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The Impact of Monetary Variables on Exchange Rate Fluctuations in Sri Lanka

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ABSTRACT

The exchange rate is an important and useful indicator of Economic performance. High fluctuations in exchange rates create uncertainty on economic activities. USD/LKR exchange rate has depreciated continuously, ignoring small appreciations experienced from time-to-time. Therefore, this study mainly focuses on the monetary variables which affect Sri Lanka-US exchange rate. The estimation is based on 116 monthly observations from January 2010 to August 2019. Nominal exchange rate and monetary variables such as money supply, Real Income and interest rate of Sri Lanka and United State of America are studied by employing cointegration analysis and Error Correction Model. Furthermore, have used some diagnostic test and special tests to describe the time series properties of the model. The study finds that, there is no evidences to supporting short run relationships between the monetary variables and exchange rate, while there is long-term co-integrating relationships between the nominal exchange rate and monetary variables. The error correction term *(ect)* is quite small and insignificant, indicating that short - term deviation from long - term equilibrium is restored within more than five years. Findings are statistically significant and correct sign reported for domestic money supply and domestic real income. The results found that variables of the model led to the ability of the flexible price monetary model in explaining future exchange rate movements of Sri Lanka.

Keywords: Exchange Rate, Monetary Model, Error Correction Model.

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1. Introduction

The exchange rate is an important useful indicator of Economic performance. High fluctuations in exchange rates create uncertainty about the profits to be made on different economic activities. Exchange rate market for researchers is compelling and complex, while it is a fascinating area of study. Exchange-rate movement is regularly monitored by central banks for macro-economic analysis and market-surveillance purposes. Forecasting exchange rate has been a challenge for academics and market practitioners, since the breakdown of the Bretton Woods system in 1973 (Lillie Lam et al.,2008). The importance of the exchange rate differs from country to country. The exchange rate is very important for small, open economies like Sri Lanka. Though there is ample research on the modelling exchange rate for advanced countries, studies based on emerging countries like Sri Lanka are limited to a few recent studies (Jayasuriya and Perera, 2016).

USD/LKR exchange rate has depreciated continuously, ignoring small appreciations experienced from time-to-time. However, since the implementation of the floating exchange rate system in 2001 considerable depreciation has occurred in the behavior of exchange rates. Therefore, this study mainly focuses on the monetary variables which, affect the variability of USD/LKR exchange rate. Basically, this study examines the long-term and short-term relationship between USD/LKR exchange rate and the monetary variables. Furthermore, this study attempts to answer the following two sub research questions.

1. How long will take to revert equilibrium level of exchange rate in Sri Lanka?
2. Can we use the monetary variables as a tool to predict exchange rate fluctuation in Sri Lanka?

Our estimation is based on 116 monthly observation from January 2010 to August 2019. Nominal exchange rate and monetary variables of Sri Lanka and the United State of America are studied by the employing Johansen multi-variate cointegration analysis and Vector Error Correction Model. Further, the study performs some diagnostic test and special tests which describing the time series properties of the expected mode.

The rest of the paper is structured into four more sections. Section 2 describes about various theoretical aspects of exchange rate determination and empirical evidences for monetary model of exchange rate. Section 3 provides the data and methodology, while the main analysis and interpretations of results are presented in section 4. 5th section summarizes main findings and conclusions of the analysis.

2. Theory and empirical evidences

Theoretical aspects of Exchange Rate Determination

In general, there are numerous models and theoretical foundations of exchange rate determination. They included several diversifications of exchange rate models and theories. Especially Purchasing Power Parity (PPP), Uncovered Interest Parity Theorems, Balance of Payments Approach and The Monetary Approach. According to the PPP theory, exchange rate determined by the general price level of domestic and foreign countries as follows,

$$ln\ e_i = ln\ p_h - ln\ p_f + c$$

Variables lne, lnp and c denote the log level of exchange rate, price level and the constant value respectively, and h stand for home country and f stand for foreign country. Otherwise the Uncovered Interest Parity Model (UIP) described the exchange rate thorough the interest rate differentials between the two countries.

$$e_t (ln\ e_{t+h} - ln\ e_t)= i - i^*$$

Here, (ln e_{t+h} - ln e_t) and I are standing for interest rate. So, UIP theory describes the exchange rate by interest rate differentials between the two particular countries. Rather, Balance of Payment Theory elaborates the exchange rate by the demand and supply of foreign currency in the domestic economy as follow,

$$BOP = \alpha_0 + \alpha_1\ ln\ EXR + \alpha_2\ ln\ X_m + \alpha_3\ ln\ I_m + \mu_t$$

Where, X and I dnote for export and import respectively and Alpha values are coefficient values under the Ceteris Paribus Condition[1]. Particularly, among these traditional models, The Monetary Approach or Monetary Model of exchange rate is very special and useful theory for empirical evaluations. Monetary Model also considered as a long term equilibrium model of exchange rate since the breakdown of the Bretton Woods system. Monetary Model is basically, based on two assumptions such as stable money demand function and continuously PPP condition. Theoretical version of the monetary model looks like,

$$e = (m_h - m_f) - k\ (y_h - y_f\ ) + \lambda\ (i_h - \lambda\ i_f\ )$$

Above equation is the flexible price monetary model. Where, e is the nominal exchange rate and m, y and I are money supply, real income and interest rate of domestic and foreign country respectively.

