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The effect of exchange rate on the money demand: evidence from ECOWAS countries

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Abstract

This paper investigates the effects of exchange rate on the demand for money in ECOWAS countries by applying panel (auto-regressive distributed lag) ARDL approach. The results reveal existence of currency substitution. We find that real effective exchange rate has positive long-run effects on the demand for money, suggesting that the expectation effect dominates the wealth effect; real effective exchange rate has negative effects in the short-run implying that the wealth effect dominates the expectation effect. When we use nominal effective exchange rate as alternative of real exchange rate, our results remain similar.

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1. Introduction

Does exchange rate affect money demand? How? Is it real for Economic Community of West African Countries (ECOWAS, hereafter)?

Empirical studies on the analysis of money demand continue to interest contemporary researchers, particularly for its role in the formulation of efficient monetary policies. Indeed, the assessment of the stability of a money demand is based on a well-specified money demand function. Researchers have tried to identify the missing variables in the modelling of the money demand function. In this respect, one of the variables that have received attention, especially for its effects on money demand, is the exchange rate. Originally, Mundell (1963) documented that in addition to income and interest rate, the money demand could also be a function of the exchange rate. Moreover, the literature suggests two channels to explain how exchange rate affects the demand for money. The first channel is referred to as the wealth effect of exchange rate. According to Arango and Nadiri (1981), when the local currency depreciates, the value of foreign assets owned by domestic residents increases in local currency. Hence, this could induce an increase in the demand for money at the domestic level, if this is perceived as an increase in wealth. The other channel is referred to as the expectation effect. In this regard, Bahmani-Oskooee and Poorheydarian (1990) documented that as domestic currency depreciates or foreign currencies appreciate, the public could expect further appreciation of foreign currencies and they could hold more of foreign currency and less of the domestic currency.

In light of this theoretical background, it is suitable to investigate empirically the relationship between money demand and exchange rates in order to inform the debate on this issue, especially for economies engaged in a process of monetary integration, such as ECOWAS. The existing empirical literature on the money demand is huge and varied. Many studies include the exchange rates in the specification of money demand with mixed results. For example, we have Domowitz and Elbadawi (1987) for Sudan, Marquez (1987) for Venezuela, Bahmani-Oskooee and Malixi (1991) for 13 developing countries, McNown and Wallace (1992) for the U.S.A, Harb (2004) for oil-producing countries, Bahmani-Oskooee and Shin (2002) for Korea, Bahmani-Oskooee et al., (2017) for Turkey, Bahmani-Oskooee and Gelan (2019) for African countries, Bahmani-Oskooee et al., (2020) for Albania, and Ho and Saadaoui (2021) for Vietnam.

For the sake of brevity, we restrict ourselves to studies on Africa, focusing on ECOWAS countries. Arize and Shwiff (1998) empirically examined the demand for money for 25 developing countries and found that both the official and black-market exchange rates significantly affect the demand for money for four countries including Ghana. They revealed

that the wealth effect was seen in Ghana as the depreciation of the national currency, both official and black market, led to consistent results. By using panel cointegration approaches, Salisu et al., (2013) estimated the money demand function in Sub-Saharan Africa (SSA, hereafter) including 10 West African countries (Burkina Faso, Cote d'Ivoire, The Gambia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, and Togo). They found a significant long-run negative effect of the exchange rate on the demand for money, establishing that when the exchange rate depreciates, the public may decide to hold more foreign currency and less domestic currency. Bahmani-Oskooee and Gelan (2009) tested the stability of the demand for money in 21 African countries, comprising some West African countries. The particularity of this study is that it uses the nominal effective exchange rate (NEER, hereafter) as well as the real effective exchange rate (REER, hereafter) in the specification of its money demand function. In simple words, the NEER relies on the adjustments of nominal bilateral exchange rates simply by applying weighted trade data of its trading partners. At the opposite, the REER, takes into account of price level (approximated by consumer price indices) differences between trading partners.

