Currency substitution monetary model in Algeria -An empirical analysis-

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Abstract:

The article attempts to investigate the estimation of Equilibrium exchange rate in Algeria during period (1995-2020), using the Currency substitution Monetary Model, by applied the Bounds Test of ARDL co-integration model, The Unit Root Testing (ADF) conceded the integration of the variables at (0) order and (1), We estimate the selected model an ARDL(1,0,1,3) and it long-run; short-term relationships, The results shows the long-run relationships with Exchange rate is adjusted towards the equilibrium within four (4) years. In short-term there are Current and Future effect of monetary supply difference gap, and no effect by GDP gap on the exchange rate, also; the result shows the superiority of the monetary effect against the reel effect on the equilibrium exchange rate in Algeria.

Keywords: Currency substitution, Monetary Models, Equilibrium exchange rate, ARDL method, Algerian dinar.

I- Introduction:

There are various theories and models of exchange rate determination; it's applicable to the estimation of the rate of exchange of currencies, This theory of exchange rate determination was introduced in the middle of the last century, It's based on stock models that derived from the IS/LM/Phillip Curve model, that goods prices are sticky; asset markets including the foreign exchange markets are persistently in equilibrium with long-run money neutrality.

Since that time many models (and their modifications) have been developed, that the Economists have tried without success to capture the fundamentals that led to fluctuating exchange rates. Of the many theories that evolved are Purchasing Power Parity (PPP), Interest rate parity (IRP), Fisher's effect and the Monetary approach to the determination of exchange rates, It's based on different economic and monetary variables in the open market macroeconomics. Good markets; money markets; labour markets; foreign exchange markets; domestic bonds (no-money assets) markets; and foreign bonds markets.

The monetary models asserts that exchange rates are the relative prices of assets, determined in organized markets where prices can adjust instantaneously, this is the principal rule of this models, But the exact details vary from one monetary model to another, in our study we will focus on the currency substitution model.

Views about the optimal degree of currency substitution cover a very wide spectrum. They range from the idea that some countries should completely give up issuing their own money and adopt a foreign currency ("full dollarization"), to the notion that every effort should be made to induce the use of the domestic currency.

This paper attempts to investigate estimate the equilibrium exchange rate in Algeria from period 1995-2020 by testing the Currency substitution monetary model, using bounds test of ARDL co-integration test and its diagnosis tests.

1. Literature Review

Mundell's conjecture in 1963 that the demand for money could depend on the exchange rate in addition to income and interest rate has received some attention in the literature by including the official exchange rate and estimating the money demand function in a few developed countries. In less developed countries, since there is a black market for foreign exchange (Bahmani-Oskooee & Tanku, 2006, pp. 249-263).

Currency substitution, in which foreign monies substitute for domestic money in its roles, medium of exchange, unit of account and a store of value, makes execution of monetary and fiscal policy extremely difficult (Adom, Sharma , & Morshed, 2006, p. 3).

The Currency substitution model aims to demonstrate how the substitution between domestic and foreign currencies money balances in the assets portfolio (private, official) affects the determination of the exchange rate, so that the higher of substitution score between domestic and foreign currencies the higher the exchange rate volatility in response to changes in underlying economic variables (Elwakil, 2006, pp. 346-356).

(Calvo & Végh, 1992, pp. 1-54) discusses, whether currency substitution should be encouraged or not; and, how the presence of currency substitution affects the choice of nominal anchors in inflation stabilization programs; and , the effects of changes in the rate of growth of the money supply on the real exchange rate; and, the interaction between inflationary finance and currency substitution; and, finally, issues related to the empirical verification of the currency substitution hypothesis.

(Fischer, 2016, pp. 214-236) Present an empirical strategy for determining global currency bloc equilibrium. by a nested logit estimation of the combined determinants of currency regime and anchor currency choice; and testing for a welfare-maximizing regime decision, in which estimates of the relative welfare of alternative regimes are inferred from the results of the first step estimation; and taking the path dependency of regime choice into account, a currency bloc equilibrium is derived. In equilibrium.

(Bahmani-Oskooee & Tanku, 2006, pp. 249-263) It was suggested that the black market exchange rate rather than the official rate should be the determinant of LDCs' demand for money. This proposal is tested by estimating the demand for money in 25 LDCs using a border test approach to integration. The main conclusion is that while the black market price in some LDCs is in the formulation of demand for money, in some other countries the official rate is the determining factor. The black market premium also played a role in some countries.

