RELATIONSHIP BETWEEN EXCHANGE RATE AND FOREIGN EXCHANGE RESERVES

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ARTICLE INFO	ABSTRACT
	The main objective of this study is to examine the existence and nature of the relationship between the exchange rate and foreign exchange reserves. To avoid influencing foreign exchange market expectations, the intervention program should indicate in advance the nature, frequency, and size of the central bank's foreign exchange transactions. Thus, in this sense, it is essential to determine the nature of the relationship between the exchange rate and the interventions made from and for the official foreign exchange reserve. Following the realization of this study, it was highlighted the conclusion that through the application of Johansen cointegration tests, between the pairs of variables - NEER and the interventions from/for the foreign exchange reserve; official exchange rate and interventions in/for the foreign exchange reserve - there is at least one cointegration relationship. That is, between the exchange rate and the interventions in/for the foreign exchange reserve, a long-term relationship is highlighted, which can facilitate the forecast.

1. Introduction.

The floating exchange rate system has faced high volatility issues and weakened competitiveness in advanced economies. The excessive overvaluation of the USD in the early 1980s and then the devaluation of the dollar in the late 1980s led to G7 countries agreeing on coordinated formal interventions to stabilize the USD exchange rate in an informal period [14] Since then, policymakers are committed to adjusting the benefits of exchange rate flexibility as a shock absorber, on the one hand, and as a mechanism to facilitate international competitiveness and macroeconomic stability, on the other [16]. In recent years, considerable fluctuations in global capital flows have led many countries, including emerging market economies, to reconsider their foreign exchange intervention strategies [13]. Monetary authorities intervene in the foreign exchange market to reduce exchange rate volatility, which affects international trade, international financial flows, and foreign investment, or, with the goal of strengthening the country's macroeconomic fundamentals, to influence the value of its currency [10]. Foreign exchange reserves are widely used as an official intervention in foreign exchange markets. Monetary authorities worldwide have adjusted their exchange rate volatility by buying and selling currency to prevent, as Calvo and Reinhart argue, the "fear of floating" outbreak [5]. This practice means that the exchange rate system of countries around the world is, in fact, a flexible managed system [16]. Theoretically, countries should not have reserve requirements under a

flexible exchange rate system, even though they may still have reserves as a precaution if they revert to a less flexible exchange rate system. Thus, regardless of exchange rate regimes, the demand for reserves always exists [1]. Since the 1990s, global foreign exchange reserves have gradually increased, especially in emerging economies.

Purpose of the study: This paper aims to identify whether there is a link of integration between the pairs of variables - NEER and the interventions in/for the foreign exchange reserve; official exchange rate and interventions in/for the foreign exchange reserve.

2. Literature review.

Amid growing global financial imbalances, rising foreign exchange reserves in emerging economies have attracted the attention of research circles, policymakers, financial market investors and generated more controversy [7]. As Ben Bernanke argued, an unprecedented amount of foreign exchange reserves contributed to the excess savings, which led to global imbalances [2]. On the contrary, Borio and Disyatat argued that global imbalances cannot cause the financial crisis and that it is more critical to address SMFI's weaknesses directly [4]. Emerging economies are an excellent way to examine the relationship between changes in foreign exchange reserves and exchange rate fluctuations. Foreign exchange interventions are more effective in developing countries than in advanced economies because foreign exchange market interventions are not completely sterilized. In other words, monetary authorities in developing countries fail to take sufficient action to offset the impact of fluctuations in foreign asset holdings on the domestic monetary base [15]. Another reason is that the scale of interventions in such markets is too large compared to narrow foreign exchange markets. In addition, the central bank has the advantage of having more information than other market participants [6]. This is also because financial markets are incomplete in emerging economies, resulting in costly and sometimes impossible hedging of foreign exchange risks for economic actors and individual economies [9]. Even if successful, nominal exchange rates in emerging economies cannot avoid volatility [3]. Moreover, due to foreign liabilities denominated in foreign currency, emerging markets have many foreign exchange reserves to limit exchange rate volatility [11].

3. Methodology.

The growing popularity of the floating exchange rate regime and the targeting of inflation in monetary policy make the interaction between the exchange rate and the value of foreign exchange reserves held by the Central Bank a vital topic. In addition, the crisis of the Moldovan banking system since 2014 and its aftermath provide room for focus on examining the nature of the causal links between the NBM's foreign exchange reserves with NEER and the official exchange rate. In this regard, we consider it appropriate to study the asymmetric relationship between the official foreign exchange reserves of the NBM and the Moldovan leu exchange rate through the cointegration test.

Cointegration is an essential property of many economic variables, showing a long-term relationship between variables, although their stochastic changes. This leads to some standard, interrelated changes when short-term changes are adjusted for the degree of deviation from long-term dependency. Such behavior is inherent in cointegrated time series. We will apply a simplified two-step methodology to examine the existence and nature of the relationship between the exchange rate and foreign exchange reserves. In the first step, using the Dickey-Fuller unit root test, we will examine the level of integration of time series in situations where there is an indeterminate structural argument. The second step of the analysis is dedicated to determining the existence of cointegration through the Johansen cointegration test.

