BANK OF SIERRA LEONE

BANK OF SIERRA LEONE POLICY BRIEF

THE EFFECTS OF EXCHANGE RATE DEPRECIATION ON EXPORT, IMPORT AND INFLATION IN SIERRA LEONE

By Robert Dauda Korsu
Director, Research and Statistics Department
Bank of Sierra Leone

JUNE 2023

BSL/PB/01/2023

BANK OF SIERRA LEONE

BANK OF SIERRA LEONE POLICY BRIEF

THE EFFECTS OF EXCHANGE RATE DEPRECIATION ON EXPORT, IMPORT AND INFLATION IN SIERRA LEONE

By Robert Dauda Korsu
Director, Research and Statistics Department
Bank of Sierra Leone

JUNE 2023

BSL/PB/01/2023

Abstract

The objective of the policy brief is to investigate the effect of exchange rate depreciation on export, import and inflation in Sierra Leone, using monthly data from January 2010 to December 2022. Autoregressive Distributed Lag Models (ARDL) of export, import and inflation are estimated using the Ordinary Least Squares, for export and import, and Robust Regression, for inflation. The result shows that depreciation of the Leone does not have a significant effect on exports, has no significant contemporaneous impact on imports but after two months it has a significant positive effect on imports. It increases inflation in the same month and the third month of the depreciation. Strengthening of domestic policy to encourage reduction of the weight of import in consumption, in favour of import-competing goods is imperative. Thus, the developments of the coordination, environment and infrastructure for more investment in domestic food production, especially rice, which is the staple food and also accounts for about 10 percent of total imports is imperative. Migration towards strong support of domestic value chain for exports is imperative and this may start with light manufactures with linkage to agricultural raw materials, as a credible trade policy option for realizing benefit of a depreciation.

1. Introduction

The exchange rate is an important price in an economy as it can determine the allocation of resources between the tradable and non-tradable sectors. Depreciation of the nominal exchange rate can translate into depreciation of the real exchange rate or merely into inflation without a net reflection on the depreciation of the real exchange rate, to increase export and reduce import. This ability to affect export favourably and reduce import also depends on the structure of imports and exports. While the performance of a country on exports and imports can strongly determine its current account, the structure of exports and imports determines whether a country can have a growth effect from exchange rate depreciation.

In Sierra Leone, trade deficit is more often than not the case. Trade balance is a component of the gross domestic product of a country, it is an important economic indicator, and a consistent trade deficit is a threat to economic growth, compared to a consistent surplus (Sokolova, 2017). Essentially, the Elasticity Approach (Robinson, 1947 and Metzler, 1948) provides argument for a depreciation to increase export, reduce import and hence improve the trade balance. When domestic import demand elasticity with respect to exchange rate is weak, the trade balance effect will be weak, as the expenditure switching effect of depreciation (switching away from imports to domestically produced goods) will be weak. Heavy reliance on essential imported commodities, including food and energy, as in the case of Sierra Leone, which make them inelastic in demand is a core constraint to the trade-balance-improvement effect and the income-increasing effect of an exchange rate depreciation. The trade balance effect of depreciation also depends on the demand and supply elasticities of exports with respect to exchange rate changes. If export supply elasticity with respect to exchange rate and foreign import demand elasticity of export with respect to exchange rate are weak, it is difficult to have an export gain from   depreciation of the exchange rate. The former can be due to heavy domestic reliance on export of primary products, as in the case of Sierra Leone. In addition, when inflation rate is strongly driven by exchange rate depreciation, as recently observed in Sierra Leone, a nominal depreciation of the local currency does not translate into a real deprecation, and the trade-balance and income benefits will not be gained.

