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Macroeconomic Fluctuations and Deposit Dollarization in Sub-Saharan Africa: Evidence from Panel Data

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Abstract

The role played by macroeconomic fluctuations in stimulating deposit dollarization in developing countries have been a subject of intense debate in the last few decades especially in Latin America and transition economies of Eastern Europe with little attention on African economies. Apart from this, most of the studies on African economies are country case studies with little scope for generalisation. This article examines the effect of macroeconomic fluctuations on deposit dollarization in 18 selected Sub-Saharan Africa for the period 1980 to 2004. Using the standard money demand model accounting for dollarization in small open economies, the article finds that inflation, expectations about exchange rate changes coupled with interaction between capital account restrictions and domestic inflation plays dominant roles in explaining deposit dollarization in Sub-Sahara Africa. Given the consequences of deposit dollarization on the vulnerability of the domestic banking system, lack of independent monetary policy and optimal exchange rate choices, the article concludes that macroeconomic instability must be adequately brought under control in order to reduce deposit dollarization in these economies.

Key Works: *Macroeconomic Fluctuations, Demand for Money, Deposit Dollarization, Panel Data and Sub-Saharan Africa*

JEL: *E31, E41, C21*

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1. Introduction

The role played by macroeconomic fluctuations in stimulating deposit dollarization in developing countries and the effects of the latter for the conduct of monetary policy have been a subject of intense debate in the last few decades especially in Latin America and transition economies of Eastern Europe with little attention on African economies. Apart from this, most of the studies on African economies are country case studies with little scope for generalisation. Following the implementation of Structural Adjustment Programmes (SAP) and subsequent liberalisation of foreign exchange markets, leading to the removal of many foreign exchange restrictions, a number of emerging market economies have moved from fixed to flexible exchange rates. In most African countries, the late 1980s and the early 1990s were characterized by massive depreciation of their currencies as they sought to reduce and/or eliminate the influence of parallel market for foreign exchange that had existed in these countries over the years (Agenor, 2004). More importantly, the policy was designed to move the real exchange rate of currencies closer to equilibrium rate. Also, this policy was adopted in the hope that it would improve the competitiveness of their exports and also boosts non-traditional exports especially manufacturing exports.

One of the major side effects of this policy shift was the use of foreign currency as a means of portfolio diversification option especially in economies where money and capital markets are under developed coupled high and prolonged inflation, and exchange rate volatility (Yinusa, 2008). In this situation, the U.S. dollar, the British pound sterling and/or German mark became means of payments and store value.

The widespread use of foreign currencies, especially since the early 1990s in many emerging economies, has triggered a lot of research in pursuit of the determinants of dollarization (Agénor and Khan 1996; Yinusa and Akinlo, 2008a), of the economic elements that are affected by its development (Berg and Borenzstein 2000, Lange and Sauer 2005), and of explanations of its inertia (Clements and Schwartz 1993, Kamin and Ericsson 1993, Tandon and Wang 1999, 2003; de Freitas 2004). In addition, a recently developed line of work examines the extent to which dollarization is important for the conduct of effective monetary policy (see Reinhart et al. 2003; Yinusa and Akinlo, 2008b).

A notable feature of most of these studies is their focus on the relationship between the rate of inflation and the degree of dollarization. On the one hand, they emphasize the direct effect the average rate of inflation has on dollarization as private agents substitute out of the domestic currency to hedge against the erosion of its value, which intensifies

dollarization. On the other hand, they stress the feedback effect of the degree of dollarization on the inflation rate as the base of the inflation tax shrinks and a financially constrained government monetizes its budget deficit, which, in turn, leads to higher inflation (Chang 1994; Bahmani and Domac 2003; Levy-Yeyati 2004). The interplay between inflation and dollarization is also present in studies that examine the inertia of dollarization. Theoretical explanations of this phenomenon have mainly focused on the transactions costs of inflation involved in switching between two currencies (Guidotti and Rodriguez 1992; Uribe 1997; and de Freitas 2004), while empirically dollarization hysteresis has been accounted for by means of “ratchet effects”.