In addition, to control for heterogeneity in the different currencies involved, the exchange rate of local currency relative to the US dollar is considered. Despite the fact that money demand is stable in most countries, the exchange rate effect is only confirmed in a few countries. Bahmani-Oskooee and Kones (2014) reached similar results. In order to account for currency substitution, Bahmani-Oskooee and Gelan (2019) investigated the asymmetric effects of exchange rate changes on the demand for money in 18 African countries. Their findings demonstrated that exchange rate changes have short-run asymmetric effects on the demand for money in Burkina- Faso, Burundi, Côte d'Ivoire, Ghana, Senegal, Sierra Leone, and Togo. Evidence of long-run effects have been detected only in Burkina-Faso, Sierra Leone, and Togo. Recently, Asongu et al., (2019) examined money demand in the proposed West African Monetary Union (WAMU). They found that in the short run, the effects of exchange rate changes on money demand are significantly positive for Cabo Verde, Gambia, Ghana and Nigeria, and negative for Liberia and Niger. In the long-run, an increase in the exchange rate has a significant and positive effect on the demand for money in the Gambia and Ghana only.

Of the contributions mentioned above, very few focused primarily on the effects of exchange rates on the money demand for ECOWAS. Since the early 2000s, ECOWAS countries have shared the project of creating a single currency by 2020 and have implemented mechanisms and reforms to accelerate the monetary integration process in the zone. In this

context, this study aims to provide the necessary tools for the design of future monetary policy in the ECOWAS region.

The objective of this paper is to analyse the effects of exchange rates on the money demand for ECOWAS region. The relevance of this study lies on the fact that money demand plays a critical role in the formulation and implementation of monetary policy. Our contributions to the existing literature are threefold: first, we build an ECOWAS specific model based on panel data; second, we derive the related error correction mechanism; third, we estimate the model using both the pooled mean group (PMG) and mean group (MG). The use of these techniques allows us to take into account the country-specific heterogeneity issue. Although there is a large body of literature that investigates the effects of exchange rate on the money demand, far less is known about this relationship in ECOWAS countries.

The remainder of the paper is organized as follows: Section 2 presents the model and econometric methodology, empirical results are reported and discussed in Section 3. In Section 4, a further assessment is provided. Section 5 concludes the paper.

2. Model and Econometric Methodology

2.1. Model Specification

The point of departure of our empirical strategy consists in a specification of the money demand function as follows:

$$M_{it} = \delta_0 + \delta_1 EX_{it} + \delta_2 GDP_{it} + \delta_3 \pi_{it} + \varepsilon_{it} \quad (1)$$

where M is the real money demand, EX the effective exchange rate, GDP refers to the real income, π the inflation rate-price level, and country and time are designed by the indices i and t, respectively, and ε_{it} is the normally distributed residual term. The study covers the period 1986 to 2020 dictated by the data availability of the sample countries. The expected sign of the different covariates and further information about data are given in Table 1. All variables in Equation (1) are expressed in log form.

Table 1. Summary statistics of variables

Variables	M	RER	NER	GDP	π
Descriptive Statistics					
Mean	22.169	4.666	4.853	22.727	4.177
Median	22.622	4.605	4.607	22.569	4.396
Maximum	25.960	5.708	9.808	26.944	6.303
Minimum	17.161	4.034	3.077	19.312	-1.382
Std. Dev.	2.089	0.227	0.868	1.566	1.078
Skewness	-0.714	1.205	2.781	0.587	-2.217
Kurtosis	2.712	5.280	12.389	3.364	9.574
Jarque-Bera	37.153	192.530	2084.208	26.414	1100.453
Probability	0.000	0.000	0.000	0.000	0.000
Observations	420	420	420	420	420

Indicator	Broad money (current LCU)/GDP deflator	Real effective exchange rate (CPI-based) 65 number of trading partners	Nominal effective exchange rate (CPI-based) 65 number of trading partners	GDP (constant 2015 US$)	Inflation, average consumer prices, index
Sources	WDI	Darvas, Zsolt (2021)	Darvas, Zsolt (2021)	WDI	IMF

List of 12 ECOWAS countries considered

Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, Gambia, Ghana, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.

