The Relationship between the Exchange Rate Volatility and Inflation in Sri Lanka

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Abstract - Exchange rate volatility is also one of the factors which determine the inflation of a country. Therefore, this study aims to analyze the relationship between the exchange rate volatility and inflation in Sri Lanka over the period 1977-2020. This study used inflation as the dependent variable. Exchange rate, export, import, money supply and foreign direct investment are used as the independent variable. Augmented Dicky- Fuller test is employed to identify the stationary of the variables. This result indicates that the variables are stationary in order one. Johansen Co-Integration test found that there is a positive and significant relationship between the exchange rate volatility and inflation, money supply and export and a negative correlation between the import. Adjustment toward the long-run equilibrium is ensured from the Vector Error Correction model result. But, there is no significant relationship in the short run between the exchange rate volatility and inflation. According to the CUSUM test result, the model is stable. From the Granger Causality test, exchange rate volatility has a one-way causal relationship with inflation. Therefore, this study concluded that exchange rate volatility and inflation have a long-run relationship and there is no significant correlation between the variables in the short-run. Hence, this study is recommended that the Sri Lankan government must try to stabilize the exchange rate and monitor the amount of money supply within the country.
Keywords: Exchange Rate, Export, Inflation, Import, Money Supply

I. INTRODUCTION

In international trade, the foreign exchange market plays an important role and its major function is to exchange one currency for another. Therefore, the rate at which one currency is exchanged against another is termed the "exchange rate". Thus, the exchange rate has been divided into domestic currency and foreign currency.

Currency appreciation and depreciation are often used in foreign exchange markets. Both situations create exchange rate volatility in a country. Moreover, Currency appreciation and depreciation depend on the demand and supply in the foreign exchange market. Therefore, even a small variation in demand and supply will appreciate or depreciate the currency of a country. Also, the government and monetary policymakers follow the American dollar as a common exchange currency.

Exchange rate volatility defines as the fluctuations in the exchange rate. Further, Yakum *et al.,* (2019) state the appreciation or depreciation of a currency over some time (Musa, 2021). Exchange rate volatility creates risk and uncertainty in international trade and investment decisions.

The currency depreciated from Rs.4.76 in 1950 to Rs.15.56 at end of 1977 in Sri Lanka. Further, it has depreciated to Rs.28.51 in 1986 and Rs.56.72 in 1996 continuously. In 2000, it was Rs.80.06 and it has depreciated to Rs.102.12 in 2005 after an independently floating exchange rate regime It was Rs.131.05, Rs.144.06, Rs.149.8 and Rs.152.85 in 2014, 2015, 2016 and 2017 respectively.

So, it has been seen that the domestic currency value has declined (Central Bank of Sri Lanka, 1950-2017). But, in 2018 depreciation is very fast over a month. In June, the value of the currency was Rs. 161.17. It was depreciated again in September and it was Rs. 165.34. But, in October currency reached Rs. 170.56 against the US dollar. In 2019 and 2020, it reached Rs. 178.78, and Rs. 185.52 respectively. But, in September of 2021, the value of the Sri Lankan currency against the US Dollar reached Rs.210.00 due to the COVID-19 pandemic.

Sri Lankan Rupee has depreciated 3.3 percent this year, the Indian Rupee has depreciated by 8 percent, the Pakistani Rupee has depreciated by 10.5 percent, Indonesian Rupiah by 5.2 percent and the Thai Bhat by 5.4 percent. So, all Asian countries are affected due to currency depreciation. But, its socio and economic impacts are less than Sri Lanka. That's why nowadays currency depreciation is one of the major issues in Sri Lanka.

Therefore, the depreciation of the exchange rate reduces the value of the domestic currency. It causes to increase in expenditure on imports including capital goods. As a developing country, Sri Lanka requires more capital goods for production and economic activities. Debt service payments of the government also increased. Both are crucial for the long-term growth of the country.

Inflation defines the rate at which increases the prices of goods and services over a given period. The cost of living in a country will be increased due to the overall price increase.

