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Optimum Exchange rate and Economic Growth in Sudan

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Abstract

This paper targets the Sudanese pound's optimum exchange rate value against the US dollar. Threshold regression is the key method for evaluating a sample duration over the period 1960-2017 for four variables, which are the real GDP (Y), the exchange rate (X) as threshold variable, two non-threshold variables labor force, and investment, which serves as a proxy for capital stock. Results point to a positive sign of the threshold variable up to the value of 2456, then a negative one above that value. This means that the exchange rate can have a beneficial impact on economic growth up to that value. As postulated, the signs of the non-threshold variables are positive. Compared with investment, the influence of the labor force is greater, indicating the superiority of the labor-intensive principle. The threshold value is in the 2005 year, which corresponds to the best shape of Kaldor square with a growth rate of 6 percent, inflation rate of 8 percent, a budget deficit to GDP ratio of (-2) percent, and a balance of payment to GDP ratio of (-1). Human capital and technology modernization must have priority. Government initiatives should strive and make every effort to lift the value of the Sudanese pound (SDG) to the threshold, that can be fostered by the accumulation of gold reserves. Particular focus on the growth rate, inflation rate, budget deficit, and balance of payments ratios to GDP. It is important to revise foreign policy to comply with economic policies.

Key Words: economic growth, exchange rate, optimum value, threshold.

1. Introduction

The exchange rate has been investigated from different perspectives of which is the preference of the exchange rate system that depends on the option between any two of capital movements, the autonomous monetary policy, and the exchange rate policy (Bańbuła, Koziński, & Rubaszek 2009; Daly 2007)). Furthermore, whether shocks are nominal or real (Calvo & Mishkin 2003); relationship to economic growth (Chetwin and Munro 2013, Razzaque et.al. (2017); the optimal currency area (Horvath

& Komarek 2002), Mongelle 2002), Ozkan 2008), and the optimum exchange rate (Korkmaz 2013).

One year after the independence in 1956, an IMF technical team helped Sudan to set the Sudanese pound's exchange rate at a fixed rate of $2.83 to 1 Sudanese pound (SDG). The fixed regime has been prevailing since September 1978. Sudan has endured a significant fall in the Sudanese pound (SDG) against the US dollar over the last four decades because of frequent devaluations from 0.35 in September 1978, to 120,000 in September 2020 i.e. a devaluation of 34285614%. The beliefs behind these major devaluations are that maintaining a high exchange rate leads to a slowdown by weakening economic growth as making exports more costly, thus less demand for exports, cheaper imports, and therefore less demand for domestically manufactured goods, this ultimately reduces the aggregate demand. Any effort to hold interest high increases investment costs, and thus adversely affects economic growth. Thus, devaluation i.e. a decrease in the exchange rate value can trigger economic growth. A lower exchange rate makes exports cheaper and more competitive, imports become more costly i.e. lower volumes, thereby increasing the current account. This will result in increased demand, which will speed up economic growth. Exchange rate management is considered a major policy priority for achieving several objectives, including fostering economic development, inflation, stabilization, and preserving export competitiveness. The current account, and therefore the balance of payments has sunk into deficits, no indication of j-curve has appeared, and constant budget deficit fueled inflation (Arabi & Abdalla 2014). Sudan joined the Common Market for Eastern and Southern Africa (COMESA) in 1994, the question of optimum currency area could therefore be addressed.

Many Sudanese scholars have researched the issue of exchange rates extensively, none of the studies has chosen to estimate an optimum exchange rate, as far as I know, they are mainly targeting the measurement of the impact of the exchange rate (Hassan 2016, Ismael 2017, Abugroon 2018, Mohamed et.al 2019). In addition to the persistence of devaluation to keep pace with the informal market prices. Therefore, the objective of this paper is to find out whether there is an optimum value of the exchange rate, and answer the following questions:

does Parity in Purchasing Power hold? Does the selection of the exchange regime influence economic growth?

Significant research findings would provide policymakers with an exchange-rate threshold value that enables them to establish goals that at least include Kaldor's Magic Square i.e. growth rate, inflation rate, unemployment rate, and the balance of payments ratio to GDP; then develop effective economic policy. By doing so, this research will contribute to bridging the gap of not deciding an optimum exchange rate value of previous studies.

The introduction is the first section of this paper followed by section two which reviews the empirical literature on the subject, section three briefly displays the key theories, section four presents the methodology and data, section five displays findings and discussions, and finally, section six concludes.