(Boyko, 2002, pp. 1-52) In him research, based and modified monetary models of exchange rate determination with flexible and sticky prices were tested for Ukraine for the period September 1996- September 2001. As empirical tests show, the error-correction model (ECM) for the basic monetary model does not fit well to Ukrainian data, while the ECM for the modified monetary model better explains behavior of the exchange rate in Ukraine. The results also support flexible price version of the model and indicate the significant role of dollarization for exchange rate stability.

(Doguwa, 2014, pp. 1-23) Examined the existence, causes and effects of currency substitution in Nigeria by estimating conventional money demand equations based on a partial adjustment and an ARDL models using three definitions of monetary aggregates. The money demand estimations reveal that short-term foreign interest rates significantly affect the demand for the currency, suggesting strong evidence of currency substitution and the possibility of importing considerable instability in the economy.

(Zhang , Lowinger , & Tang, 2007, pp. 397-406) Examine the monetary model of exchange rate determination for the US dollar exchange rates against the currencies of Canada, Japan, and the United Kingdom. by utilize the co-integration methodology for testing long-run relationship, and VECM model for short-run dynamics and out-of sample forecasting. The existence of co-integration supports the long-run relationship among nominal exchange rate and a number of fundamental variables, that the monetary model of exchange rate determination is a reliable tool for policy makers to evaluate their currency.

2. History of Exchange rate in Algeria:

1878 to November 1942: The Algerian franc was linked to the French franc, where the franc was converted into dollar and pound sterling.

6 December 1944 until 1964 : after which the franc was returned to the franc area and the Algerian franc was linked to the French franc (Reinhart & Rogoff, 2004, p. 54).

1962-1963, Algeria was assigned to the franc area, which is characterized by two exchange rules; Control of exchange, foreign trade liberalization and capital movement.

1974-1986: The value of the dinar was determined on the basis of a basket of fourteen (14) currencies including the United States dollar. (Hamidat, 2005, pp. 157-158).

1986-1991: the Algerian dinar experienced a rapid decline. This year of 1991, the dinar lost three quarters (3/4) of its value. (Bentabet & Ziad, p. 5).

1987-1992; The gradual crawly is intended to adjust the exchange rate by gradually and orderly devaluing the dinar. This phase continued from the end of 1987 to September 1992 (Boukhari, 2010, p. 299).

1988-1989: the exchange rate of dinars against the dollar moved from 5.9 at the end of 1988 to 7.6 in 1989 at a decrease of 28.81% (latrache , 2013, pp. 394-396)

September 1991: Algeria applied an explicit reduction by 22% to 22.5 Algerian dinars per dollar.

March 1994: The exchange rate of the dinar was stable, but before the conclusion of the new agreement with the International Monetary Fund (IMF) there was a slight adjustment of only 10% (Belazzouz, 2006, p. 218)

10 April 1994: new agreement with IMF on 10/04/1994 and without prior announcement of a slight adjustment to the exchange rate, 10% was no longer conducive to the Monetary and Loan Board's decision of 10/04/1994 of 40.17%. (Boukhari, 2010, p. 298):

After 10 April 1994: Due to the imbalances in the value of the dinar, the Bank of Algeria has adopted a new strategy for pricing the dinar according to a floating regime directed from the stabilization sessions to the possibility of transferring the dinar through the interbank exchange market.

28 September 1994: The Installation sessions Through the issuance of instruction No. 61-94, which introduced the stabilization regime with a view to determining the dinar's value for foreign currency by allocating a tender code to commercial banks. (Mokrani, 2008, p. 62).

23 December 1995: instruction No. 95-08, which includes the establishment of an interbank exchange market to sell and buy convertible foreign currencies against Algerian dinars on a free basis among all commercial banks including the Central Bank and financial institutions (Berberi, 2011, pp. 214-215)

1995-2002: The real real exchange rate was 20% higher between 1995 and 1998, while the real exchange rate fell 13% between 1998 and 2001. In the second half of 2003, the Central Bank restored the real exchange rate to the level of 79.683 dinars per dollar at the end of 2002 (Boukhari, 2010, p. 299).