As well as, inflation declines the purchasing power of the individual over time.

The annual inflation of Sri Lanka rose to 9.9% in November 2021 from 7.6 percent in October. It was noted that the highest inflation rate since February of 2013. Because this is the first time that prices rose at a faster pace both for food products from 17.5% in September to 12.8% in October and non-food products from 6.4% in September to 5.4% in October. Consumer prices rose to 2.6 % in October (Press Release, 2021).

The exchange rate volatility is determined by political and economic factors. Importantly, inflation affects the exchange rate of the national currency and leads to economic instability. Monfared and Akin (2017) criticized that examining the relationship between inflation and exchange rate over a while plays a vital role in the case of developing countries (Alsmadi & Ali, 2020). So, there is a strong association between the exchange rate volatility and the inflation rate of the country. Therefore, this study aimed to identify the relationship between exchange rate volatility and inflation over the period 1977 to 2020.

II. LITERATURE REVIEW

A. Theoretical Framework

Jingan (2021) expressed that the Purchasing Power Parity (PPP) theory explains the exchange rate between countries is determined by the relative price of the goods and services (Musa, 2021). The formula is shown as

$$P_t = E_t P_t^*$$

Where, P_t denotes the domestic price index. E_t represent the exchange rate between two countries and P_t^* is foreign prices.

According to the Mundell-Flemming model, the expansionary monetary policy increases the money supply and shifts the LM curve. This leads to decrees in the interest rate and depreciates the domestic currency. As well, the depreciation of currency induces domestic production through export. It causes IS curve and BP curve to shift to the right. As a result of this, higher output indirectly leads to a price increase.

B. Empirical Literature

Fetai, Koku, Caushi, & Fetai, (2016) investigated the relationship between exchange rates and inflation based on the Western Balkan countries. Quarterly data is collected in Western Balkan countries from 1996-2014. This study is analyzed by using the 'Pooled OLS', 'Fixed Effects', 'Random Effectes' and 'Hausman-Taylor IV'. This study found that fluctuations in the exchange rate will have a strong influence on inflation in Western Balkan countries. As well as this study reveals that the exchange rate is the key cause of inflationary pressure in these countries. Policymakers must consider the relative costs and benefits in small open economies.

This study has assessed the impact of depreciation on the economic performance in Turkey. Quarterly data from 1987 to 2001 is collected. Unit Root Tests, Cointegration Tests and VAR model is employed to achieve the objectives. Results reveal that output and real exchange rate are negatively correlated. Further, this study found that there is a long-run correlation between the exchange rate, inflation and output. These results show that real exchange rate movements play a vital role in the variability of output. Finally, this study concluded that real exchange rate depreciation leads to inflationary (Berument & Pasaogullari, 2003).

Hoang, Thi, & Minh (2020) estimated the effect of the exchange rate on inflation and economic growth of Vietnam from 2005-2018. This study performed the VAR self-regression model to achieve the objectives. This study identifies the effect of inflation on the exchange rate, exports, money supply, imports, GDP and consumer price index. This study recommended that the Vietnam government should implement some goals to stabilize the economy.

Musa, (2021) investigated the effect of exchange rate volatility on inflation in Nigeria by the annual data 1986 - 2019. This study is analyzed by the Generalized Autoregressive Conditional Heteroskedasticity and Vector Error Correction Model. These results revealed that money supply and nominal exchange rate affected positively and significantly the consumer price index. Further, this study suggested that increase in the money supply must be controlled by the central bank.

Kiguel, (1994) examined the effectiveness of alternative exchange rate policies and regimes. This study exposed that the exchange rate policies exist a limited effect on affecting the real exchange rate. Like that, devaluations affect the real exchange rate in the short run. Further, counties can maintain a stable real exchange rate while following stable macroeconomic policies.

Edwards, (2006) intended to identify the association between inflation targeting and exchange rates. This study used the quarterly data for the period of 1985 to 2005 for seven countries including two advanced and five emerging countries. To achieve the objectives, this study employed the generalized autoregressive conditionally heteroskedastic (GARCH) model. This study found that decline has been different from CPI inflation than for PPI inflation in many of the countries among the selected sample. Further, this study decided that the adoption of IT monetary policy procedures have not caused an increase in exchange rate volatility.