3. Literature Review

Since the breakdown of the Bretton Woods system enormous growth in the literature on exchange rate economics. Exchange rate economics is most important for several reasons such as sales and profit forecasts, capital budgeting plans and the value of international investments. Obviously, changes in exchange rates have a significant impact on the world's political, economic stability and the welfare of individual countries (Bitzenis and Marangos, 2007). In this respect the importance of the exchange rate in the open economy, it is not surprising that exchange rate economics is one of the most heavily and interesting research area in the discipline for small and open economies. Several studies have tested the validity of the monetary approach in exchange rate determination. However, the results of these studies remain controversial. Erdal (2018) says that, Modeling of exchange rate behavior is one of the unsolved issues of research to be deal with.

Factors affecting exchange rate can be economic, political, psychological and exchange rate regimes. However, the behavior of the exchange rate can be more appropriately studied, through the monetary variables. Testing the monetary model beyond 1978 produced poor results in terms of the signs and significance of the coefficients. With several advances in econometric analysis and improved research design subsequent studies began to rebuild support for the monetary model at least as a long-run

[1] Ceteris paribus is a Latin phrase that generally means "all other things being equal"

phenomenon (Wilson, 2009). In mid 1980s statistical techniques began to shed new light on the monetary model of exchange rates. Work by Engle- Granger provided a new statistical technique that had promise in re-examining the models of exchange rate determination. Then, Johansen (1988, 1991) developed multivariate cointegration approach that was superior to the simple regression model of Engle and Granger. They were able to identify the underlying time-series properties of the data and provide tests for the number of co-integrating vectors in a data set. After this econometric revolution, several studies have been conducted to test the long-run properties of the monetary model using cointegration and error correction models.

Makrydakis (1998) examined the monetary model of exchange rate determination as a long-run equilibrium of the Korean Won - US Dollar rate using monthly data from 1980 to 1995 and concluded that the monetary model provides a valid framework for analyzing long-run movements in the exchange rate. Therefore, the monetary model of exchange rate determination is a reliable tool for policy makers to evaluate their currency and the monetary authority should expect much shortened response time to the monetary policy impulse in the surging trend of international economic integration.

Several studies founded the existence of cointegration between the nominal exchange rate and flexible price monetary model in world-wide. Bitzenis and Marangos (2007) concluded that the monetary model is validated as a long-run equilibrium condition in Greek. As a same Lee China et al., (2007) are found that the monetary model is a valid framework for the long-run exchange rate between Philippines Peso and US Dollar exchange rate. However, the typical linear restrictions of flexible-price monetary model and proportionality between the exchange rate and relative money are rejected. Frenkel (1976) also found support for the monetary model of exchange rates and the relationship among money, prices, expectations and the exchange rate. The coefficients were similar to the predictions of the model.

In short-run, sticky price monetary model explains better the refusing of the puzzle evidence which provided macro-economic fundamental that affect exchange rate movement. Nevertheless, in the long run Frenkel - Bilson flexible price model provide a little support in the refusing of the puzzle evidence (Agus Salim and Ignatius Abasimi, 2018).

Civcir (2003) applies the Johansen cointegration technique to examine the validity of the monetary model of exchange rate determination of the Turkish Lira-United States dollar relationship over 1987 – 2000 by quarterly data. He found single co-integrating vector lending support to the interpretation of the model as describing a long-run equilibrium relationship. He also tested for weak exogeneity of the nominal exchange rates and monetary fundamentals from the estimated vector error correction models. This gives insight into the adjustment process through which the long-run equilibrium relationship between exchange rates and monetary fundamentals is maintained.

There is little evidence of a long-run relationship between monetary fundamentals and exchange rates, typically with the signs and magnitudes of estimated coefficients not in support of monetary theories. Some empirical evidence concluded that week relationships between the monetary variables and exchange rate.

John Hunter and Faek Menla Ali (2013) apply the Johansen methodology to quarterly data over the period 1980–2009 and show that the historical inadequacy of the monetary approach is due to the breakdown of its underlying building-blocks, money demand stability and purchasing power parity. These findings on long-run weak exogeneity tests emphasize the importance of the extended model employed here. The same result carried out by Tawadros (2001). He studied the Australian dollar/ U.S. dollar exchange rate and found a week relationship among the exchange rate, money supplies, industrial output, and short-term interest rates.

Especially in the developing and high inflation countries monetary fundamentals are more important tools in determining behavior of the exchange rate fluctuations. Findings of Jegajeevan (2012) clearly indicated that there is long-term co-integrating relationship between the nominal exchange rate and variables of monetary model in Sri Lanka. The error correction term is quite large and significant indicating that short-term deviation from long-term equilibrium is restored within a year. However, regardless of the existence of a long-term relationship found between variables of the monetary model and exchange rate, the evidence is not strong enough to support the validity of the monetary model.

In the Indian context, a few attempts have been made to test the impact of monetary model of exchange rate. For example, Dua and Ranjan (2011) have attempted to analyze the issue and concluded that the monetary model has a strong impact in the Indian case. But in Sri Lanka the lack of empirical evidence for long-run relationship among nominal exchange rates and monetary fundamentals implies that, the monetary model has little practical relevance and also considers as a research gap. Now it’s clear that, there are ample research attempts and evidence on the impact of the monetary variables in exchange rate in advanced countries. But, evidences from emerging countries is too limited. Therefore, this study analysis the impact of the monetary variables on Sri Lanka- US exchange rate and relationships between the variables.