Through its intervention, the Bank of Algeria adjusts periodically the nominal exchange rate so as to achieve its real exchange rate target. In practice, the central bank holds the Counter part of most transactions on the foreign exchange market, as a result of the combination of three factors (Koranchelian, 2005, p. 5)

- hydrocarbon exports account for more than 95 percent of total exports;
- by law, the foreign exchange receipts from hydrocarbon exports have to be converted into dinars directly at the central bank
- capital account transactions are subject to strict controls.

3. Model specification and Data

According to this consideration, the basic monetary model expand by adding the currency substitution variable when determining the exchange rate, and the currency substitution variable has a greater effect on the exchange rate in the event of a change in the future growth expectations of the monetary variables (Elwakil, 2006, pp. 346-356).

The equilibrium exchange rate shall be given in accordance with the currency substitution model, as follows: (Elwakil, 2006, pp. 346-356).

$$\nabla e = \alpha_0 + \alpha_1\left(m - m^*\right) + \alpha_2\left(y - y^*\right) + \alpha_3\left(\nabla m - \nabla m^*\right) + 2\alpha_4 \nabla e + \mu$$

or

$$e = \alpha_0 + \alpha_1\left(m - m^*\right) + \alpha_2\left(y - y^*\right) + \left(\alpha_3 + \alpha_4\right)\left(\nabla m - \nabla m^*\right) + \mu$$

e : The official exchange rate

m, m^* : Logaritm of domestic and foreign money supply

y, y^* : Logaritm of domestic and foreign gdp

- Official exchange rate: refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

- money supply (Broad money): is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits

of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.

- GDP at purchaser's prices: is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Table (1): Descriptive statistics

	e	*m*	*y*	*dm*
Mean	81.61864	-5.093888	-4.836189	0.023453
Median	75.25979	-4.967874	-4.771145	0.019697
Maximum	126.7768	-4.528553	-4.353476	0.330130
Minimum	54.74893	-5.825556	-5.288301	-0.250802
Std. Dev.	20.13044	0.414548	0.316459	0.125447

4. Econometrics Methodology

In this section, by applying the above methodologies, we derive four time series, official exchange rate, money supply, GDP, money supply difference.

The long-term estimation process may make false regression if variables are not stationary in the sense of convergence of the behavior of variables without causation between them, to avoid this, we use co-integration model, which also allows the long-term relationship to be studies and applies this on non-stationary time series but integrated a same degree.

In addition to addressing, the problem of false regression, the famous models used, is the Engel-Granger model, Johanson and Juselius Model, ARDL model of Pesaran.

An ARDL is a least squares regression containing lags of the dependent and explanatory Variables. ARDLs are usually denoted with the notation $ARDL(p, q_1, ..., q_k)$, where p the number of lags of the dependent variable is, q_1 is the number of lags of the first explanatory variable, and q_k is the number of lags of the kth explanatory variable.

An ARDL model may be written as:

$$y_t = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-1} + \sum_{i=1}^{k} \sum_{i=0}^{q_j} X_{j,t-i}{}' \beta_{j,i} + \varepsilon_t$$

Some of the explanatory variables, X_j, may have no lagged terms in the model $(q_j = 0)$.

These variables are called static or fixed regressors. Explanatory variables with at least one lagged term are called dynamic regressors.

Bounds Testing

Using the co-integrating relationship form in previous Equation, (Pesaran, Shin, & Smith, 2001, pp. 289-326) describe a methodology for testing whether the ARDL model contains a level (or long-run) relationship between the independent variable and the regressors.

The Bounds test procedure transform into the following representation:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{i=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-i}{}' \beta_{j,i}^* - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}{}' \delta_j + \varepsilon_t$$

The test for the existence of level relationships is then simply a test of

$$\rho = 0$$

$$\delta_1 = \delta_1 = ... = \delta_k = 0$$

5. Empirical results

Unit Root Testing: Augmented Dickey-Fuller test can help avoid false results through stationary tests of times series. Our results represented in table 2, we accept the null hypothesis in the level for official exchange rate, money supply, GDP, and reject it from all

Variables in first difference that this three time series signifies integration at order 1, and series of money supply difference stationary in level.