Monfared & Akın, (2017) analyzed the connection between exchange rate and inflation. This study performed the Hendry General to Specific Modeling method and Vector Autoregression (VAR) model. This study used the quarterly data between 1997: 3 - 2011: 4. Hendry's model found that there is a positive relationship between the exchange rate and inflation. Both the money supply and the exchange rate have a positive effect.

III. METHODOLOGY

This empirical study has been carried out in the Sri Lankan context. This study has used a dataset over the period 1977 to 2020. This dataset is collected from the Annual Report of the Central Bank of Sri Lanka and Reports of Economics and Social Statistics of Sri Lanka. The dependent variable of this study is inflation (CPI) and independent variables are exchange rate (EX), money supply (M2), export (X), import (M) and foreign direct investment (FDI). Consumer Price Index represents the inflation rate of Sri Lanka. The exchange rate against US Dollar is used as the proxy of the exchange rate volatility. Export and import (as a percentage of Gross Domestic Product) represent the external sector. M_2 Broad Money is a proxy of the money supply. Foreign Direct investment represents the capital inflow.

A. Model Specification

This study used the Augmented Dicky – Fuller (ADF) and Phillips-Perron tests to check whether selected variables are stationary or not. Akaike Information Criterion (AIC) is adopted to identify the optimal lag length. This study performed the Johansen Co-Integration Test and Vector Error Correction Model (VECM) to identify the long-run, long-run equilibrium and short-run dynamic relationship between the exchange rate and inflation in Sri Lanka.The CUSUM test is used to check the stability of the model. The

Granger Causality test is performed to analyze the causal relationship.

The mathematical function of the study is specified as
$$CPI = f\ (EX, M2, X, M, FDI)$$

The econometric model of the study is stated as
$$CPI = \delta_0 + \delta_1 EXt + \delta_2 M2t + \delta_3 Xt + \delta_4 Mt + \delta_5 FDIt + u$$

Where, δ_0 is an intercept/slope coefficient, δ_1 to δ_5 are coefficient parameters.

IV. RESULTS AND DISCUSSION

The relationship between two variables is called the correlation. Scatter diagrams and Confidence ellipse graphs are used to show the correlation. Figure:1 shows the graphical presentation of the relationship between the two variables inflation and exchange rate volatility. It indicates the positive correlation between the variables.
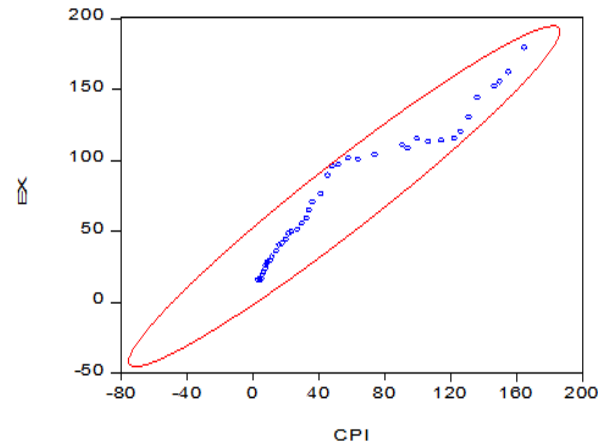