2. Literature Review

This section presents a multi-threshold model, an empirical analysis on the selection of exchange regime optimum currency area (OCA), analytical studies, and the contributions of Sudanese scholars studying the relationship between exchange rate and the balance of payments and its components. Finally, dissertations and thesis are briefly discussed.

Chong et.al. (2014) regressed weight average growth rates of nominal exchange rate, discount rate differential, and reserves on bilateral growth rates of the exchange rate, differential interest rate, and foreign exchange reserves of the US with a trade partner as non-threshold variables. The thresholds were fiscal deficit and real exchange rate.

Horvath and Komarek (2002) opened the debate on the optimum number of countries in the currency union via regression analysis examining the convergence of the Czech Republic with Germany, Portugal, and Greece. The standard deviation of the bilateral exchange rate explained by four independent variables i.e. standard deviation of real output, the absolute sum of the share of agriculture, minerals, and manufacturing in merchandise trade, size of export ratio to domestic GDP, and GDP in US dollar. Results indicate convergence to Germany took the first place. Mongelle (2002) has divided the European Monetary Union (EMU) period into four phases. The groundbreaking debate during 1960-1970 opened debate on borders' costs and benefits, factor mobility, diversification, openness, and inflation. This phase was influenced by weighting the properties. Then the reconciliation phase during the 1970s

strengthened properties and weights. But the issue of inconclusiveness has not been resolved. The third phased during the 1980s was the interest in the monetary union and single currency in terms of models and time. The fourth phase of empiric was examining the properties in great detail. Ozkan (2008) measured the relative distance between Turkey and EMU using the Fuzzy clustering-mean about Maastricht criterion i.e. nominal and real convergences. The optimal number of clusters is four or five. His outcomes show that the Fuzzy criterion is superior to the Maastricht criterion. Ogawa and Kawasaki (2008) state that oca prevents and manage future currency crisis in light of the optimum size of the region, exchange rate regimes, movement of countries toward monetary union in East Asia.

Daly (2007) investigated the reasons behind the selection of the 17 Middle East and North African (MENA) countries for their exchange rate using Probit. She discovered that a high level of per capita income is an indication of the option of a fixed regime, in addition to foreign reserves. Chetwin and Munro (2013) deliberated the mixture of the exchange rate, monetary policy, and capital account policies for New Zealand. Dao and Nga (2020) investigated the influence of exchange rate regimes on economic growth in 46 Asian countries, explained by trade openness, government spending, and education by way of the Generalized Method of Moments to conclude that the weak flexible exchange regime is successful in both directions.

Hassan (2016) has researched the implications of the Sudanese monetary and fiscal policies over the last thirty years via the error correction model (ECM) and simultaneous equations. His findings demonstrate the policy's ineffectiveness and the flaws of the program. Besides, the expected sign is as anticipated except for foreign reserves. Ismael (2017) investigated the impact of the exchange rate on the inflation rate through simple linear regression over the period 2005 – 2015. The finding was the existence of a positive exchange rate relationship with the inflation rate. The impact has been exacerbated by the halt of oil proceeds due to the independence of South Sudan. Abugroon (2018) scrutinized the problems caused by the exchange movement on macroeconomic variables through a descriptive and ECM. The exchange rate leads to an increase in money supply, a contraction in economic growth, an improvement in the balance of trade, and an unexpected reduction in inflation. Shogar (2019) used the technique of autoregressive disturbed lag (ARDL), measured the short-ran and the long-run impact of the exchange rate discovering a positive relationship between the exchange rate and GDP, and the inflation rate while detecting an inverse relation was with foreign reserves, exports, and

South Sudan's secession. Mohamed, Jamaleldeen, and Abbakar (2019) employing ARDL assessed the effect of GDP, the inflation rate, the exchange rate, and the external debt on the balance of payments detecting an adverse influence of the inflation rate and the exchange rate, as well as positive GDP and external debt effects.
The influence of the exchange rate on the foreign sector was the favorite subject to the postgraduate students while nine of the 14 studies were MSc thesis. The studies are categorized according to the effect of the exchange rate on the current account (Musa 2005, Amani 2005, Idrees 2011, Ruaa 2012, Rasha 2015); the balance of payments (Mohamed 2002, Ibtisam 2003, Mamoon 2005, Ahmed 2009, Salma 2013, Habbab 2015); foreign direct investment (Hytham 2007); and the Sudanese economy (Manal 2004).

All the empiric studies and dissertations mentioned above were aimed at measuring the effect of the exchange rate, nobody tried to estimate an optimum exchange rate value that could stimulate economic growth, and therefore this research would concentrate on estimating an optimum exchange rate value.