Agenor and Montiel (1996) provides four channels of transmission of exchange rate to domestic price level, which are (i) imported input price increases (ii) imported final goods price increases (iii) uncertainty in foreign currency price translating into domestic price increases through changes in expectation formation and (iv) wage increases emanating from increase in the price of foreign currency. The transmission channels identified by Svenson (2000) capture much of these channels. In Sierra Leone, before March 2022, inflation rate had been less than 20 percent for a long period (over 25 years) and in March 2022, it rose to 22.06 percent from 17.59 percent in February 2022. The pressure mounted throughout the year, which was due to a combination of factors, including the supply chain disruption from the COVID-19 pandemic and the Russian-Ukraine war, as well as the growing depreciation of the Leone. In the last decade, on a monthly basis, annual depreciation of the Leone has been more common than an appreciation, and in 2022 and 2023, the

depreciation rates have been higher than rates observed in the decade ending in 2021. In 2021, the average of the year-on-year exchange rate depreciation was 5.79 percent, average of the inflation rate was 11.85 percent while the average of the year-on-year export and import growth rates were 0.83 percent and 0.32 percent respectively. During the period March 2022 to December 2022, the average of the depreciation rates rose to 26.7 percent, the average of inflation rates rose to 28.9 percent, while average of export growth rates declined to 0.73 percent and that for import growth declined to 0.21 percent, suggesting that higher inflation and insignificant low export and import growth follow a depreciation.

The question then is whether depreciation of the Leone filters into export and import of Sierra Leone, to improve the trade balance and increase income. When this is the case, then exchange rate depreciation is pro-growth. When the depreciation leads to strong exchange rate pass-through to domestic price level, the exchange rate depreciation itself becomes a challenge for the role of monetary policy in achieving price stability. When there is no trade-balance or income effect and there is high pass-through to domestic price level, then the country loses from both (i) no-trade-balance and no-income effect and (ii) high-inflation effect. We therefore investigated the response of export, import and inflation to exchange rate depreciation in Sierra Leone. The rest of the paper is organized as follows. Section 2 is the stylized facts, section 3 is the methodology, section 4 is the estimated export, import and inflation model, and section 5 is conclusion.

2. Stylised Facts

Figure 2.1 shows the movements of export growth, import growth and inflation with exchange rate depreciation. It shows that there is a positive link between inflation and exchange rate depreciation, no relationship between exchange rate depreciation and import growth and also no relationship between import and depreciation.

Table 2.1 shows the correlations between export growth, import growth, inflation and exchange rate depreciation. The table shows that export growth and exchange rate depreciation are negatively correlated and the correlation is not significant at the 5 percent level; the correlation between import growth and exchange rate depreciation is positive and not significant; while the correlation between inflation and exchange rate depreciation is positive, strong and significant at the 1 percent level of significance.