4. Methodology

Data and model

Data

Data used in this paper consists of secondary data with respect to Sri Lanka and USA. For empirical testing, this paper employs monthly data on rupee-dollar nominal exchange rate and the independent flexible monetary variables such as money supply (M2b for domestic and M2 for USA), real income or output proxied by Index of Industrial Production (IIP) and policy interest rates of domestic and foreign countries. Data from January 2010 to August 2019 are used due to the availability of the data for this period on all the variables required and the same base year. The data of all the variables for Sri Lanka are collected from a database available at the Central Bank of Sri Lanka (CBSL data library), IMF’s International Financial Statistics database and reports of Statistics on central bank of Sri Lanka, while that of United States is gathered mainly from statistics of the Federal Reserve Bank.

Key monetary variables involved in the money demand function such as money supply, interest rate and real income have been chosen to develop the flexible price monetary model of exchange rate. Since GDP (Gross Domestic Production) estimates are available only quarterly, the industrial production index has been chosen as a proxy for real income. A detailed description of data is included in Appendix.1 has been used for econometric analysis of the model.

Theoretical Model

The monetary model of exchange rate determination suggests a strong link between the nominal exchange rate and monetary variables. This makes it an attractive theoretical tool for understanding fluctuations in exchange rates over time. In this paper, we follow the flexible-price monetary model. The objective of this paper is to employ modern econometric techniques to test the impact of the monetary variables on exchange rate fluctuations in Sri Lanka.

The simplest version of the monetary model is derived by assuming the following stable money demand function. The monetary model assumes a stable money demand function in domestic and foreign countries. The money market equilibrium conditions for domestic and foreign countries are assumed to depend on the logarithm of real income (y) and the logarithm of price level (p) and the nominal interest rate (i).

The derivation of the model basically follows the ideas of Moosa (2000) Guangfeng Zhang (2014), Jegajeevan (2012), Grauwe (2000), Ibhagui (2018), Venus et al,. (2009), Shidong zhang et al,. (2007), Idil et al,. (2009), John Hunter and Faek Menla Ali (2013), Ian (2009) and Neely and Sarno (2002). In discrete time, monetary equilibria in the domestic and foreign country respectively are given by equation (1) and (2),

$$ln\ m_h = ln\ p_h + k_h\ ln\ y_h - \lambda_h\ i_h \qquad (01)$$

$$ln\ m_f = ln\ p_f + k_f\ ln\ y_f - \lambda_f\ i_f \qquad (02)$$

where m, p, y and i denote the log-levels of the money supply, the price level, income, and the level of the interest rate, respectively, at time t. κ and λ are positive constants and h and h refers to domestic and foreign country. The monetary model also assumes that purchasing power parity holds continuously. This will be given by the following equation.

$$e = p_h – p_f \qquad (03)$$

Solving equations 01 and 02 for ph and pf, respectively, and replacing in the equation (03) yields the representation of the flexible price monetary model given in the following equation,

$$ln\ e = ln\ m_h – ln\ m_f – k\ ln\ y_h – k\ ln\ y_f + \lambda\ i_h – \lambda\ i_f \qquad (04)$$

All variables, apart from the interest rate terms, are expressed in natural logarithms (*ln*). Since the nominal exchange rate (lne) is expressed in terms of Sri Lankan Rupee per unit of US dollar. A positive relationship between domestic money supply and nominal exchange rate and a negative relationship between foreign money supply and exchange rate are expected. An increase in domestic income through an increase in demand for money tends to appreciate the exchange rate and therefore a negative relationship is expected and vice versa. When the domestic nominal interest rate increases domestic currency is expected to lose its value through inflation. The domestic interest rate is expected to have the same effect as the domestic money supply, and therefore a positive relationship is expected with the exchange rate. An increase in foreign interest rate, in contrast, tends to appreciate the local currency. According to equation (04) an increase in the domestic money supply and domestic interest rate induces a depreciation of the domestic currency in terms of the foreign currency. Conversely, a boost in domestic real income, ceteris paribus, creates an excess demand for the domestic money stock. That implies an appreciation[2] of the domestic currency in terms of the foreign currency.

Methods

Cointegration test and Vector Error-Correction Model (VECM) are utilized in this paper to examine the impact of the monetary variable on exchange rate fluctuations in Sri Lanka. The cointegration analysis requires all the variables to be integrated in order one (I (1)). Generally, most of the macro economic variables are not stationary. Thus, a regression involving these variables will be spurious[3]. Therefore, before running a cointegration test all the variables are tested for the presence of unit root using the Augmented Dickey Fuller (ADF) test based on SIC.

$$\Delta y_t = \alpha_1 + \delta y_{t-1} + \rho_i \sum_{i=1}^{m} \Delta y_{t-I} + \mu_i$$

Here, y is the dependent variable and y_{-1} is the past values of dependent variables. If δ = 0 we can conclude that, the series is non-stationary and otherwise stationary (δ ≠ 0). This generally means a data series is non-stationary which means & variance vary overtime. The Unit root test is carried out to test whether a series is level stationary [I (0)] or first difference stationary [I (1)]. The Augmented Dickey-Fuller test (ADF) has been employed at three different types in this research. Here our decision is based on alpha value and probability value. If the alpha values smaller than the probability value at 1 per cent, 5 per cent or 10 percent significance level, then the null hypothesis is accepted. [$h_{0:}$ series has a unit root, or the series is not stationary at its level].