Fig. 1 Correlation between the Inflation and Exchange Rate

TABLE I RESULTS OF ADF AND PP UNIT ROOT TEST

Variables	ADF Test (Trend and Intercept only)		PP Test (Trend and Intercept only)		Order of Integration
	Level	1st Difference	Level	1st Difference	
CPI	-0.6390 (0.9711)	-5.3170* (0.0005)	-0.8490 (0.9522)	-5.1054* (0.0009)	I(1)
EX	-0.2451 (0.9898)	-4.1905** (0.0102)	-1.6860 (0.7394)	-4.8112* (0.0020)	I(1)
M2	-0.8937 (0.9470)	-8.5142* (0.0000)	-0.7988 (0.9574)	-8.3014* (0.0000)	I(1)
FDI	0.9384 (0.9998)	-6.2814* (0.0000)	0.1091 (0.9964)	-7.7761* (0.0000)	I(1)
X	-2.3821 (0.3825)	-4.9435* (0.0014)	-1.5624 (0.7905)	-5.1075* (0.0009)	I(1)
M	-2.5709 (0.2948)	-6.4949* (0.0000)	-2.6447 (0.2638)	-6.8352 (0.0000)*	I(1)

Note: 1%, 5%, and 10% significance level denote *, **, *** respectively

In Table II, findings of the ADF and PP unit root test show that all the series (CPI, EX, M2, M, X, FDI) are stationary at the first difference with the trend and intercept and integrated in order one [I(1)]. Since all the variables are stationary at the same level, this result suggests that to carry out the co-integration test.

TABLE II RESULTS OF LAG LENGTH SELECTION

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1102.370	NA	4.71e+16	55.41848	55.67181	55.51008
1	-850.4687	415.6366	9.87e+11	44.62343*	46.39676*	45.26461*
2	-807.2696	58.31870*	7.80e+11*	44.26348	47.55680	45.45424

Note: * indicates lag order selected by the criterion. LR: sequentially modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Table II shows the optimal leg length of the Vector Auto-Regressive (VAR) model. Akaike Information Criterion (AIK), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ) tests are adapted to find the optimal leg length of this model. AIK, SC and HQ lag length selection criteria are suggested to select one lag as an optimal lag length.

TABLE III RESULTS OF JOHANSON CO-INTEGRATION TEST (TRACE AND MAX-EIGEN)

No. of CE(s)	Trace			Max-Eigen		
	Statistic	0.05 Critical Value	Prob.**	Statistic	0.05 Critical Value	Prob.**
None *	152.8381	103.8473	0.0000	52.41480	40.95680	0.0017
At most 1 *	100.4233	76.97277	0.0003	46.88164	34.80587	0.0012
At most 2	53.54164	54.07904	0.0558	24.10984	28.58808	0.1683
At most 3	29.43181	35.19275	0.1831	14.97622	22.29962	0.3770
At most 4	14.45559	20.26184	0.2592	12.12414	15.89210	0.1789
At most 5	2.331451	9.164546	0.7112	2.331451	9.164546	0.7112

Note: Trace test indicates 2 cointegrating eqn(s) at the 0.05 level and Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

This study used the trace statistics and maximum eigenvalue statistics of the Johansen Co- Integration test to identify the cointegrating relationship at the 5% significance level. According to Table III, Johansen Co-integration Trace statistics and Maximum Eigen Value are implied as two co-integrating relations at the 5% significance level. This result indicates the existence of the long-run relation between the dependent and independent variables. Hence, two co-integrating relations are used in the Vector Error Correction Model of this study.

A. Results of Long Run Johansen Co-Integrating Equation

$$CPI = -143.4218C + 6.936962M2 + 0.556707EX - 0.003214FDI - 16.06616X + 8.868304M$$
$$(49.0603) \quad (1.73053) \quad (3.37311) \quad (0.00034) \quad (2.20263) \quad (2.03077)$$

The inflation rate of a country plays a key role in the value of the currency of the country and the foreign exchange rate. Hence, a high level of inflation affects the depreciation of the exchange rate and vice versa. The results of the Johansen Co-integrating equation show that the exchange rate has a positive and significant long-run association with inflation. When the exchange rate increases by 1 unit that leads to an increase the inflation by 0.557 units while other variables are remaining constant at the 5% significance level. This result implies that the depreciation of the exchange rate leads to a rise the inflation in Sri Lanka.

The exchange rate is depreciated in Sri Lanka due to the increase in the US interest rate, the trade war between the major economies, the rise in oil prices and COVID-19 pandemic in Sri Lanka. Therefore, the domestic price of imported goods and services increases when converted into domestic currency and export prices increase when converted into foreign currency. Therefore, exchange rate volatility has an impact on the inflation rate in Sri Lanka.