3. Theoretical Background

Under the gold standard era the amount of gold in the coin was that really counted, and then, in the next stage paper money backed by gold assumed a fixed exchange rate with little value. The exchange rate became more substantial after countries abandoned the gold standard, and resorted to the floating rate, thereby serves as a relative price. It relates to GDP utilizing exports and imports i.e. the current account that generates supply and demand for foreign currency, or more generally records of the balance of payments (Roland 2007). The acquisition of foreign assets or selling off domestic goods abroad point toward indirectly that there is a shift in the foreign currency market (Chapter 12). The current account arises from the interactions between savings and investment, economic growth and trade openness, prices and the exchange rates, fiscal and monetary policy, in short, the relationship between the domestic economy and the foreign market (Mann 2002). The state of the current account whether surplus or deficit influences the exchange rate, and reacts to the changes. The floating Exchange rate system equalizes the current account deficit to capital account surplus, whereas, under the fixed system the relationship between the trade balance and the net foreign asset acting a key role in determining the changing aspects of the exchange rate in a variety of exchange rate models (Roland 2007).

The Purchasing Power Parity (PPP) is the first principle that we have to turn to determine if the exchange rate is overvalued or undervalued, where the exchange rate applies to the prices in two countries taking into account zero shipping costs, zero currency transaction costs, and no trade barriers or quotas. Absolute PPP postulates that the exchange rate is the ratio of home prices to foreign prices (Roland 2007). However, the disparity in the two countries' inflation rates changes the exchange rate as postulated by the relative theory (Pavlos & Virginie 2008). The real exchange is defined as the quotient of home prices relative to foreign prices, but the nominal and real exchange rates shift proportionally in the short-run (Floyd 2010). The test of PPP is performed by simple regression as the exchange rate is a function of a constant and two countries' relative inflation minus one, assuming that the constant equal zero and the slope is one if either of the two coefficients does not satisfy this condition the PPP does not hold. The efficient market PPP count on the arbitrage of capital account assuming perfect capital mobility, where the real exchange rate is calculated by the uncovered parity of interest (Roland 2007). However, the covered interest rate parity replaces the spot for forward rate and offers an estimation of potential exchange activities (Dictionary of Finance and Banking 4 ed.).

International Fisher Effect (IFE) theory assumes an equivalent forward rate and expected spot rate, due to the comparability of the actions of the market participants. Thus, this does not cover the forward exchange rate market risk. The test of IFE is executed by simple regression as the exchange rate is a function of a constant and two countries' relative interest rates minus one by assuming that the constant equal zero and the slope is one if either of the two coefficients does not satisfy this condition the IFE does not hold.

The j-curve denotes a shift in a country's balance of trade often after a currency devaluation or depreciation, while the consumption of imports decreases after some time due to their costly nature, exports instead become cheaper which induces the demand for them and therefore improves the balance of trade given that both exports and imports are elastic (Roland 2007, Leon and Mussurov 2019).

Horvath and Komarek (2002) present Mundell (1961) views on OCA that based on the fixed exchange rate, internal factor mobility, and external immobility, absorption of shocks by elastic wage, labor movement, and taxes to tackle fiscal transfers problems. The costs are joint control of monetary policy, doubts about fiscal policy individuality, loss of printing money (seignorage), and welfare gain. The long-run gain of one currency

remunerations is higher trade integration and operational resource allocation. They identified the features as the degree of labor freedom of movement, the system of fiscal transfers, the extent of trade, the resemblance of shockwaves, and business cycles. Generally, the selection of the exchange rate regime has to consider various basic features of the country, its tactical policy ends, and timing. Usually, the most deliberate characteristics are factor movement, size and openness of the country, diversity of the production structure and employee expertise, budget mechanisms, price and wage stickiness, financial system, and the asymmetry of the shocks.

The monetary policy ties the economic growth to the exchange rate by using the monetary instruments at the disposal of the central bank to influence the volatility of the nominal exchange rate. The effect depends on the type of regime that has been chosen. Generally, the nominal exchange rate is often volatile in the floating regime compared to the fixed regime (Ghosh 2003).

Cobb-Douglas production function relates the aggregate output to the production factors that is capital input and labor input, also the quality factor total productivity factor, which represents the state of technology as well as the level of skills and education of the labor force (Cottrell 2019).