Figure 2.1:   Scatter Plot of Export Growth, Import Growth and Inflation on Exchange Rate Depreciation
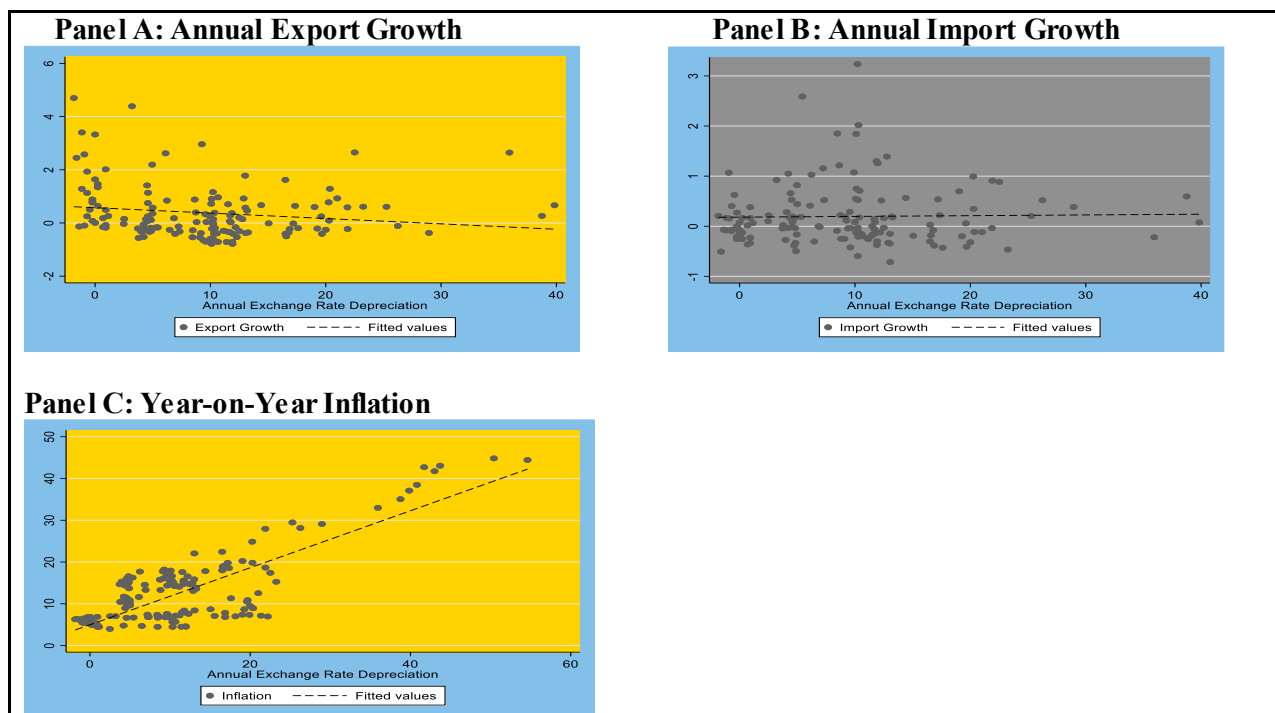
Table 2.1: Correlation of Export Growth, Import Growth and inflation with Exchange Rate Depreciation in Sierra Leone

	Correlation	P-value
Export Growth	-0.161	0.055
Import Growth	0.020	0.814
Inflation	0.812	0.000

Table 2.2 shows the percentage contributions of exports of Sierra Leone, which shows that mineral exports account for more than 75 % of the total exports of Sierra Leone and when coffee, cocoa and timber are added to this category to form the primary product category; it is observed that over 85 % of total exports are primary products[1].

A major feature of primary products, which is dominated by mineral exports and unprocessed agricultural export in Sierra Leone, is that they are export supply inelastic as exporters cannot exploit exchange rate depreciation benefit by exporting more in the short run. Thus, given this structure, Sierra Leone is not likely to benefit from exchange rate depreciation by exporting more to benefit from a depreciation.

---

[1] This number is a conservative number, which is obtained by assuming that other exports (re-export items) are actually manufactured products.

Table 2.2: Percentage Composition of Exports of Sierra Leone

Year	Mineral Export	Coffee	Cocoa	Timber	Palm Oil	Fish and Shrimps	Others	Total
2010	63.14	0.53	11.66	-	-	0.05	24.62	100.00
2011	76.02	0.63	13.93	-	0.003	0.24	9.18	100.00
2012	74.92	0.40	2.34	-	-	1.82	20.52	100.00
2013	93.26	0.19	0.60	-	0.001	0.54	5.41	100.00
2014	91.61	0.23	2.15	-	-	0.10	5.91	100.00
2015	73.53	0.26	3.74	-	-	0.81	21.65	100.00
2016	75.89	0.55	2.93	-	-	0.81	19.82	100.00
2017	76.65	0.08	2.70	-	-	1.67	18.90	100.00
2018	72.39	0.07	2.03	-	-	2.12	23.39	100.00
2019	74.94	0.31	3.99	8.86	1.02	1.44	9.43	100.00
2020	75.18	0.14	5.52	9.81	2.26	1.05	6.04	100.00
2021	80.76	0.02	5.53	3.96	5.29	0.68	3.76	100.00
2022	86.18	0.20	2.91	1.97	4.95	0.29	3.50	100.00
Average	78.04	0.28	4.62	1.89	1.04	0.89	13.24	100.00
Median	75.89	0.23	2.93	6.41	3.61	0.81	9.43	100.00