The next stage is to determine the appropriate lag length through unrestricted VAR estimation. After the lag length selection, we should identify no of co-integrating vectors that span the variables in equation 04. We use Johansen multi-vitiate cointegration analysis to find out no of cointegration at level form.

$$Z_t = \beta_1 + \beta_2 y_2 + \beta_3 y_3 + \dots\dots\dots\dots + \beta_k y_n + e_t$$

Where z_t is a vector of non-stationary variables, while y is I (1) and error term is e_t I (0). In order to test for the number of cointegration relationships amongst the variables, there are two different test statistics to determine the number of co-integrating vectors, namely trace test and maximum eigenvalue test. We use the trace test to determine the rank. Here the null hypothesis is r = 0 (no cointegration) against the alternative 1 < r. (at least one cointegrating vector).

According to the cointegration results we can decide which model (VAR or VEM) is appropriate for our expected model. If we find the one or more cointegration vectors VECM is appropriate for the estimation, otherwise we run with VAR model. Another famous way to confirm the existence of a co-integrating relation

[2] Appreciation: a rise in the value of domestic currency in terms of foreign currency

is the test for causality. If two variables are co-integrated, causality in the Granger sense must exist in at least one direction (Granger, 1988, cited in Dua and Ranjan 2011).

VEC estimates help to study short-term dynamics and equilibrium level more than the long-term relations established by the cointegration test. Basic VECM is specified as follow,

$$\Delta y_t = \delta + \sum_{i=1}^{k-1} \gamma_i \Delta y_{t-l} + \sum_{i=1}^{k-1} \eta_j \Delta x_{t-l} + \lambda ect_{t-1} + \mu_i$$

Here *ect* is the error correction term, which shows how deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. Generally, a smaller error correction term (*λ*) means convergence to equilibrium level at a slowest rate.

Further we performed some residual diagnostic tests and special tests which shows the relationship between the variables namely VEC Granger Causality/Block Exogeneity Wald Tests, IRF[4] (Impulse Response Function) and Variance Decomposition.

5. Empirical Results

Unit Root test result

We first investigated the time series properties of the variables using augmented Dickey Fuller unit root tests. The cointegration relationship is tested for non-stationary variables. In this respect, our analysis begins with unit root test.

Table 1: Unit root test results.

ADF unit root test (SIC) Info criterian							
	Intercept only		Trent and Intercept		None		
variables	At level	At difference	At level	At difference	At level	At difference	Order of integration
ln e	0.9731	0.0000*	0.2535	0.0000*	0.9930	0.0000*	I(1)
ln mh	0.1651	0.0000*	0.9958	0.0000*	1.0000	0.1130	I(1)
ln mf	0.2487	0.0000*	0.9456	0.0000*	1.0000	0.0741***	I(1)
ln yh	0.0905	0.0032*	0.2508	0.0201**	0.7810	0.0002*	I(1)
ln yf	0.2103	0.0000*	0.4719	0.0000*	0.9999	0.0000*	I(1)
Ih	0.5543	0.0000*	0.8393	0.0000*	0.3711	0.0000*	I(1)
If	0.1586	0.0000*	0.1234	0.0000*	0.1344	0.0000*	I(1)

Source: Author's Estimates

(Note: The superscripts * ,** and *** are denotes rejection of null hypothesis at 1%, 5% and 10% respectively)

[4] The impulse response function (IRF) shows the dynamic properties of the model. It facilitates to test the response of dependent variable to unit shock of independent variables.

Test results showed that all of the variables are I (1) in each method such as intercept only, trend and intercept and none. This result conclude that the long-run monetary model is to use cointegration procedures.

From the standard VAR estimation, we were selected one lag length for our model according to AIC and FPE. Appendix 2 shows the lag length selection criteria in detail.

Cointegration Test Results

The second step is to identify the co-integrating vector among the variables. Cointegration analysis is carried out that these I (1) variables are linearly cointegrated or not in the long-run. The Johansen multivariate cointegration results are shown in table 2.

Table 2: The test results of Johansen trace and max-eigen value tests

Hypothesized No. of CE(s)	Trace statistics	5 % critical value	Prob.	Max-Eigen Statistics	0.05 Critical Value	Prob.
None	169.4091	125.6154	0.0000*	58.96559	46.23142	0.0014*
At most 1	110.4436	95.75366	0.0033*	41.25403	40.07757	0.0367*
At most 2	69.18952	69.81889	0.0560	37.30126	33.87687	0.0187*
At most 3	31.88827	47.85613	0.6183	16.56886	27.58434	0.6171
At most 4	15.31941	29.79707	0.7590	6.848438	21.13162	0.9596
At most 5	8.470970	15.49471	0.4165	5.220564	14.26460	0.7138
At most 6	3.250406	3.841466	0.0714	3.250406	3.841466	0.0714

Source: Author's Estimates (* is denotes rejection of the hypothesis at the 0.05 significant level)

From the above table both tests reject the null hypothesis of no co-integrating vectors at different rank but both statistics find out at least one cointegration vectors. Trace statistics identifying two cointegration vectors while max-eigen value tests identifying three cointegration vectors. According to both max-eigen value and trace statistics the estimated long-term co-integrating equation is as follows.

$$ln\ e_t = 22.36522\ lnmh^*_t\ -63.39638\ lnmf^*_t\ -45.51945\ lnyh^*_t\ +33.82643\ lnyf^*_t\ +0.129745\ ih_t\ -1.48783\ if_t$$

*(Here * is refer the variable is significant at 5% significant level)*

All domestic variables are report correct signs, and except domestic money market rate all the variable statistically significant. An increasing in the local money supply and interest rate leading to depreciation of local currency in long term, while only domestic income lead to appreciation. Among the US related variables, money supply and interest rate has reported the correct sign as expected.