Musa (2021), Monfared & Akın (2017) and Fetai, Koku, Caushi, & Fetai (2016) found that the exchange rate and inflation have a positive relationship. Increases in the money supply encourage high inflation. This equation indicates the positive and significant correlation between inflation and money supply. If the money supply increases by 1 percent, inflation rise by 6.937 percentage in Sri Lanka. Due to COVID-19, Gross Domestic Product is at a low level. But the Central Bank of Sri Lanka prints the money.

This will increase the money supply level of the country while GDP out remaining low. Eventually, this will lead to inflation. (Musa (2021) identified that the money supply has a direct correlation with inflation. FDI implies a negative connection with inflation. So, when the FDI increases, inflation will decrease. But, this is insignificant. According to the results, exports has a negative relation to inflation and import is positively significant to inflation. But, due to the COVID-19 pandemic and lack of foreign reserves, Sri

Lanka restricted imports. This leads to a decrease in input supply and affects domestic manufacturing. Consequently, the price level of goods and services increases. In the meantime, the price of intermediate goods increases and it leads to a rise in production cost. Finally, it affects the inflation rate.

B. Results of the Vector Error Correction Model

$$CPIt = -0.020752_{t-1} + 0.482085\text{DCPI}_{t-1} + 0.371369\text{DCPI}_{t-2} + 0.200044DM2_{t-1} + 0.253897DM2_{t-2}$$
$$- 0.016242DEX_{t-1} - 0.136075DEX_{t-2} - 7.81DFDI_{t-1} - 7.65DFDI_{t-2} + 0.104077DX_{t-1}$$
$$- 0.422658DX_{-2} + 0.083773DM_{t-1} + 0.077295DM_{t-2}$$

Vector Error Correction results indicate the coefficients of the speed of adjustment. It explains how the above model is adjusted towards the long-run equilibrium. According to the results, there is a negative and statistically significant adjustment toward the long-run equilibrium between the exchange rate and inflation in Sri Lanka. Error correction coefficient (0.031) of inflation implies that 3.1% disequilibrium is corrected by each year after the shocks.

To determine the stability of the model, the CUSUM test is employed. The CUSUM test result is shown in Fig. 2. This estimated model lies between the dotted two red lines by upper and lower limit at the 5 percent significance level. Hence, this study found that this model is stable and there are no structural breaks. In the trend of the model.

Fig. 2 Results of Stability Test (CUSUM Test)

TABLE IV RESULTS OF GRANGER CAUSALITY TEST

Null Hypothesis	Obs	F-Statistic	Prob.
DEX does not Granger Cause DCPI	40	5.26145	0.0100*
DCPI does not Granger Cause DEX	40	0.0536	3.18440

Note: significant at 5% denotes by *

In Table IV, Granger Causality Test indicates the one-way causal association between inflation and exchange rate volatility. The null hypothesis of "EX does not Granger Cause CPI" is rejected as the value of probability is less than the 5 percent significant level. Hence, the alternative hypothesis is accepted. So, the model is revealed that there is "EX does Granger Cause CPI" at the 5 percent significance level.

V. FINDINGS AND CONCLUSION

The objective of the study is to examine the relationship between inflation and the exchange rate volatility in Sri Lanka over the period 1977-2020. The exchange rate slightly fluctuated over the years. But the exchange rate is highly depreciated from the end of 2018 to 2021. Sri Lankan currency is depreciated against to US dollar to Rs.210 in October 2021. Inflation shows fluctuation from 1977 to 201. It is determined by social, economic and political factors.