4. Results and discussion.

In our analysis, three NEER data series were used, the interventions from / for the currency reserve, the official exchange rate of the Moldovan leu taken from the International Financial Statistics and the NBM. Each data series consists of 84 numerical values (weekly logarithmic series, period 01.01.2015 - 01.12.2021).

Table 1. Dickey Fuller test results

Dickey-Fuller test (ADF(stationary) / k: 4 /NEER, log):	
Tau (Observed value)	-2.064
Tau (Critical value)	-3.401
p-value (one-tailed)	0.538
alpha	0.05
Test interpretation:	
H0: There is a unit root for the series.	
Ha: There is no unit root for the series. The series is stationary.	
As the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis H0.	

Dickey-Fuller test (ADF(stationary)/k: 4 /cursul valutar oficial):	
Tau (Observed value)	-2.921
Tau (Critical value)	-3.401
p-value (one-tailed)	0.148
alpha	0.05
Test interpretation:	
H0: There is a unit root for the series.	
Ha: There is no unit root for the series. The series is stationary.	
As the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis H0.	

Dickey-Fuller test (ADF(stationary)/k: 4/intervenții din/pentru rezerva valutară):	
Tau (Observed value)	-3.190
Tau (Critical value)	-3.401
p-value (one-tailed)	0.070
alpha	0.05
Test interpretation:	
H0: There is a unit root for the series.	
Ha: There is no unit root for the series. The series is stationary.	
As the computed p-value is greater than the significance level alpha=0.05, one cannot reject the null hypothesis H0.	

Source: analysis data.

The official exchange rate is limited in the sense that it represents the ratio between two currencies, so NEER, expressed in USD and which is a weighted average of a basket, was also introduced in the analysis. An increase in NEER means an appreciation of the country's currency, and to measure international competitiveness it is considered more appropriate than the official exchange rate.

Dickey-Fuller test. Dickey-Fuller test. The Dickey-Fuller Augmented Test (ADF) is a standard statistical test used to test whether a given time series is stationary or not. We apply the ADF test for each data set.

From the data in Table 1, we note that for our data series, the null hypothesis of a unit root in the data generation process is not rejected, which means that all three series are integrated of order I (1). Next, we need to check through the Johansen test if there is a cointegration relationship between the following series: NEER and interventions in/for the foreign exchange reserve; official exchange rate and interventions in/for the foreign exchange reserve.

Johansen cointegration test. Because all variables are first order (1) integrated, applying the Johansen cointegration test is more appropriate. The approach we use is based on VAR (Vector Autoregressive) models. Tables 2 and 3 show the four values of the criteria for estimating the VAR command. Each row evaluates several offsets from 1 to the maximum number of offsets. The discriminatory criterion is presented in bold.

Table 2. VAR assessment (NEER and interventions in/for the foreign exchange reserve)

VAR order estimation:				
Number of lags	AIC	HQ	BIC	FPE
1	**-10.740**	-10.692	-10.619	0.000
2	-10.667	-10.570	-10.425	0.000
3	-10.686	-10.541	-10.323	0.000
4	-10.631	-10.437	-10.147	0.000
5	-10.589	-10.347	-9.985	0.000
The VAR order estimate according to AIC is 1.				

Source: *analysis data.*

Table 3. VAR assessment (official exchange rate and interventions in / for the foreign exchange reserve)

VAR order estimation:				
Number of lags	AIC	HQ	BIC	FPE
1	-10.230	-10.182	-10.109	0.000
2	**-10.384**	-10.288	-10.143	0.000
3	-10.349	-10.204	-9.986	0.000
4	-10.293	-10.099	-9.809	0.000
5	-10.289	-10.048	-9.685	0.000
The VAR order estimate according to AIC is 2.				

Source: *analysis data.*

The Lambda max test displays the corresponding eigenvalue for each cointegration rank tested, the lambda max test statistic, the critical value, and the associated p values, and the tracking test indicates the corresponding eigenvalue, tracking test statistic, critical value, and values for each cointegration rank tested. p associated.

Table 4. Johansen cointegration test results

| Lambda max test:						Trace test:				
H0 (Nbr. of cointegrating equations)	Eigenvalue	Statistic	Critical value	p-value		H0 (Nbr. of cointegrating equations)	Eigenvalue	Statistic	Critical value	p-value
None	0.279	26.500	11.225	<0.0001		None	0.279	26.599	12.321	<0.0001
At most 1	0.001	0.100	4.130	0.795		At most 1	0.001	0.100	4.130	0.795
Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.						Trace test indicates 1 cointegrating relation(s) at the 0.05 level.				

Source: *analysis data.*

Foreign exchange reserves are an essential macroeconomic category, especially for developing countries, as confidence in its financial system grows as it strengthens. Given that developing countries are exposed to external shocks, it is helpful to have a specific "pillar" (foreign exchange reserves) to defend their macroeconomic position. The importance of foreign exchange reserves stems from the purpose of their use [3]. The IMF has developed a Guide outlining all possible uses of a

country's foreign exchange reserves [12]. In this context, in the foreign exchange intervention mechanism, it is essential to respect the exchange rate regime, a country's ability to pay, the degree of vulnerability of the economy to the country's external shocks, as well as the domestic instruments available to the country's monetary policy.