4. Methodology and Data

The analysis covers the period 1960 – 2017 issued by the Central Statistics Bureau- Sudan with the following variables: real gross domestic product (Y), economic growth rate (GR), a nominal exchange rate (X), development spending ration to GDP (DVR), trade openness (OPN), total investment (INV), and labor force (Labor) in thousands. Real effective exchange rate (REER), and world inflation rate (WINF) are collected from World Bank, school attainment (SCH) Barrow tables.

The discrete Threshold Regression (TR) describes the basic type of nonlinear regression that occurs when an observed variable crosses an unknown threshold. The dependent variable only shifts until it exceeds the reaction threshold by the calculated behavior of the independent variables and by the terms of error (Hurlin 2018). The model is as follows:

$$y_t = \alpha + \beta_0' x_t + \beta_1' x_t h(q_t; \theta) + \varepsilon_t \quad (1)$$

Where β_0 and β_1 are $K \times 1$ vectors is $\boldsymbol{q_t}$ is a threshold variable, $\boldsymbol{\theta}$ is a vector of parameters and $h(q_t; \theta)$ is a transition function if it is binary then:

$$h(q_t; c) = \begin{cases} 1 \text{ if } q_t \geq c \\ 0 \text{ if } q_t < c \end{cases} \quad (2)$$

$$y_t = \begin{cases} \alpha + (\beta_0' + \beta_1')x_t + \varepsilon_t \text{ if } q_t \geq c \\ \alpha + \beta_0' x_t + \varepsilon_t \text{ if } q_t < c \end{cases} \quad (3)$$

When we have two regimes for the slope parameters (β_0 and $\beta_0 + \beta_1$) we use the following logistic transition function:

$$h(q_t; \gamma, c) = \frac{1}{1 + \exp(-\gamma(q_t; c))'}; \ \gamma > 0 \ (4)$$

The proposed model includes the real gross domestic product (Y) as the dependent variable explained by total investment (INV) as a proxy to the capital stock, and labor force (Labor). The nominal exchange rate (X) is the threshold variable. Notably, the model variable was selected in light of the Cob-Douglas production function.

5. Results and Discussion

5.1 Empirical Results

Variables Characteristics

In applied research, the use of unit root tests to differentiate between trend and difference stationary data has become an important method. Applying unit root with Break tests to the model variables discloses that the dependent variable Y is integrated of order one i.e. I(1) with a breakpoint in 1995 when the inflation rate peaked 129%, the nominal exchange rate X has one unit root I(1) with a breakpoint in 2010, INV conceals one unit root I(1) with a breakpoint in 2011 subsequent the South Sudan separation, the Labor series is stationary I(0) with a breakpoint reflecting the peak of unemployment rate in 2014.

The Cointegration test makes known that there are two cointegrating equations which mean the model variables have a long-run relationship.

Following Dao and Nga (2020) vector error correction model bring forth the long-run estimates as:

GR(-1)=46.43*d1(-1)***+176*OPN(-1)***-5.72*DVR(-1)***-21*sch(-1)***

Thus, the selection of the exchange regime substantially affects (GR) as expressed by the dummy variable (D1), which is zero for a fixed exchange regime, and 1 for the floating regime.

Applying tests provided by Roland (2007), below is the outcome of simple regression to test the PPP hypothesis:

LOG(X) = 0.268*** + 0.934*LOG(CPI/WCPI)*** + [MA(1)=0.764]***

REER = 100.326 (Prob. 0.000) + 2.985*RINF (Prob. 0.15), so Wald statistics rejects the hypothesis of PPP (F-statistic = 75.0.3***).

Discrete Threshold regression (TR) estimated the exchange rate value that divides real output series into three regions, the first embodies the positive effect, as opposed to the second and third, revealing adverse effect as follows:

Variable	Regime I	Regime II	Regime III
X	2.085505***	-3.63903**	-16.1679***
C	2687.154**	15882.47**	78778.3***
Observations	X < 2456 = 43	2456 <= X < 4754=10	4754 <= X=5
Non-Threshold Variables			
INV	0.000313***		
LABOR	0.4150575***		
R^2	0.983	Durban-Watson	1.977

***,**,* suggests the rejection of the null hypothesis at 0.01, 0.05, and 0.10.

The statistical and econometric tests disclose the significance of all estimated parameters with the anticipated signs, the goodness of fit with R^2 explains 98% of the dependent variable variation and lack of autocorrelation with Durban-Watson statistic about 2. The results of the first regime have a positive impact, that the exchange rate value less than 2456 will stimulate growth. The second and third regimes point toward an adverse effect when the exchange rage values cross the threshold set by the first regime. The effects of the constant term, the exchange rate in the third regime are five times a second. Turning to the non-threshold variables labor is far more influential than the capital stock, suggesting the superiority of labor-intensive doctrine. Figure (1) in the Annex indicates how similar the simulated values are to the actual values.