In this study, the Johansen Co-integration test indicates the long-run association between all variables. According to the results, there is a direct relationship between inflation and exchange rate volatility, money supply and import. But, export has a negative relationship with inflation. As per the Vector Error Correction Model results, negative significant adjustments towards the long-run equilibrium and short-run relationship are ensured. But, the Vector Error Correction model indicates the negative relationship between inflation and exchange rate volatility and there is no significant relationship between the two variables. Therefore long-run relationships and long-run equilibrium are concluded that there is a significant and positive relationship between the exchange rate volatility and inflation. The Granger Causality test is employed to identify the direct relationship. Hence, this study found that one-way causal relationship between inflation and exchange rate volatility. Further, this study concluded that the model is stable and there are no structural breaks.
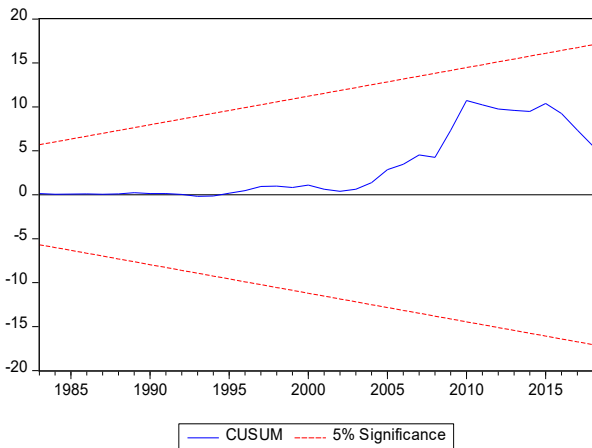
VI. RECOMMENDATIONS

According to the findings of the study, the government should consider exchange rate depreciation and inflation. As well, the government should adopt some policies and act to stabilize the value of the currency in Sri Lanka as soon as possible. Further, the Central Bank of Sri Lanka should regulate and properly monitor the amount of money supply. As well, the government should reduce and restrict input and capital imports. Because the rise in the cost of imports can lead to the inflation of goods and services with is domestic. Then only the country's economic activities will be stabled and moved towards sustainable development.

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REFERENCES

[1] Alsmadi, A. A., & Ali, B. (2020). Analyze the Impact of Exchange Rate on Inflation Rate: Kuwait as a Case Study for the Period of 1990 to 2019. *Change Management Journal, 175*(1), 1-8.

[2] Berument, H., & Pasaogullari, M. (2003). Effects of the Real Exchange Rate on Output and Inflation: Evidence from Turkey. *The Developing Economics*, 401-435.

[3] Edwards, S. (2006). The Relationship Between Exchange Rates and Inflation Targeting Revisited. NBER Working Paper No. 12163. Retrieved from http://www.nber.org/papers/w12163.

[4] Fetai, B., Koku, P. S., Caushi, A., & Fetai, A. (2016). The Relationship Between Exchange Rate And Inflation: The Case Of Western Balkans Countries. *Journal of Business, Economics and Finance-JBEF, 05*(04), 360-364. DOI: 10.17261/Pressacademia. 2017.358.

[5] Hoang, T. T., Thi, V. A., & Minh , H. D. (2020). The impact of exchange rate on inflation and economic growth in Vietnam. *Management Science Letters, 10*, 1051-1060. Retrieved from http://www.growingscience.com/msl.

[6] Kiguel, M. A. (1994). Exchange Rate Policy, the Real Exchange Rate, and Inflation: Lessons from Latin America. *Cuadernos De Economia, 31*(93), 229-249.

[7] Monfared, S. S., & Akın, F. (2017). The Relationship Between Exchage Rates and Inflation: The Case of Iran. *European Journal of Sustainable Development, 6*(4), 329-340. DOI: 10.14207/ejsd.2017. v6n4p329.

[8] Musa, N. (2021). Impact of Exchange Rate Volatility on Inflation in Nigeria. *Journal of Contemporary Research in Business, Economics and Finance, 3*(1), 26-38. DOI: 10.33094/26410265.2021.31.26.38.

[9] Press Release. (2021). Central Bank of Sri Lanka, Statistics Department. Colombo, Sri Lanka: Communication Department, Retrieved 12 15, 2021, from https://www.cbsl.gov.lk/ sites/default/ files/cbslwebdocuments/press/pr/press_20211130_inflation_in_nove mber2021ccpie.pdf.