Source: Bank of Sierra Leo

Table 2.3 shows the percentage contributions of the components of imports to total imports of Sierra Leone, which shows that during the period 2010 to 2022, food accounted for about 25 percent of annual imports, machinery transport and equipment accounted for a little below this value, and fuel accounted for about 16 percent of total import while chemicals accounted for about 6 percent of total imports. Thus, over 70 percent of total imports are necessities for welfare and development, making their demand inelastic. Hence, when their import prices increase in domestic currency terms, it is difficult to shift demand away from them. To shift domestic demand from these imports to domestically produced ones is difficult as domestic substitutes are either not available (for fuel, machinery transport and equipment and chemical) or are very weak in supply (for food). This suggests the need for a strong consistent domestic effort to create close substitutes for these imports, especially for food and specifically, rice, which accounts on average about 9 percent of total imports and is the staple food. Thus, once it is difficult to reduce imports following exchange rate depreciation, the income effect of depreciation, through the import channel is difficult to hold in Sierra Leone, implying that exchange rate depreciation cannot have an expenditure switching (import reduction) effect in Sierra Leone.

Table 2.3: Percentage Composition of Imports of Sierra Leone

Period	Food	Ow Rice	Beverages & Tobacco	Crude Materials	Mineral Fuels & Lubricants	o/w Fuel	Animal and Vegetable Oils	Chemicals	Manufactured Goods Classified by Materials	Machinery, Transport and Equipments	Miscellaneous Manufactured Articles	Miscellaneous Transactions and Commodites	Total
2010	13.62	9.31	2.53	1.72	22.26	17.78	1.23	5.69	14.35	32.30	2.37	3.93	100.00
2011	14.32	4.94	4.17	1.08	16.06	13.75	0.56	3.91	10.24	44.06	1.82	6.02	100.00
2012	19.09	6.95	5.28	2.08	21.61	18.26	0.62	6.67	10.56	30.30	1.90	5.38	100.00
2013	20.10	7.27	1.83	1.66	23.37	18.36	0.79	7.32	8.17	22.51	1.62	12.63	100.00
2014	21.47	7.70	2.14	2.43	31.23	21.66	0.56	5.56	7.39	21.13	2.02	6.06	100.00
2015	34.49	9.25	2.85	2.70	18.16	11.66	0.56	3.39	7.95	21.88	2.45	5.57	100.00
2016	27.47	8.91	3.54	4.48	16.90	14.69	0.47	6.90	11.44	19.03	3.95	5.83	100.00
2017	33.62	14.24	2.57	3.46	14.50	13.42	0.55	4.00	10.01	22.23	3.58	5.47	100.00
2018	30.23	11.31	2.38	2.31	24.80	17.08	0.67	3.74	9.25	18.87	1.92	5.82	100.00
2019	20.07	9.02	1.28	3.43	17.63	13.51	0.48	7.60	14.56	22.58	11.80	0.58	100.00
2020	33.36	14.32	1.49	1.42	21.49	15.10	0.57	8.31	11.70	16.29	4.78	0.58	100.00
2021	24.98	9.41	1.31	1.35	22.52	15.74	0.25	10.37	10.59	17.16	9.66	1.80	100.00
2022	24.52	9.62	1.34	0.84	30.38	23.71	0.32	7.42	10.89	18.79	5.07	0.42	100.00
Average	**24.41**	**9.40**	**2.52**	**2.23**	**21.61**	**16.52**	**0.59**	**6.22**	**10.55**	**23.63**	**4.07**	**4.62**	**100.00**
Median	**24.52**	**9.25**	**2.38**	**2.08**	**21.61**	**15.74**	**0.56**	**6.67**	**10.56**	**21.88**	**2.45**	**5.47**	**100.00**