2.2. Econometric Methodology

In general, studies in panel time-series involve problems of non-stationarity and an inappropriate assumption of the homogeneity of the slope coefficients. In order to deal with these issues, the current study adopts the autoregressive distributed lag (ARDL) dynamic heterogeneous panel cointegration test proposed by Pesaran et al. (1997, 1999). This approach allow us to assess long-run and short-run effects of exchange change rates on money demand. The dynamic heterogeneous panel ARDL model of the money demand function is specified in the following panel error correction model:

$$\Delta M_{it} = \theta_i + \sum_{j=1}^{p-1} \hat{\delta}'_{ij} \Delta M_{i,t-j} + \sum_{j=0}^{q-1} \hat{\delta}_{1ij} \Delta EX_{i,t-j} + \sum_{j=0}^{q-1} \hat{\delta}_{2ij} \Delta GDP_{i,t-j} + \sum_{j=0}^{q-1} \hat{\delta}_{3ij} \Delta \pi_{i,t-j} + \hat{\vartheta}_i \left(M_{i,t-1} - \hat{\psi}_{1i} EX_{it} - \hat{\psi}_{2i} GDP_{it} - \hat{\psi}_{3i} \pi_{it} \right) + \mu_i + \varepsilon_{it} \quad (2)$$

where Δ is the first difference, $\hat{\vartheta}_i$ refers to the error correction coefficient, $\hat{\psi}$ corresponds to the long-run coefficient, $\hat{\delta}$ is the averaged short-run coefficient, μ_i indicates the group-specific effect.

The mean-group (MG) and pooled mean-group (PMG) estimators related to the model (2) are presented as follow,

$$\hat{\vartheta}_{MG} = \frac{1}{N} \sum_{i=1}^{N} \hat{\vartheta}_i, \hat{\psi}_{MG} = \frac{1}{N} \sum_{i=1}^{N} \hat{\psi}_i, \hat{\delta}_{MG} = \frac{1}{N} \sum_{i=1}^{N} \hat{\delta}_i \quad (3)$$

$$\hat{\vartheta}_{PMG} = \frac{1}{N}\sum_{i=1}^{N}\hat{\vartheta}_i, \hat{\psi}_{PMG} = \frac{1}{N}\sum_{i=1}^{N}\hat{\psi}_i, \forall_i, \hat{\delta}_{PMG} = \frac{1}{N}\sum_{i=1}^{N}\hat{\delta}_i; \quad \forall_i = 1,2,\ldots,N \qquad (4)$$

As previous stated, panel ARDL approach uses two estimators: MG and PMG estimators. The MG estimator (see Pesaran and Smith 1995) is based on the estimation of a time series regression for each individual (here the ECOWAS countries) and the average of the long-run coefficients. The PMG estimator (see Pesaran et al., 1997, 1999), depends on the combination of the pooling of coefficients for the long-term relationships between countries and the average of the individual coefficients for the short-term dynamics. Based on Equation (2), the country *i* steady-state equilibrium can be given such as:

$$\theta_i + \hat{\vartheta}_{MG}\left(M_i - \hat{\psi}_{1_{MG}} EX_i^* - \hat{\psi}_{2_{MG}} GDP_i^* - \hat{\psi}_{3MG}\pi_i^*\right) = 0 \qquad (5)$$

$$\theta_i + \hat{\vartheta}_{PMG}\left(M_i - \hat{\psi}_{1_{PMG}} EX_i^* - \hat{\psi}_{2_{PMG}} GDP_i^* - \hat{\psi}_{3_{PMG}}\pi_i^*\right) = 0 \qquad (6)$$

Given the error correction term $\hat{\vartheta}$ in the model, the money demand function requires a stable long-run relationship between money demand variable and its covariates i.e., exchange rate, real income, and price level. $\hat{\vartheta}$ implies speed of adjustment and it is expected to be significantly negative and different from zero. Conversely, if the coefficients of the cointegrating vector are not statistically different from zero, no conclusion can be drawn about the stability of the long-term relationship between money demand and exchange rates.

