARCH specification

  - Volatility series extracted from TGARCH model is then used in a in the tri-variate VAR model

Model Specification and Empirical Setup: TARCH(p,q)

- Mean equation

$$r_t = a_0 + \sum_{i=1}^{T} a_{1i}\, r_{t-i} + \epsilon_t$$

with unpredictable shock, ϵ_t, is defined as;

$$\epsilon_t = \sqrt{h_t u_t}$$

$$u_t \sim i.i.d.(0,1), \qquad E(u_t) = 0, \qquad \epsilon_t | \Omega_{t-1} \sim N(0, h_t)$$

- Variance equation

$$h_t = \omega_0 + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-j}^2 + \tau d_{t-1}\varepsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_j\, h_{t-j}$$

where $\omega_0, \alpha_j, \beta_j > 0$: sufficient condition for $h_t > 0$.

Model Specification and Empirical Setup: TARCH(p,q)

- Unexpected return, ϵ_t, is presented as a normalised error

  - used to model the conditional volatility of the exchange rate returns, h_t, based on the information set, Ω, available at time $t-1$

- ARCH effects are captured by the parameters α_j

  - high α_j indicates that volatility reacts sharply to shocks

- GARCH effects are captured by the parameters β_j

  - high β_j indicates persistence in volatility of exchange rate returns

- $\alpha_j + \beta_j$ measures the long-run persistence of impact of shocks to returns

Model Specification and Empirical Setup: TARCH(p,q)

- d_{t-1} is the dummy variable that takes the form of

$$d_{t-1} = \begin{cases} 1, & \varepsilon_{t-1} < 0 \\ 0, & otherwise \end{cases}$$

- If the coefficient $\tau > 0$, negative shocks will have larger effects on volatility than the effects of positive shocks

- $\sum_{j=1}^{q} \alpha_j + \sum_{j=1}^{p} \beta_j < 1$ ensures the stability of the model

Model Specification and Empirical Setup: TARCH(p,q)

- The specific TGARCH(1,1) model used in the empirical analysis of this study takes the form;

$$EXR_t = \varphi_0 + \varphi_1 EXR_{t-1} + \varphi_2 dAWCMR_{t-3} + \varphi_3 dRESM_{t-1} + \varphi_4 SALES_t +$$
$$\varphi_5 PURCHSES_t + \varphi_6 CUS\_NET_t + \epsilon_t$$
$$h_t = \omega_0 + \alpha\varepsilon_{t-1}^2 + \tau d_{t-1}\varepsilon_{t-1}^2 + \beta h_{t-1}$$

where d_{t-1} is the dummy variable that takes the form of $d_{t-1} = \begin{cases} 1, & \varepsilon_{t-1} < 0 \\ 0, & otherwise \end{cases}$.

EXR: Exchange rate returns
$dAWCMR$: First difference of log of average weighted call money rate
$dRESM$:   First difference of log of reserve money rate
$SALES$:   Foreign exchange sales
$PURCHSES$: Foreign exchange purchases
CUS_{NET}:   Net customer inflows

TGARCH (1,1) Model Parameter Estimates

Variable	Parameter	TGARCH(1,1)
Conditional mean equation (10^{-3})		
Constant	φ_0	0.221 (0.000)
Exchange rate returns	φ_1	168.261 (0.000)
Average weighted call money rate	φ_2	-21.702 (0.000)
Reserve money	φ_3	-26.547 (0.000)
Forex sales	φ_4	0.020 (0.000)
Forex purchases	φ_5	-0.011 (0.228)
Net customer inflows	φ_6	-0.006 (0.026)
Conditional Variance Equation		
Intercept	ω	0.000 (0.000)
ARCH	α	0.269 (0.000)
GARCH	β	0.643 (0.000)
Threshold	τ	0.272 (0.001)
Diagnostic Test Statistics		
Ljung-Box Q (LBQ) statistic	Q(36)	29.651 (0.763)
	$Q^2(36)$	11.883 (0.999)
ARCH LM Test	LM(5)	0.456 (0.994)

Empirical Results and Discussion

- **An increase in AWCMR, which was chosen as the monetary policy indicator, causes an appreciation of the Sri Lankan rupee**