Source: Bank of Sierra Leone

3. Methodology

In order to determine the effect of depreciation of the Leone on export, import and inflation in Sierra Leone, a bi-variate autoregressive distributed lag model (ARDL) is estimated for export, import and inflation using monthly data from January 2010 to December 2022. This period suffices to determine the impact of exchange rate on the variables of interest as it gives 156 observations. The choice of the ARDL model is to account for the existence of both persistence and delayed effects of exchange rate changes. Each variable (export, import and inflation) is modelled by considering that it is determined by the dynamics of its own past values and the current and past values of exchange rate depreciation. The most appropriate number of lags is chosen using the Akaike Information Criterion (AIC), as it is a consistent estimator of the lag length, though it tends to produce a larger lag length than the Bayesian Information Criterion (BIC). All the data are from Bank of Sierra Leone Data Warehouse. The exchange rate is Leone per US dollar, inflation rate is the year-on-year headline inflation rate, export is total export and import is total import.

All variables are tested for stationarity using a combined approach by applying the ADF and ADF-GLS, though the ADF-GLS has been argued to have better size and power than the ADF test, However, as structural break could render a series to be taken as non-stationary even though it is stationary when the break is taken into account, the Perron-Vogelsang test, which tests for only one structural break and the Clement-Montane-Reyes test, which tests for the existence of two breaks, are also applied. The combined test results indicate that while export is stationary, import, inflation rate and exchange rate are stationary only after first differencing. The test results for the stationarity of the variables are not included here to conserve space. Hence, they enter the relevant models in first differenced forms to ensure they are stationary, which makes the application of the Ordinary Least Squares valid. The natural log of exports, imports and the nominal exchange rate are used. This is meant to have coefficients as elasticities, while it also stabilises the variances of export and import values as the figure (in millions of Leones) are large compared to inflation and exchange rate. Inflation enters

the model in its original form without log, as it does not have a large variance as measured by the standard error and the first differences of the variable.

The Ordinary Least Squares (OLS) estimation is used to estimate the models and tests for residual normality of residuals from model estimates are carried out. Where there is non-normality, the residual is investigated to determine possible outliers and dummy variables capturing the periods of occurrence of the outliers are introduced. If in the second round of estimation there is evidence of non-normality of residuals, the robust regression is applied as an alternative to the OLS since it is resistant to residual non-normality and makes no assumption about the residuals. In the case of the OLS, when a model passes the residual normality test, tests for serial correlation and heteroscedasticity are then carried out. The test results are not included here to conserve space.

4. The Estimated Export, Import and Inflation Models

(i) Effect of Exchange Rate on Exports of Sierra Leone

Panel A of Table 3.1 shows the estimated model of export as an autoregressive distributed lag (ARDL) model. The model result shows that while export performance in a given month has a significant persistence for up to a quarter (three months), exchange rate does not have a significant effect on export performance, though the sign follows the conventional wisdom as proposed in the elasticity approach to the balance of payments, that a depreciation improves export performance. This suggests that Sierra Leone does not benefit from export performance following exchange rate depreciation. This result is linked to the structure of the economy, as over 85 percent of the exports of Sierra Leone are primary products (mining exports and unprocessed agricultural exports). This implies that through the export channel, exchange rate depreciation does not have impact on the trade balance and income of Sierra Leone.