3. Empirical Results

Given that we apply a typical dynamic heterogeneous panel data model, the ARDL, it is reasonable to determine the integrated properties of variable used. The ARDL procedure allows variables to have mixed order of integration I(1)/I(0), however, to achieve the adjustment of the variables to a long-run situation, it is important to verify whether the order of integration is at most one. The panel unit root tests adopted for empirical purpose are those of Levin, Lin, and Chu (LLC) (Levin et al., 2002); Im, Pesaran, and Shin (IPS) (Im et al., 2003); the ADF-Fisher chi-square (χ^2); and the PP-Fisher (χ^2) (Maddala and Wu 1999). Table 2 reports the results of the panel unit root tests for the model in levels and first differences including individual intercept and trend specification. Regardless the test applied there is a clear evidence for non-stationarity of money demand, income and price variables in their levels but stationary at their first differences, indicating a unit root property, I(1). However, the tests reveal the stationarity of the two effective exchange rate measures (*REX* and *NEX*) in levels, integrated of order zero I(0). Having proved that the candidate variables have a mixed order of integration

I(1) and I(0)), and that none of the series is integrated of order 2, the panel ARDL approach is appropriate and can be implemented.

Table 2. Tests of unit roots in Panel

	Levin, Lin & Chu t	Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
Level				
M	0.693	2.009	11.197	16.683
REX	-15.904***	-16.654***	351.632***	35.826*
GDP	-1.117	-1.426*	40.173**	25.011
Π	8.9701	6.049	10.063	10.013
NEX	-31.3198	-58.955***	2409.47***	615.62***
First difference				
M	-9.1327***	-9.785***	144.53***	253.697***
REX	2.350	-3.824***	69.750***	305.143***
GDP	-4.109***	-7.900***	120.508***	207.256***
Π	-3.699***	-4.775***	100.238***	101.008***
NEX	303.749	-7.997***	107.820***	787.142***

Notes: Levin, Lin & Chu test: H_0 = Unit root (assumes common unit root process) and for the three other panel unit root tests: H_0 = Unit root (assumes individual unit root process). Exogenous variables: Individual effects, individual linear trends; Automatic lag length selection based on AIC; Newey-West automatic bandwidth selection and Bartlett kernel. *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels; Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

We estimate Equation 2 using both the PMG and MG estimators and then we subject the findings from these estimators on the Hausman test to discriminate the more efficient model allowing consistent results. Table 3 shows the outcomes based on these two estimators and the Hausman test. The absence of rejection of the null hypothesis suggests that the PMG estimator is adopted while rejection indicates that the preferred estimator will be MG. In other words, the PMG estimator is the efficient estimator under the null hypothesis while the MG estimator is the efficient estimator under the alternative hypothesis. The Hausman distributed chi-square is 0.27 with prob>χ^2 = 0.965 impliying that the PMG is the best efficient estimator than MG for modelling money demand for ECOWAS countries; the comparison of the PMG results with those of MG shows that the imposition of long-term homogeneity reduces the standard errors of the long-term coefficients. In other words, the countries in the sample can be grouped together to obtain common long-term slope coefficients. The PMG estimates demonstrated the following results. For the coefficients associated to the short run dynamics, we observe that R*EX* (-0.166) and *GDP* (0.322) are statistically significant, respectively, at the 1 and 5 percent levels. Moreover, the estimated error correction term (ECT), or adjustment coefficient equal to -0.126, is negative and statistically significant at the 5% level. This result suggests that there are short-run deviations in the relationships, converging to a dynamic long-run relationship between money demand, real effective exchange rate, real income and price level. These values imply that the rate of adjustment towards long-term equilibrium is about 12% in 1 year.

Concerning the long run dynamics, coefficients of *REX* (0.793) and *GDP* (2.204) are both positive and strongly significant at 1 percent level. The findings point out that price level π is not significant in any regression.