The management of foreign exchange reserves is a process that must ensure an adequate level of foreign assets for the public sector [14]. In addition, improper practices of managing foreign exchange risks and reserves can lead to high financial costs and significantly increase reputational risk. Therefore, the management of foreign exchange reserves should ensure an adequate level of foreign exchange reserves necessary to achieve the set objectives, adequate control of liquidity risk, market risk, credit risk, achievement of a certain level of return, which is in line with the limits of risk required. The management of foreign exchange reserves is a segment of the economic policy closely linked to the monetary policy system and the objectives to be achieved. To maintain the adequate availability of reserves, it is essential to maintain the optimal number of reserves safely invested. In the Republic of Moldova, the volume of foreign exchange reserves, for the most part, exceeds the established optimal level. From the point of view of the structure of the foreign exchange reserve by instruments, we can see that, in the last five years, there has been a decrease in term investments and an increase in the category of cash and investments in correspondent accounts (including overnight). Regarding the foreign exchange reserve composition by currency, we can observe that it does not differ much from the foreign exchange component of the global official foreign exchange reserves (fig. 1).
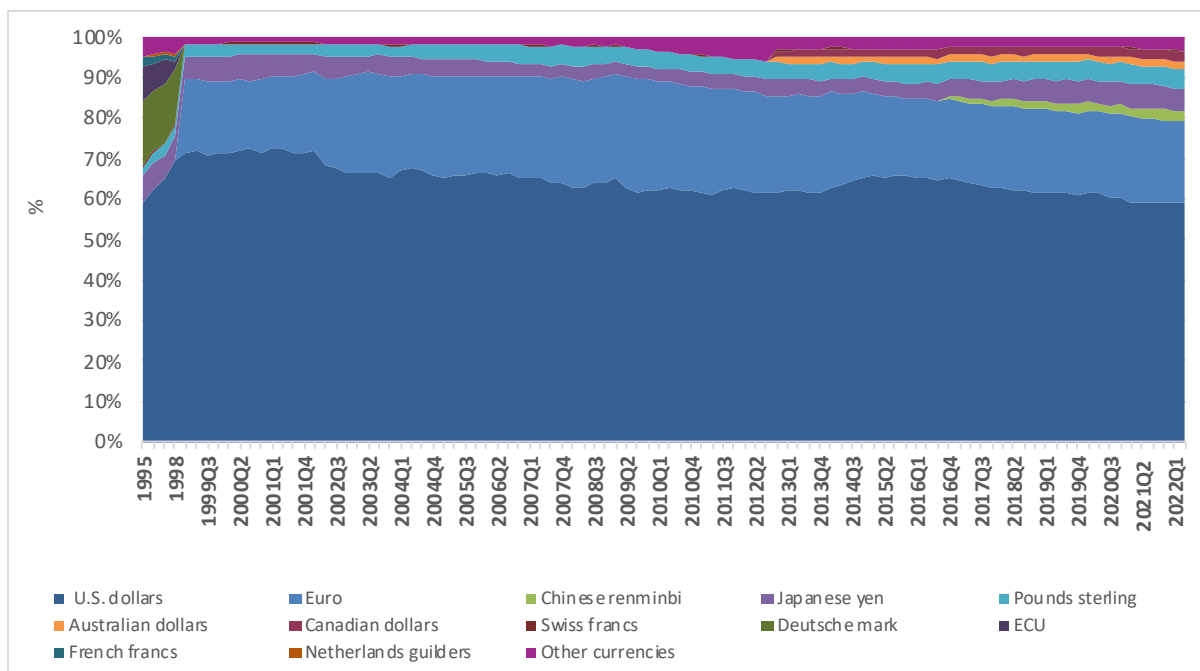
Fig 1. Foreign exchange reserves
Source: [8].

Conclusions.

Foreign exchange reserve management is a process that must ensure an adequate level of foreign assets for the public sector. In addition, inappropriate risk and foreign exchange reserve management practices can induce high financial costs and significantly increase reputational risk. The management of foreign exchange reserves should ensure an adequate level of foreign exchange reserves necessary to achieve the established objectives, adequate control of liquidity risk, market risk, credit risk, and the achievement of a certain level of return, which is following the limits of necessary risk. Foreign exchange reserves management is a segment of the economic policy closely related to the monetary policy system and the objectives to be achieved. In this sense, it is essential to establish the relationship between interventions from the foreign exchange reserves and the monetary policy objectives (primary or operational), in our case, the operational objective - the exchange rate.

Thus, following the application of Johansen cointegration tests, we can conclude that between the pairs of variables - NEER and the interventions in/for the foreign exchange reserve; official exchange rate and interventions in/for the foreign exchange reserve - there is at least one cointegration relationship. That is, between the exchange rate and the interventions in/for the foreign exchange reserve, a long-term relationship is highlighted, which can facilitate the forecast.

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