Table (2):Unit Root Test Results (ADF)

Null Hypothesis: the variable has a unit root				
variables	**At Level**		**At First Difference**	
	τ_{cal}	***Prob.***	τ_{cal}	***Prob.***
e	2.9613	0.9985	-3.0577	**0.0038**
m	-1.0501	0.2568	-3.7474	**0.0006**
y	-0.4823	0.4966	-3.7921	**0.0006**
dm	-3.7474	**0.0006**	-6.8183	**0.0000**
(***) Significant at the 1%				

Bounds Testing: The objective is to verify that there is co-integration between our variables or not, the result of Bounds Test draw in the table (3), that we reject the Null Hypothesis (No long-run relationships exist), as long-run relationships exist between variables.

Table (3): ARDL Bounds Test

Test Statistic	**Value**	**k**
F-statistic	17.90839	3
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66

To estimate the relationship in the short and long term we specified the model, the next output gives a summary of the settings used during estimation. Here we see that automatic selection (using the Akaike Information Criterion), the procedure has selected an ARDL(1,0,1,3) model, one lag of the dependent variable (official exchange rate), gdp, three (3) lags for money supply difference and 0 lag for money supply, we use with a maximum of 4 lags of the dependent variable and 3 lags of the regressors. Out of the 256 models evaluated.

Table (4): Model Selection Criteria Table

Model	LogL	**AIC***	BIC	HQ	Adj. R-sq	Specification
249	**-40.916653**	**4.537878**	**4.984213**	**4.643021**	**0.988797**	**ARDL(1, 0, 1, 3)**
245	-40.677370	4.607034	5.102962	4.723859	0.988124	ARDL(1, 0, 2, 3)
233	-40.755875	4.614170	5.110099	4.730996	0.988039	ARDL(1, 1, 1, 3)

Findings of co-integration test is given in Table 5,

Table (5): Long Run Coefficients

Dependent Variable: ***e***				
Variable	***Coefficient***	***S E***	***t-Statistic***	***Prob.***
m	58.202888	23.740419	2.451637	0.0291
y	-70.176067	27.279792	-2.572456	0.0232
dm	-315.999135	48.605904	-6.501250	0.0000
constant	62.659459	34.788287	1.801165	0.0949
diagnostic testing				
Q-stat	***JB***	***Breusch-Godfrey***	***ARCH***	***Ramsey RESET***
0.303	*0.85*	*0.24*	*0.62*	*0.59*

Through the short Run Coefficients estimation we Extract the Error correction equation like:

$$\text{Cointeq} = \text{e} - (58.203m - 70.18y - 316\text{d}m + 62.66)$$

Table 6 exhibits the results of short Run Coefficients relationship test:

Table (6): short Run Coefficients

Dependent Variable: ***e***				
Variable	***Coefficient***	***S E***	***t-Statistic***	***Prob.***
d(m)	12.635432	6.464476	1.954595	0.0725
d(y)	-29.049575	4.669385	-6.221285	**0.0000**
d(dm)	-27.475855	5.300538	-5.183598	**0.0002**
d(dm(-1))	23.847464	5.370648	4.440333	**0.0007**
d(dm(-2))	12.801622	3.653539	3.503896	**0.0039**
cointeq(-1)	-0.217093	0.020748	-10.463091	**0.0000**
test				
test	***Adj R-squared***	***Durbin-Watson***	***F-statistic***	***Log likelihood***
value	*0.8736*	*2.13*	*19.15*	*-40.92*

6. Analyze and Discussions:

Since the result of bounds test shows a no existence of long-run relationship between exchange rate and its determinants based on bound testing approach permits us to estimate long- and short run models.

Through the results of the short-term and long-term estimation of ARDL model, the error correction coefficient has a negative and significant, this result supports the long-term equilibrium relationship between exchange rate and its explanatory variables, The coefficient value reflects the speed of adjustment to move from short-term imbalances to long-term equilibrium.

Since the value of the error correction coefficient was -.2171. Exchange rate is adjusted to the equilibrium value during one period (year) by 21.71%, meaning that; if the level of dinar deviates from the short-term equilibrium (t-1) from the long-term, it is 21.71%, which needs to be adjusted entirely within four (4) years and six months by the substitution currency method.