Table 3 Effect of the real effective exchange rate on the money demand, Panel ARDL estimates

ARDL (*p=1, q=1*)	PMG estimates			MG estimates		
	Coef.	Std. Err.	*t*-ratio	Coef.	Std. Err.	*t*-ratio
Long-run coefficients						
REX	0.793***	0.126	6.290	0.598	0.775	0.770
GDP	2.204***	0.074	29.700	1.881***	0.544	3.460
Π	-0.012	0.071	-0.170	0.260	0.469	0.560
Error correction coefficients						
EC	-0.126**	0.053	-2.380	-0.361***	0.047	-7.710
Short-run coefficients						
ΔREX	-0.166***	0.057	-2.900	-0.161	0.105	-1.530
ΔGDP	0.322**	0.149	2.160	0.229	0.181	1.260
$\Delta\pi$	-0.196	0.139	-1.410	0.119	0.245	0.480
Constant	-3.744**	1.676	-2.230	-7.641**	3.052	-2.500
Number of observation	420			420		
Number of countries	12			12		
Hausman's test						
Chi2	0.27					
Prob.>Chi2	0.9650					

***Notes*:** *, **, and ***, respectively, indicate the significance at 10%, 5%, and 1% levels; the estimated ARDL is of order (1, 1, 1, 1). and the order of variable is is *M* (money demand), *REX* (real effective exchange rate), *GDP* (real gross domestic product), and π (price level). Hausman test H_0: PMG is efficient than MG estimation

Focusing on the principal goal of this work (that is the effects of exchange rate on the demand for money). The fact that the real effective exchange rate carry significant coefficients support evidence of currency substitution. The negative estimates suggest that depreciation of the local currencies raises the demand for money, supporting that the wealth effect dominates the expectation effect in ECOWAS countries over the short-term. This is reflected by the fact that domestic residents demand more money to achieve a higher level of transaction (i.e. the motive for the transaction). In other words, an increase in the value of foreign money leads domestic residents to increase their consumption. On the other hand, the positive estimates support the view that the expectation effect outweighs the wealth effect in the long-run for ECOWAS countries. This means that depreciation effectively reduces the demand for money because of the expectation of further depreciation. Domestic residents would hold more foreign currencies and less local currencies.

In search of robustness, we estimate currency substitution by using the nominal effective exchange rate with the panel ARDL-MG as privileged upon the Hausman test. In Table 4, the results obtained with nominal exchange rate are consistent with those based on the real effective exchange rate.

Table 4. Effect of the nominal effective exchange rate on the money demand, Panel ARDL estimates

ARDL (*p=1, q=1*)	PMG estimates			MG estimates		
	Coef.	Std. Err.	*t*-ratio	Coef.	Std. Err.	*t*-ratio
Long-run coefficients						
NEX	1.088***	0.225	4.840	1.554**	0.741	2.100
GDP	1.548***	0.114	13.600	1.705***	0.531	3.210
Π	1.007***	0.225	4.460	0.265	0.398	0.660
Error correction coefficients						
EC	-0.130***	0.044	-2.930	-0.352***	0.049	-7.200
Short-run coefficients						
ΔNEX	-0.233***	0.057	-4.090	-0.148**	0.064	-2.320
ΔGDP	0.269*	0.154	1.750	0.264	0.193	1.370
$\Delta\pi$	-0.331**	0.162	-2.040	-0.085	0.297	-0.290
Constant	-2.724***	0.940	-2.900	-6.619**	3.017	-2.190
Number of observation	420			420		
Number of countries	12			12		
Hausman's test						
Chi2	51.35					
Prob.>Chi2	0.000					

Notes: *, **, and ***, respectively, indicate the significance at 10%, 5%, and 1% levels; the estimated ARDL is of order (1, 1, 1, 1). and the order of variable is *M* (money demand), *NEX* (nominal effective exchange rate), *GDP* (real gross domestic product), and π (price level). Hausman test H_0: PMG is efficient than MG estimation

4. A Further Assessment

The above estimates focused on the index of (real and nominal) effective exchange rates, which is used to determine the appreciation or depreciation of the home currency against the basket of currencies of trading partners. In addition to the issue of substitution, convertibility between home currencies to foreign currency also matter. The degree of convertibility for a country' currency to foreign currency differs from others. For that purpose, we use the exchange rate of local currency relative to the U.S. dollar (OEX) to control for the effects of different currencies in our model. Properties and other information of OEX are reported in Appendix