In addition to the long-term relationship, short-term dynamics of the models could be analyzed based of on the VEC output shown in Appendix 3.

lne = 0.003954 + 0.376872 d(lne(-1)) - 0.129439 d(lnmh(-1)) - 0.024979 d(lnmf(-1)) - 0.032512 d(lnyh(-1)) + 0.347245 d(lnyf(-1)) -0.002124 d(ih(-1)) +0.008322 d(if(-1))*

There is no evidence for supporting short run relationships between the monetary variables and exchange rate. While past month exchange rate positively related with current exchange rate.

Accordingly, the error correction term is negative, as expected, and statistically insignificant. A coefficient of -0.015450 indicates that around 1.54% of disequilibrium in the nominal exchange rate in the short-term is corrected monthly. To be more specific, it takes more than five year to correct short-term disequilibrium and to restore long-term equilibrium of nominal exchange rate.

Time series properties of the model

According to the VECM there are no any short run relationships between the monetary variables while same relationships found among the monetary variables. The next step is to determine how these variables drive each other. This is done through VEC Granger Causality/Block Exogeneity Wald Tests, IRF and variance decomposition.

The granger causality method clarified how these variables affect (drive) each other. The VEC Granger Causality/Block Exogeneity Wald Tests results are shown in appendix 4. from these results, there were not causal relationship between the exchange rate and monetary variables. However, we found causal relationships between the domestic money supply and other monetary variables, the domestic real income and exchange rate and other monetary variables and the domestic interest rate and exchange rate and other monetary variables.

The impulse response function (IRF) shows the dynamic properties of the model. It facilitates to test the response of dependent variable to unit shock of independent variables. According to the IRF results one unite shock of monetary variables made different impact in exchange rate in long term. One unit of standard deviation shocks of domestic money supply, foreign money supply, and domestic interest rate are made the negative impact on exchange rate in short run while this shocks are made positive impact in long term. Further one unit of standard deviation shocks of foreign real income and interest rate are made the positive impact on exchange rate in short run while this shocks are made negative impact in long term. Impulse Response Function results shown in appendix 5. Finally, we find the major monetary variable that have a strong impact on exchange rate is domestic real income through Variance Decomposition shown in the appendix 6.

Diagnostic test

The following table 4 is summarizing same of the important residual based Diagnostic test results. Namely Residual Serial Correlation LM Tests and Residual Heteroscedasticity Tests.

Table 4 : Summary of the Diagnostics Tests

Diagnostic test	***Test statistics / p-value***	***Null hypothesis***
VEC Residual Serial Correlation LM Tests	54.47204 / 0.2742	No Serial Correlation

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VEC Residual Heteroskedasticity Tests (Includes Cross Terms)	1571.943 / 0.1383	Homogeneity

Source: Author's estimation

Basing on table above, it is now clear that our estimation is stable. Its mean data are normally distributed, serial uncorrelated with an equal variance and the parameters are stable. In another way, our estimation is does not suffer from Auto correlation and Heteroskedasticity problem. This is a strong evidence for reliability of our analysis.

6. Conclusion

This research aimed to analyze the impact of monetary variable on exchange rate in Sri Lanka. Some monetary variables like money supply, real income and interest rate were selected by the researcher in order to find out their impact on exchange rate fluctuation of Sri Lanka rupee into United States dollars for the period ranging from January 2010 up to August 2019.

In order to achieve the main aim of the study, we used Johansen multivariate cointegration test by ascertaining the long run relationship between exchange rate and monetary variable. Error Correction Model was used in order to help the identification of short run dynamics among the variables. By the end impulse response function and variance decomposition were used for the purpose of assessing the dynamic of the model and the quantitative effect results to a shock from any one of the selected determinants of exchange rate.

This study found two cointegration relationships between exchange rate and monetary variable. All the domestic monetary variable reported correct sign and only domestic interest rate insignificant in long term. However, there is no evidence for supporting short run relationships between the monetary variables and exchange rate. The quite small error correction term *(ect)* indicating that short - term deviation from long - term equilibrium is restored within more than five years.

A major determiner of exchange rate is domestic real income and there is no any causality between past values of the monetary variables and exchange rate. However, we find some causality relationship among the past values of monetary variables. Our key findings are statistically significant and correct sign reported for domestic money supply domestic and real income. This evidence found on key variables of the model led to the ability of the flexible price monetary model in explaining future exchange rate movements of US dollar – Sri Lankan rupee in the free-floating exchange rate regime.

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References

Agus, S., and Ignatius, A. (2018), "An Evidence Analysis Of The Exchange Rate Disconnect Puzzle In Indonesia". *Journal of Business Management and Economic Research,* Vol.2 (Issue.5), pp. pp.47-60.

Anon., (1985), "The Monetary Approach To Exchange Rate Determination Under Rational Expectations". Journal of International Economics 18 North-Holland , 16-I (Economic Studies Program, The Brookings Institution, Washington, Dc), pp. pp 01-16.

Bitzenis, A ., and Marangos, J. (2007), "The monetary model of exchange rate determination: the case of Greece (1974–1994)". Int. J. Monetary Economics and Finance, Vol. 1(No. 1), pp. pp.57-88.

Civcir, I., (2003), "The Long-run Validity of Monetary Exchange Rate Model for a High Inflation Country and Misalignment: The Case of Turkey". Forthcoming in Russian and East European Finance and Trade, pp. pp.02-19.

Dua and Ranjan,. (2011), "Modelling and Forcasting the Indian Re/US Dollar Exchange Rate". Working Paper 197, Center for dovelopment economics, Delhi school of Economics, India.