  - Provides evidence for the validity of Interest Rate Parity condition in the Sri Lankan context

- **An increase in reserve money (monetary variable used as a proxy for money supply) causes the exchange rate to appreciate**

  - Finding is somewhat different from some prior research (Increase in broad money have positive, but statistically insignificant effect on exchange rate - Ojede and Lam 2017)

  - Money is not neutral and play a notable role in determining the exchange rate movements

  - Further analysis is required to establish a sound conclusion

Empirical Results and Discussion

- An increase in net customer inflows leads to an appreciation of the exchange rate

- However, foreign exchange intervention seems generating some ambiguity in the case of Sri Lanka

  - An increase in forex sales leads to further depreciate the exchange rate, while forex purchases cause further appreciation in the exchange rate

- One day lagged exchange rate seems to drive the movement of the exchange rate in Sri Lanka significantly

Empirical Results and Discussion

- **In terms of the variance equation,**
    - Intercept term is very small as in typical GARCH models
    - ARCH(1) - the first lag of the squared return (α), the threshold (τ) and the GARCH(1) - the first lag of the conditional variance(β) are found to be statistically significant
    - Coefficients of ARCH(1) and GARCH(1) terms sum up to a number less than one (α+ β<1)
    - So, the model satisfies the requirement to have a mean reverting variance process
    - α+ β=0.91, implies that shocks to the conditional variance are highly persistent
    - Statistically significant positive value of τ suggests that the conditional variance of exchange rate returns increases following a negative shock in the previous day

Empirical Results and Discussion

- **Model is re-estimated as an robustness check by replacing;**

  - forex sales and purchase variables by 'net forex purchases'

  - AWCMR by the interest rate differential based on the effective Federal fund rates in the US

- **Estimated results remain unchanged**

  - Confirms that Interest Rate Parity holds in Sri Lanka

  - Calls for the further analysis to explore the effectiveness of the intervention strategy

Empirical Results and Discussion

- **As an extension to the study, an unrestricted tri-variate VAR model is estimated:**

    - Order variables in the VAR model as AWCMR, reserve money and the exchange rate volatility

    - Employ similar specifications, data transformations and the lag structure of the TGARCH model

    - Exchange rate volatility series is extracted from the estimated TGARCH model

    - Dynamic interactions among monetary policy variables and exchange rates were gauged by IRFs