(ii) Effect of Exchange Rate on Imports of Sierra Leone

Panel B of Table 3.1 shows the estimated autoregressive distributed lag model of import. In the initial estimated model with OLS, the residuals were not found to be normal and a dummy variable for all residuals more than two standard deviations of the mean and another one for those less than negative two standard deviations of the mean were created (Dummy high and Dummy_low) and introduced into the model, which made the residuals normal. The result shows that in the current month to second month of an exchange rate depreciation, while an exchange rate depreciation has a negative effect on import growth, this effect is not significant, as indicated by the p-values. Hence, the effect of depreciation on income is insignificant through the import channel. In the second month of a depreciation of the exchange rate, it has a positive effect on import. This implies that following a depreciation, imports increase in two months, though it has no significant impact initially. This could be due to the nature of imports of Sierra Leone, as imports are

dominated by essential commodities, especially food and energy. Thus, a depreciation of the exchange rate does not lead to lower import but higher import, though with a lag.

Table 3.1: The Effects of Exchange Rate Depreciation on Export, Import and Inflation in Sierra Leone

Panel A: Estimated ARDL Export Model of Sierra Leone

Variable	Lags	Coefficient	P-value
Export	Lag1	0.262	0.001
	Lag2	0.319	0.000
	Lag 3	0.238	0.003
Exchange Rate	Lag 0	2.944	0.141
Constant		0.705	0.009
R^2=0.51		**Residual Diagnostics Tests**	
Adj.R^2=0.50		Normality: χ^2 (Prob)=0.446(0.800)	
F-stat.= 38.74		Heteroscedasticity: χ^2 (Prob)=0.160(0.686)	
F-Prob=0.000		Serial correlation (1st order χ^2): (Prob)=0.160(0.686)	
		Serial correlation (2nd order χ^2): (Prob)=4.934(0.085)	

Panel B: Estimated ARDL Import Model

Variable	Lags	Coefficient	P-value
Import	Lag1	-0.782	0.000
	Lag2	-0.438	0.000
	Lag 3	-0.275	0.000
Exchange Rate	Lag 0	-2.484	0.131
	Lag 1	-0.964	0.643
	Lag 2	4.165	0.018
Dummy_High		0.795	0.000
Dummy_Low		-0.650	0.000
Constant		-0.006	0.806
R^2=0.63		**Residual Diagnostics Tests**	
Adj.R^2=0.62		Normality: χ^2 (Prob)=2.093(0.351)	
F-stat.= 31.35		Heteroscedasticity: χ^2 (Prob)=1.15(0.284)	
F-Prob=0.000		Serial correlation (1st order χ^2): (Prob)=0.849(0.357)	
		Serial correlation (2nd order χ^2): (Prob)=1.123(0.570)	

Panel C: Estimated ARDL Inflation Model

Variable	Lags	Ordinary Least Squares	Robust Regression	Quantile Regression
Inflation	Lag1	0.097 (0.092)	0.074(0.197)	0.138(0.037)
	Lag2	0.163 (0.005)	0.183(0.002)	0.176(0.008)
Exchange Rate	Lag 0	20.104 (0.000)	18.003(0.000)	22.491(0.000)
	Lag 1	1.039 (0.848)	2.254(0.681)	-2.028(0.747)
	Lag 2	-3.135 (-0.584)	-4.590(0.405)	-2.459 (0.697)
	Lag3	12.272 (0.022)	13.480(0.013)	8.613 (0.162)
	Constant	-0.066 (0.302)	-0.090(0.162)	-0.084 (0.249)
Constant				
		R^2=0.66 Adj.R^2=0.64 F-stat.= 35.34 F-Prob=0.000	F-stat.= 17.25 F-Prob=0.000	Psudo R^2= 0. 143

(iii)   The Effects of Exchange Rate on Inflation Sierra Leone

Panel C of Table 3.1 shows the estimated autoregressive distributed lag model of inflation. The model is estimated using robust regression as the residuals from the OLS estimates were not found to be not normally distributed even after inclusion of dummies to capture all residuals that were more than two standard deviations of the mean. The median regression (quantile regression) estimation result is also presented in the table for comparison as both the robust regression and median regression are robust to outliers and they make no assumption about the residuals, unlike the OLS.