Erdal, b., (2018), "Monetary approach to exchange rate determination under flexible exchange rate regime : empirical evidence from turkey". advanced management and applied economics, vol 8, no 3., pp. 1-9.

Frenkel, J. A., (1976), "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence". The Scandinavian Journal of Economics, pp. pp.200-224.

Guangfeng, Z,. (2014), "Exchange Rates and Monetary Fundamentals: What Do We Learn from Linear and Nonlinear Regressions". Economics Research International, Volume 2014, Article ID 746956,(Hindawi Publishing Corporation), pp. 1-14.

Idil, U.Z, Mehrin, D.B.,* (2009), "The Monetary Approach To Exchange Rate Determination: The Case Of Argentina, Brazil, Taiwan And Turkey". Applied Econometrics and International Development , Vol. 9(2), pp. pp.53-63.

Jayasuriya, D.P.S.H. and Perera,S.S.N., (2016), "Analysis of Factors Affecting USD/LKR Exchange Rate". Symposium on Statistical & Computational Modelling with Applications, pp. 19-21.

Jegajeevan, s., (2012), "Validity of the Monetary Model of the Exchange Rate: Empirical Evidence from Sri Lanka". staff studies,, volume 42(nos. 1&2), pp. PP.47-74.

John, H., and Faek, M.A., (2013), "The Monetary Model of the US Dollar–Japanese Yen Exchange Rate". Economics and Finance Working Paper Series, 13(08), pp. pp.01-29.

Lee, C.M., Azalia, Zulkornain, B., Yusopa and Mohammed B. Yusoffb., (2007), "The monetary model of exchange rate: evidence from The Philippine". Applied Economics Letters, Volume 14, pp. 993-997.

Lillie, L,. Laurence, F,. and Ip-wingYu,. (2008), "Comparing Forecast Performance Of Exchange Rate Models". Working Paper, 08(hong kong monetary authority), pp. 01 - 23.

Makrydakis, S., (1998), "Testing the long-run validity of the monetary approach to the exchange rate: the won-US dollar case". Applied Economics Letters, Vol. 5 (No. 8), p. pp.507–512.

Tawadros, G. B., (2001), "The Predictive Power of the Monetary Model of Exchange Rate Determination". Applied Financial Economics, 11(1), pp. pp.279-286.

Wilson, I., (2009), "The Monetary Approach to Exchange Rates: A Brief Review and Empirical Investigation of Debt, Deficit, and Debt Management: Evidence from the United States". The Journal of Business Inquiry, 8(1), pp. pp.83-99.

Appendices

Appendix 1 : Detailed Description of Data

Variable	Definition	Source
LNNER	Domestic Currency Per U.S. Dollar, Month End Nominal Exchange Rate In Log.	Central Bank of Sri Lanka – Data Library
SLMS	Broad Money M2b, LKR, Million (in Log)	Central Bank of Sri Lanka – Data Library
SLIPI	Seasonally Adjusted Industrial Production Index in Log (2010=100)	Central Banks Annual Reports (2010 - 2018)
SLINT	Money Market Rate Percent Per Annum (In Level)	International Financial Statistics
USMS	M2 Money Stock, Billions of Dollars, Monthly, Seasonally Adjusted (in Log)	Federal Reserve Economic Data
USIPI	Industrial Production Index, Index 2012=100, Monthly, Seasonally Adjusted (In Log)	Federal Reserve Economic Data
USINT	Treasury Constant Maturity Rate, Percent, Monthly, Not Seasonally Adjusted (in Level)	Federal Reserve Economic Data

Appendix 2 : lag length selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1745.471	NA	1.82e-23	-32.49479	-32.31993*	-32.42390*
1	1808.434	116.5114	1.41e-23*	-32.75578*	-31.35692	-32.18870
2	1845.168	63.16893	1.79e-23	-32.52651	-29.90364	-31.46324
3	1887.863	67.83172	2.07e-23	-32.40864	-28.56177	-30.84917
4	1922.195	50.05421	2.88e-23	-32.13448	-27.06360	-30.07881

5	1966.555	58.87055	3.45e-23	-32.04775	-25.75287	-29.49589
6	2008.008	49.58877	4.59e-23	-31.90669	-24.38780	-28.85863

Appendix 3 : Vector Eroor Correction model

(Here () stant for standard error and [] stant for test statistical value)