The results of model estimate in short-term showed that the current gdp gap (t) is significant and negative signal, so that gdp gap has a negative impact on exchange rate, according to the results, with the 1% degree of gdp gap in the (t), the change of exchange rate are 29.05% In the reverse direction, the money supply difference coefficient was significant with a negative signal in (t) period and positive signal in (t-1), (t-2) periods. That the money supply difference is restart's.

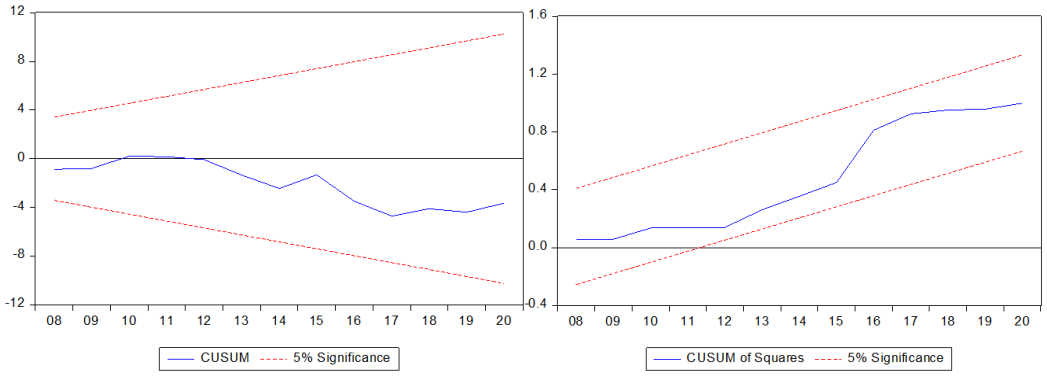
The money supply coefficient was no significant. That no effect by it, this result shows the superiority of the monetary effect against the reel effect.

The Adjusted determination Coefficient was 0.8736. it indicates the high quality of explanation, so that the explanatory variables interpreted Exchange Rate at 87.36%, which is a high degree of explanation, as Fisher's statistics show the overall statistical significant of the model's coefficient, and there are not autocorrelation between errors, "Durbin-Watson" if it statistic is 2.13 and is within the field of no autocorrelation errors.

Jarque-Bera's statistic confirms that errors are normal distributed, the statistical probability is 0.85 which is greater than 0.05, and errors are not related in k's degree. that is proven by Breusch-Godfrey's statistic, which is 0.24 greater than 0.05, and ARCH's statistic showed Heteroskedasticity of variance, which is 0.62 greater than 0.05.

In addition the function form is correct, that the probability value of Ramsey RESET's statistic is 0.59 and is greater than 0.05, also; The graphs of Cosum and Cosum of Squares indicate the realization of a structural stability, where the graphic curve of these two tests fell within critical boundaries at a 5% signification level, its meaning that the coefficients are structurally stable during the period (Figure 1).

Figure (1): COSUM and COSUM of Squares graphs



Conclusion

The currency substitution phenomenon raises many interesting and difficult problems, both from a monetary policy and analytical perspectives, Therefore, many contributions emerged in the form of approaches and models to study currency behavior under this hypothesis, since the Currency substitution, in which foreign monies substitute for domestic money in its roles, medium of exchange, unit of account and a store of value.

This paper has estimate and analyzed the Currency substitution monetary model in Algeria during period 1995-2020, by applying co-integration method. This method are more general than the econometric methods based on non-stationary series, where the long-term estimation process may make false regression if variables are not stationary in the sense of convergence of the behavior of variables without causation between them.

To avoid this problem, we use co-integration model, which also allows the long-term relationship to be studies and applies this on non-stationary time series but integrated a same degree, the method has the basic steps resume in Unit Root Testing, Bounds Testing, long-term and short-run relationship between variable, and the diagnostic tests.

The connection between economic fundamentals and exchange rate behavior has also been controversial. Many studies have failed to find a statistical link between real exchange rates and fundamentals, our result shows a no effect of gross domestic product, on the exchange rate At least 5% significance level.

The result shows the superiority of the monetary effect against the reel effect, that Interbank market its no margin limits are imposed on the buying and selling exchange rates in the interbank foreign exchange market. As of December 31, 2019, nineteen (19) banks had been license to engage in banking operations, including foreign exchange transactions; they therefore participate in the interbank foreign exchange market.

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