(Table A.1). In Table 5, the Hausman test' result is in favour of the panel MG specification (Column [2]). The short run estimates show that coefficient of OEX (0.123) is positive and significant at 5 percent level meanwhile the long run estimate (-0.661) is negative and significant at 1 percent level. The ECT coefficient (-0.408) is negative and statistically significant at 1 percent level. These findings call for some comments. First, contrary to REX and NEX estimates, the case of OEX indicates that the wealth effect dominates the expectation effect over the long-run and the expectation effect outweighs the wealth effect in the short-run. Second, although the currency substitution takes place, the convertibility between national currencies to US dollar is also important.

Furthermore, the results for each country from the MG estimation are listed in columns [3] - [12]. We find that ECT coefficients are negative and statistically significant for 10 countries. Accordingly, it appears that when a shock occurs in West African region, Senegal is the first to restore its long-term equilibrium, while Nigeria is be the last. In the short-run, we detect a positive and significant effect of OEX only in Benin, Senegal and Sierra Leone. Meanwhile, the long-run estimates reveal that OEX exerts a negative and significant effect in Benin, Cote d'Ivoire, Niger, Senegal and Togo. The positive and significant effect of exchange rate occurs only for Ghana.

To sum up, our results support evidence of currency substitution in the ECOWAS region. However, the occurrence of the expectation or the wealth effect in short/long run is conditioned by the exchange rate between the local currency and the foreign currency under consideration.

Table 5. Effect of the official exchange rate on the money demand, Panel ARDL estimates

ARDL (p=1,q=1)	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
	PMG	MG	Benin	Burkina-Faso	Cote d'Ivoire	Cabo Verbe	Ghana	Gambia	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
Long-run coefficients														
OEX	0.655***	-0.661***	-1.065***	-0.439	-1.228***	-0.848	0.541***	-0.528	0.101	-0.975*	0.405	-0.410***	-2.051	-1.439***
	(0.170)	(0.221)	(0.357)	(0.822)	(0.252)	(1.029)	(0.178)	(1.092)	(0.208)	(0.499)	(0.321)	(0.098)	(1.414)	(0.305)
GDP	0.251*	1.904***	1.627***	2.251**	2.456***	-0.896	0.243*	6.565*	1.628***	2.016***	1.894***	2.113***	1.483***	1.464***
	(0.137)	(0.503)	(0.407)	(1.004)	(0.258)	(1.705)	(0.147)	(3.850	(0.316)	(0.476)	(0.380)	(0.123)	(0.288)	(0.379)
Π	-0.383**	0.306	0.068	-0.869	-0.094	4.560	-0.256	-1.443	-0.613	-0.090	-0.505	-0.045	1.995	0.957*
	(0.188)	(0.462)	(0.519)	(2.226)	(0.283)	(3.196)	(0.199)	(1.710)	(0.618)	(0.901)	(0.324)	(0.223)	(1.395)	(0.504)
Error correction coefficients														
EC	-0.057	-0.408***	-0.352***	-0.192	-0.494***	-0.177	-0.737***	-0.284*	-0.568***	-0.391***	-0.280**	-0.759***	-0.303**	-0.362***
	(0.058)	(0.055)	(0.093)	(0.127)	(0.139)	(0.131)	(0.188)	(0.156)	(0.193)	(0.146)	(0.156)	(0.185)	(0.142)	(0.116)
Short-run coefficients														
ΔOEX	0.063*	0.123**	0.358**	-0.011	0.051	-0.050	0.009	0.084	0.058	0.228	-0.088	0.202*	0.481**	0.160
	(0.036)	(0.049)	(0.171)	(0.202)	(0.171)	(0.186)	(0.151)	(0.387)	(0.162)	(0.294)	(0.102)	(0.118)	(0.210)	(0.169)
ΔGDP	0.648	0.204	1.137	0.031	-0.265	0.584**	1.003	-0.996	0.227	0.189	-0.914	0.729	0.332	0.396
	(0.178)	(0.193)	(0.729)	(0.894)	(0.529)	(0.252)	(0.900)	(1.051)	(0.589)	(1.081)	(0.754)	(0.598)	(0.276)	(0.360)
Δπ	-0.334***	0.014	0.212	0.635	1.856**	-1.189*	-0.555**	0.821	-0.238	-0.422	-0.567**	-0.026	-0.597**	0.244
	(0.140)	(0.234)	(0.398)	(0.662)	(0.716)	(0.657)	(0.249)	(1.178)	(0.413)	(0.721)	(0.249)	(0.329)	(0.265)	(0.468)
constant	0.901**	-6.681**	-2.712	-4.070	-13.349***	4.114**	10.606***	-30.856*	-6.979**	-6.519	-6.759	-17.329***	-4.761**	-1.566
	(0.858)	(3.027)	(3.119)	(4.089)	(3.936)	(2.094)	(3.390)	(16.747)	(3.527)	(4.487)	(4.860)	(4.512)	(2.343)	(2.870)
No. Countries	12	12												
No. Observations	408	408												
Log likelihood	324.2657													
Hausman's test														
Chi2	36.65													
Prob.>Chi2	0.000													