5.2 Discussion

Empirical findings reject the PPP hypothesis in Sudan due to its restrictive assumptions of perfect capital mobility and zero transportation costs. The shift to a managed floating exchange rate in 1978 has a positive effect on economic growth. The Threshold regression set the optimum value of the exchange rate to 2456, which corresponds to the 2005 year that witnessed the ratification of the peace treaty with the People Liberation Army to end the twenty-year civil war. The 2005 year perceived the best performance of the economy with a growth rate of (6) percent, low inflation of (8) percent, the budget deficit to GDP ratio of (-2) percent, and bop to GDP ratio of (-1) percent. Defenders of exchange rate devaluation based their argument on the impact of exchange rate on exports and imports, the trade balance follows a j-curve trend and therefore has a positive effect on the demand real production, but the results contradict this fallacy, there is no presence at all in the j-curve (Arabi & Abdalla, 2014). At the same time, there is a pass-through indirect impact on real production by consumer prices and end consumption (Arabi, 2015). Historically, the exchange rate is much influential than the interest rate (Arabi 2020). The central bank has frequently changed foreign exchange policy concerning restrictions on opening a current account, special account, account of foreign investors, use of foreign exchange in the current account, transfer of remittance, savings and investment, payment mode for imports. Subsequently, the central bank has mostly used the required reserve ratio, the internal liquidity limit, the discount rate, and Islamic bonds. The fiscal policies triggered by a persistent budget deficit funded largely by borrowing from the central bank i.e. printing money, feeding inflation, gradually depreciating the exchange rate, and slowing economic growth. Thus, the validity of this research is to question the proponents of repeated devaluations by setting a threshold value that involves the appreciation of SDG back to that value. The analytical technique is superior to the techniques used by previous studies in reasonably identifying a value that separates positive and negative regimes. Compared to the studies reviewed one thing they have in common is the restricted data scope with a maximum of 39 years, this research covers 58 years. One of the problems confronted by the research is the lack of reliable and up-to-date capital stock data, the solution being to use aggregate investment as a proxy. The technique often has different values according to the specification of the model. To improve the current account, in turn, stabilize the exchange rate Sudan needs to formalize internal and external policies, impose law and order, rehabilitate infrastructure, reform producers' taxes, tackle inflation, increase jobs and productivity, diversify exports, curb luxurious imports, and raise the investment climate to attract foreign direct investment.

6. Conclusion

Sudan introduced a fixed exchange rate from independence in 1956 to September 1978 and has since switched to the managed floating exchange rate system. The vector error correction technique verified the effect of regime choice, whereas the era of managed floating rate witnessed more economic growth than the fixed one. PPP's regression findings contradict its applicability in the context of Sudan's economy. The core objective of this paper was to find the optimum value of the exchange rate which fosters economic growth. The related analytical method was the Threshold regression which brings forth fair results showing that 2456 is the optimum value of the exchange rate. Economic policy must be reversed from devaluation to the appreciation of SDG back to the threshold value. Reduction of unemployment rate particularly among graduates is important; improving the investment climate is vital for foreign direct investment FDI; sufficient gold reserves will soon assist in the appreciating of the SDG; we recommend further studies on the optimum currency area for the reason that Sudan is a member of COMESA with 20 other countries.

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Appendixes

Annex (1) Coefficients of Variation

	Y	X	INV	LABOR
C.V.	72.18	144.28	222.74	29.85

Annex (2) Results of Threshold Regression of Y, on X, labor, inv

Variable	Coefficient	Std. Error	t-Statistic	Prob.
X < 2456 -- 43 obs				
X	2.845505	0.45163	6.300518	0.0000
C	2687.154	836.6124	3.211947	0.0023
2456 <= X < 4754 -- 10 obs				
X	-3.63903	1.808483	-2.0122	0.0496
C	15882.47	4797.034	3.310893	0.0017
4754 <= X -- 5 obs				
X	-16.1679	1.924843	-8.3996	0.0000
C	78778.3	7898.176	9.974239	0.0000
Non-Threshold Variables				
INV	0.000313	2.80E-05	11.17546	0.000
LABOR	415.0575	90.27003	4.597955	0.000
R-squared	0.983081	Durbin-Watson stat		1.976886

Figure (1) Stability