Error Correction:	D(LNE)	D(LNMH)	D(LNMF)	D(LNYH)	D(LNYF)	D(IH)	D(IF)
CointEq1	-0.015450	-0.047618	-0.002464	-0.237924	-0.019568	-1.005065	-0.892049
	(0.02428)	(0.01192)	(0.00626)	(0.10266)	(0.00946)	(0.56555)	(0.29109)
	[-0.63622]	[-3.99375]	[-0.39351]	[-2.31764]	[-2.06762]	[-1.77715]	[-3.06447]
CointEq2	-0.015310	0.010326	-0.001823	0.550734	0.016960	0.095097	0.876176
	(0.02370)	(0.01164)	(0.00611)	(0.10018)	(0.00924)	(0.55192)	(0.28408)
	[-0.64602]	[0.88748]	[-0.29839]	[5.49728]	[1.83630]	[0.17230]	[3.08430]
D(LNE(-1))	0.376872	0.078135	-0.013752	0.978942	0.022891	6.341794	0.738009
	(0.10109)	(0.04963)	(0.02607)	(0.42735)	(0.03940)	(2.35429)	(1.21177)
	[3.72805]	[1.57423]	[-0.52760]	[2.29074]	[0.58103]	[2.69372]	[0.60903]
D(LNMH(-1))	-0.129439	-0.164626	0.007786	-0.100172	-0.081175	-11.24008	1.703134
	(0.19485)	(0.09567)	(0.05024)	(0.82369)	(0.07594)	(4.53779)	(2.33564)
	[-0.66431]	[-1.72083]	[0.15498]	[-0.12161]	[-1.06899]	[-2.47699]	[0.72919]
D(LNMF(-1))	-0.024979	0.032777	0.252982	4.085923	-0.076169	11.50161	-13.86365
	(0.38725)	(0.19013)	(0.09985)	(1.63706)	(0.15092)	(9.01866)	(4.64199)
	[-0.06450]	[0.17239]	[2.53359]	[2.49589]	[-0.50470]	[1.27531]	[-2.98658]
D(LNYH(-1))	-0.032512	0.000580	-0.008860	-0.115860	0.006076	-0.114143	0.358959
	(0.02335)	(0.01147)	(0.00602)	(0.09872)	(0.00910)	(0.54386)	(0.27993)
	[-1.39219]	[0.05058]	[-1.47147]	[-1.17361]	[0.66763]	[-0.20987]	[1.28231]
D(LNYF(-1))	0.347245	-0.076578	0.052504	-0.280980	0.046911	2.996092	-8.692421
	(0.25440)	(0.12490)	(0.06560)	(1.07544)	(0.09914)	(5.92465)	(3.04947)
	[1.36496]	[-0.61309]	[0.80043]	[-0.26127]	[0.47316]	[0.50570]	[-2.85047]
D(IH(-1))	-0.002124	-0.001863	8.29E-05	0.004954	9.81E-05	-0.074055	-0.078178
	(0.00427)	(0.00210)	(0.00110)	(0.01806)	(0.00167)	(0.09951)	(0.05122)
	[-0.49721]	[-0.88824]	[0.07524]	[0.27425]	[0.05893]	[-0.74421]	[-1.52637]
D(IF(-1))	0.008322	0.011300	0.000389	-0.000444	0.004089	0.090470	0.187391
	(0.00793)	(0.00389)	(0.00204)	(0.03352)	(0.00309)	(0.18468)	(0.09506)
	[1.04942]	[2.90228]	[0.19047]	[-0.01326]	[1.32303]	[0.48987]	[1.97136]
C	0.003954	0.014193	0.003593	-0.020278	0.002848	0.038546	0.037944
	(0.00332)	(0.00163)	(0.00086)	(0.01402)	(0.00129)	(0.07725)	(0.03976)
	[1.19207]	[8.71529]	[4.20144]	[-1.44616]	[2.20330]	[0.49900]	[0.95432]
R-squared	0.183675	0.297372	0.106275	0.530471	0.069549	0.146825	0.280744
Adj. R-squared	0.113032	0.236568	0.028933	0.489839	-0.010971	0.072993	0.218500
Sum sq. resids	0.015821	0.003814	0.001052	0.282728	0.002403	8.580766	2.273264
S.E. equation	0.012334	0.006056	0.003180	0.052140	0.004807	0.287241	0.147846
F-statistic	2.600031	4.890636	1.374096	13.05540	0.863745	1.988625	4.510423
Log likelihood	344.5503	425.6446	499.0657	180.2106	451.9760	-14.31850	61.39498
Akaike AIC	-5.869303	-7.292011	-8.580099	-2.986152	-7.753966	0.426640	-0.901666
Schwarz SC	-5.629285	-7.051993	-8.340082	-2.746134	-7.513948	0.666658	-0.661649
Mean dependent	0.004008	0.012325	0.004948	0.001745	0.001564	-0.015526	-0.021930
S.D. dependent	0.013096	0.006931	0.003227	0.072999	0.004781	0.298335	0.167241