The model estimate shows that inflation has a significant persistence of two months, which is the case even with the OLS and quantile regression. That is, when inflation rate increases in a month, it has tendency to increase further after two months. While according to the robust regression there is no significant persistence after a month, there is evidence of significant persistence after two months, at the 5 percent level of significance according to the quantile regression. Hence, inflation expectation plays a role in Siera Leone's inflationary process for up to two months.

Exchanger rate is found to have a significant contemporaneous (same month) positive effect on inflation rate, which is also the case for both the quantile and OLS estimates of the inflation model. In addition, it is found to have a significant third-month lag effect, though both the first and second lags are not significant. Hence, exchange rate depreciation significantly translates into inflation in the same month of the depreciation and with a delayed effect after a quarter.

5. Conclusion

The exchange rate is an important price in an economy, as it determines the allocation of resources between tradable and non-tradable sectors. Depreciation of the nominal exchange rate can translate into depreciation of the real exchange rate or merely into inflation, without reflecting in the depreciation of the real exchange rate, which depends on the strength of the exchange rate pass-through effect to domestic price level. The effect on export and imports also depends on the structure of imports and exports of the economy.

We investigated the effect of exchange rate on export, import and inflation in Sierra Leone using monthly data from January 2010 to December 2022. The structure of the exports and imports of Sierra Leone was reviewed, which shows that during the period 2010 to 2022, over 85% of the exports of Sierra Leone were primary commodities, which are minerals and unprocessed agricultural products, with minerals accounting for 78 % while unprocessed agricultural products account for about 7.5 % of total exports. Also, over 70 % of the imports are essential products with food taking a little below 25 %, of which rice accounts for about 9.4 % while mineral fuel and lubricant accounts for 21.6 % of total imports and machinery, transport and equipment accounts for 23.63 % and out of this, fuel accounts for 16.5 %. This structure is not conducive for exchange rate depreciation to increase export and reduce import, in order to improve trade balance and hence the current account and income of Sierra Leone. Given the high proportion of food and fuel in total import (about 25 %), which are essential imports for Sierra Leone, exchange rate depreciation increases the cost of these imports and their domestic wholesale and retail prices, which translates into higher inflation.

An autoregressive distributed lag model of export, import and inflation was estimated to determine the effect of exchange rate depreciation on export, import and inflation in Sierra Leone. The Ordinary Least Squares was applied by leveraging on the results of tests for stationarity and results of residual diagnostic tests. However, for the inflation model, the Robust Least Squares regression was applied given the result of the residual normality test. The result shows that a depreciation of the Leone has no significant impact on exports, no significant impact on imports but after two months it has a significant positive effect on import. In addition, it increases inflation in the same month of depreciation and in the third month of depreciation.

The results therefore point out the need for strengthening of domestic policy towards reducing the weight of import in consumption, in favour of imports that can be produced domestically (import-competing goods), which requires developments of the coordination, environment and infrastructure for more investment in domestic food production, especially rice, which is the staple food and

accounts for about 10 percent of total imports. It also suggests the development of coordination and infrastructure to support domestic value chain in exports, which may start with light manufactures with linkage with agricultural raw materials.

References

Agenor, P.R., and Montiel, P.J. (1996), "Development macroeconomics." (3ʳᵈ edition). Princeton University Press, 215.

Metzler, L. (1948), "The Theory of International Trade." In Howard S. Ellis (ed.) A Survey of Contemporary Economics. Vol. I. Philadelphia: Blakiston.

Robinson, J. (1947), "The Foreign Exchanges." In Essays in the Theory of Employment. Oxford: Blackwell.

Sokolova, M.V (2017), "Exchange Rates, International Trade and Growth; Re-evaluation of undervaluation." ADBI Working Paper Series No. 684, March 2017.

Svensson, L.E.O. (2000). "Open-economy inflation targeting." Journal of International Economics. Vol. 50 ,155–183.