***Notes*:** Standard errors in parentheses. *, **, and ***, respectively, indicate the significance at 10%, 5%, and 1% levels; the estimated ARDL is of order (1, 1, 1, 1). and the order of variable is *M* (money demand), O*EXR* (Official exchange rate, national currency per US$), *GDP* (real gross domestic product), and π (price level). Hausman test H_0: PMG is efficient than MG estimation. PMG [Pooled Mean-Group estimator] constrains the long-run coefficient vector to be equal across panels while allowing for group-specific short-run and adjustment coefficients. MG [Mean-Group estimator] fits parameters as averages of the N individual group regressions. Countries listed results [3]-[14] are from MG estimates.

5. Final Remarks

Since the pioneering conjecture of Mundell (1963), one of the variables that has received increased attention in the specification of money demand is the exchange rate. Changes in the exchange rate influence the money demand in one direction or the other because of the wealth effect and the expectation effect.

This paper tests the currency substitution by investigating the effects of exchange rate changes on the demand for money in 12 ECOWAS countries over the period 1986 to 2020. We apply a panel ARDL approach to achieve the main objective of this study. Our empirical results reveal that the real effective exchange rate has positive long-run effects on the demand for money in ECOWAS, suggesting that the expectation effect dominates the wealth effect whereby domestic residents would hold more foreign currencies and less local currencies. Alternatively, real effective exchange rate is negative in the short-run implying that the wealth effect dominates the expectation effect whereby domestic residents demand more money to achieve a higher level of transaction. When we use nominal effective exchange rate as alternative of real exchange rate, our results remain consistent with those obtained from real effective exchange rate. The outcomes of this study could be helpful to improve the understanding of the relationship between monetary policy and exchange policy in a perspective of monetary integration for ECOWAS countries.

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APPENDIX

Table A.1. Descriptive statistics and Panel unit root for Official exchange rate (OEX, Local currency per US dollar)

Descriptive Statistics	
Mean	4.512
Median	5.706
Maximum	6.596
Minimum	-4.72
Std. Dev.	2.541
Skewness	-1.535
Kurtosis	4.629
Jarque-Bera	211.345
Probability	0.000
Observations	420

Panel Unit Root Test		
Test	**Level**	**First difference**
Levin, Lin & Chu t	-7.09127***	-8.69175***
Im, Pesaran and Shin W-stat	-11.3739***	-12.6190***
ADF - Fisher Chi-square	164.501***	172.990***
PP - Fisher Chi-square	37.6019**	182.233***

Notes: variable OEX comes from WDI database and is expressed in logarithm form. Levin, Lin & Chu test: H_0 = Unit root (assumes common unit root process) and for the three other panel unit root tests: H_0 = Unit root (assumes individual unit root process). Exogenous variables: Individual effects, individual linear trends; Automatic lag length selection based on AIC; Newey-West automatic bandwidth selection and Bartlett kernel. *, **, and *** respectively indicate the significance at 10%, 5%, and 1% levels; Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.