Appendix 4 : Results of VEC Granger Causality / Block Exogeneity Wald Tests

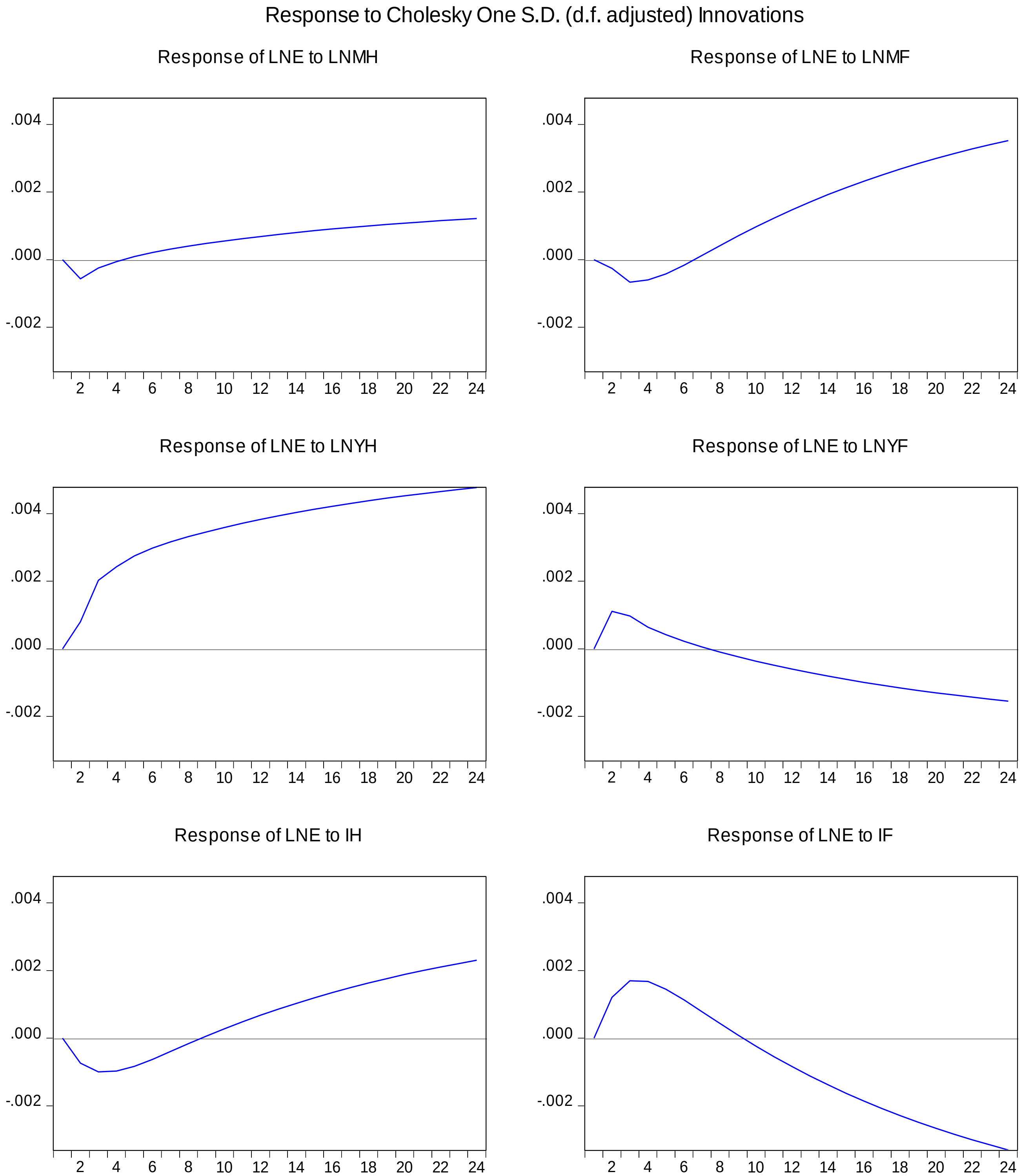
Dependent variable D(LNE)		Dependent variable D(LNMH)	
D(LNMH)	0.5065	D(LNE)	0.1154
D(LNMF)	0.9486	D(LNMF)	0.8631
D(LNYH)	0.1639	D(LNYH)	0.9597
D(LNYF)	0.1723	D(LNYF)	0.5398
D(IH)	0.6190	D(IH)	0.3744
D(IF)	0.2940	D(IF)	0.0037*
All	**0.6232**	**All**	**0.0178****

Dependent variable D(LNYH)		Dependent variable D(IH)	
D(LNE)	0.0220**	D(LNE)	0.0071*
D(LNMH)	0.9032	D(LNMH)	0.0132**
D(LNMF)	0.0126**	D(LNMF)	0.2022
D(LNYF)	0.7939	D(LNYH)	0.8338
D(IH)	0.7839	D(LNYF)	0.6131
D(IF)	0.9894	D(IF)	0.6242
All	**0.0550*****	**All**	**0.0373****

Dependent variable: D(LNMF)		Dependent variable: D(LNYF)	
D(LNE)	0.5978	D(LNE)	0.5612
D(LNMH)	0.8768	D(LNMH)	0.2851
D(LNYH)	0.1412	D(LNMF)	0.6138
D(LNYF)	0.4235	D(LNYH)	0.5044
D(IH)	0.9400	D(IH)	0.9530
D(IF)	0.8489	D(IF)	0.1858
All	**0.8345**	**All**	**0.5903**

Dependent variable: D(IF)	
D(LNE)	0.5425
D(LNMH)	0.4659
D(LNMF)	0.0028**
D(LNYH)	0.1997
D(LNYF)	0.0044**
D(IH)	0.1269
All	**0.0052****

Appendix 5 : Impulse Response Function



Appendix 6 : Results of Variance Decomposition

Period	S.E.	LNE	LNMH	LNMF	LNYH	LNYF	IH	IF
1	0.012334	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.020826	99.01722	0.073525	0.015433	0.148189	0.282399	0.125965	0.337267
3	0.027746	98.21973	0.049432	0.066496	0.618154	0.280976	0.200411	0.564798
4	0.033458	97.84439	0.034321	0.077981	0.951686	0.229807	0.222627	0.639184
5	0.038193	97.61284	0.026929	0.071980	1.247447	0.188319	0.218298	0.634190
6	0.042174	97.44246	0.024652	0.060533	1.522210	0.157233	0.200924	0.591989
7	0.045572	97.28568	0.025825	0.052581	1.785043	0.134799	0.179601	0.536470
8	0.048515	97.11306	0.029591	0.053693	2.043428	0.119341	0.159617	0.481266
9	0.051097	96.90836	0.035479	0.067075	2.301186	0.109714	0.144035	0.434155
10	0.053391	96.66240	0.043210	0.094469	2.560489	0.105169	0.134625	0.399636
11	0.055449	96.37032	0.052603	0.136718	2.822481	0.105194	0.132390	0.380294
12	0.057315	96.02992	0.063521	0.194101	3.087639	0.109416	0.137860	0.377547