Response of Exchange Rate Volatility to Monetary Policy Indicators

Exchange Rate

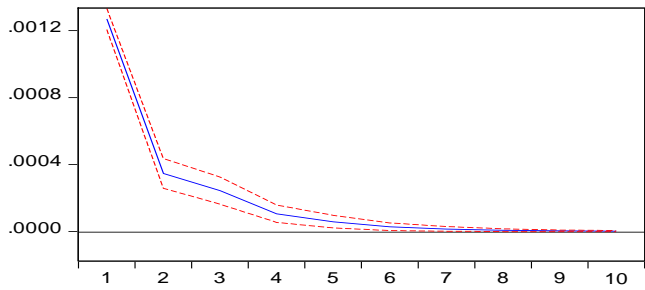Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of DLEXRATE to DLAWCMR
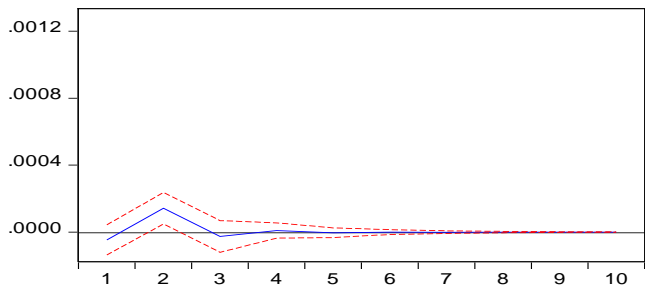
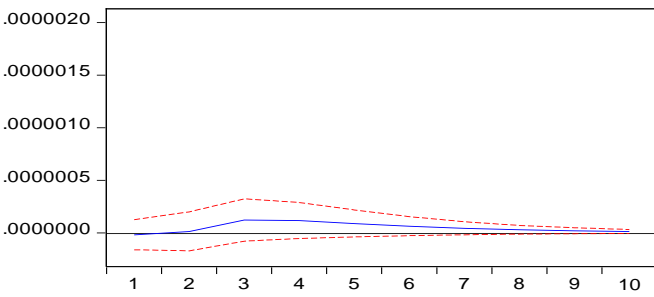### Response of DLEXRATE to DLRESM
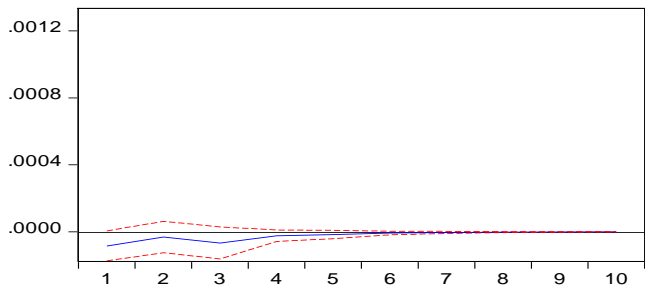
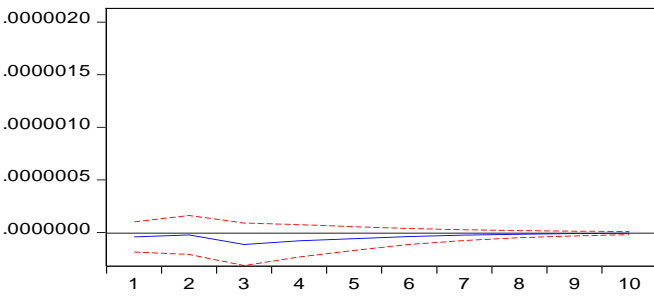### Response of DLEXRATE to DLEXRATE

Exchange Rate Volatility

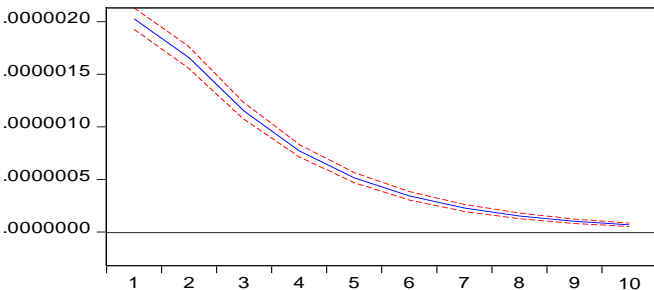Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

Response of EXRATEVOLTILITY to DLAWCMR

Response of EXRATEVOLTILITY to DLRESM

Response of EXRATEVOLTILITY to EXRATEVOLTILITY

Empirical Results and Discussion

- **Shocks to interest rates, cause some volatility in the exchange rates**

  - Although the magnitude appears relatively small, an innovation to AWCMR leads to some volatility in the exchange rate at least in the very short term

  - Following an increase in the short-term interest rates relative to foreign interest rate, the exchange rate volatility may increase due to a flow of funds into the exchange rate market

  - This observation is consistent with the implications of the Mundell–Fleming model

  - **A shock to exchange rate via interest rates does not indicate persistence as some convergence to the long run equilibrium path is observed**

- **Some response of the exchange rate volatility to a shock for reserve money**

  - The response does not appear significant although the volatility exhibits some convergence to its steady path within a shorter period of time

Conclusions and Policy Implications

- **Conclusions**
  - Monetary policy actions holds a significant relationship with the movements of the exchange rates
  - Quantity based monetary policy indicators such as money does not hold a neutral relationship with the exchange rate
  - Exchange rate volatility is highly persistent in Sri Lanka and negative shocks tend to increase volatility

Conclusions and Policy Implications

- **Policy Implications**
    - A central bank would need to focus on the exchange rates in the pursuit of monetary policy conduct

    - Foreign exchange intervention may not be the optimum strategy to stabilize the exchange rate on a sustainable basis

    - Further investigations are needed to assess the effectiveness of foreign exchange intervention strategy

Thank You.