On the policy making side, dollarization has attracted a lot of attention with regard to its influence in the design and transmission of monetary policy. Although the earlier literature expressed the concern that dollarization, by raising the volatility of money demand, may impede the ability of the central bank to conduct monetary policy and reduce inflation, recent work by Reinhart et al. (2003) and Havrylyshyn and Beedies (2003) find no empirical evidence in favour of this hypothesis.

Most of these studies focused on Latin American countries where the phenomenon has become very pronounced. But in the recent past, the phenomenon of dollarization has become intense in virtually all developing countries especially African countries without much attention. Therefore, the focus of this study is to document key determinants of deposit dollarization in 18 Sub-Saharan African Countries for which data is available. This study is important because region-specific factors driving dollarization can be identified which provides the basis for comparative analysis of the determinants of dollarization in Africa with its determinants in other continents. Also, elaborate studies on the determinants of dollarization beyond country-specific studies in Africa have been lacking. This study is an attempt to fill the gap.

The remaining part of the paper is structured as follows: section 2 traces the evolution of dollarization in selected African countries while section 3 presents literature review. Section 4 contains the methodology and section 5 presents empirical results of the model. Sections 6 contain policy implications of results while section 7 concludes.

2. Evolution of Deposit Dollarization in Selected African Countries

The evolution of deposit dollarization in selected African countries is presented in this section. This is to give us an idea about the extent and the dynamics of its behaviour over

time and space. In Botswana for example, deposit dollarization has been on the increase as from 1998 and reached its peak in 2007. One of the major drivers of this phenomenon was inflation uncertainty exacerbated by exchange rate instability. While the Pula/Rand exchange rate have been stable over the period under review, the Pula/Dollar instability was obvious creating an environment of instability leading to deposit dollarization as asset holders tries to avoid loss of value of their assets due to Pula/Dollar exchange rate instability. On the other hand, the Pula/Pound exchange rate has been relatively more stable but the pula has consistently been depreciating against the British pound sterling (see figure 2). The mono-product and undiversified nature of the economy also increased the vulnerability of the economy. Another perceived structure of the economy is the huge number of foreign nationals who prefer to keep their assets in foreign currency to avoid domestic loss of value due to inflation and exchange rate swings following periodic discrete devaluation of the Pula, i.e. the national currency.

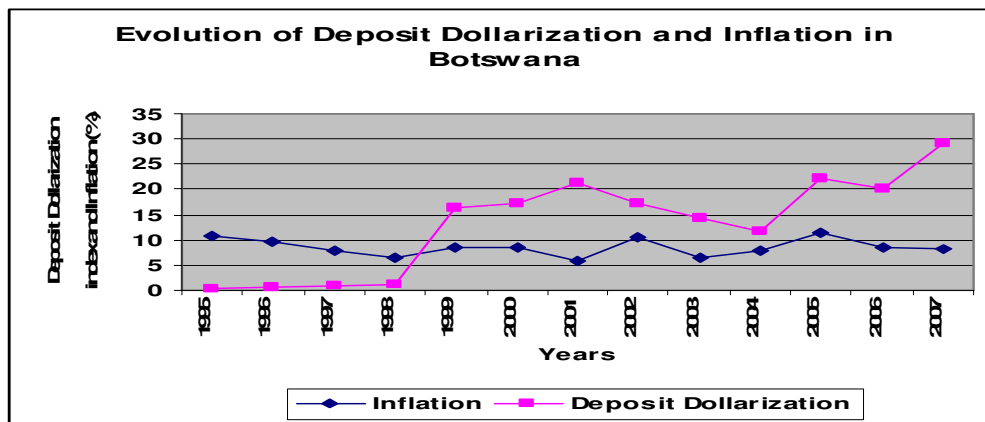


Figure 1: Evolution of Deposit dollarization in Botswana (1995-2007)

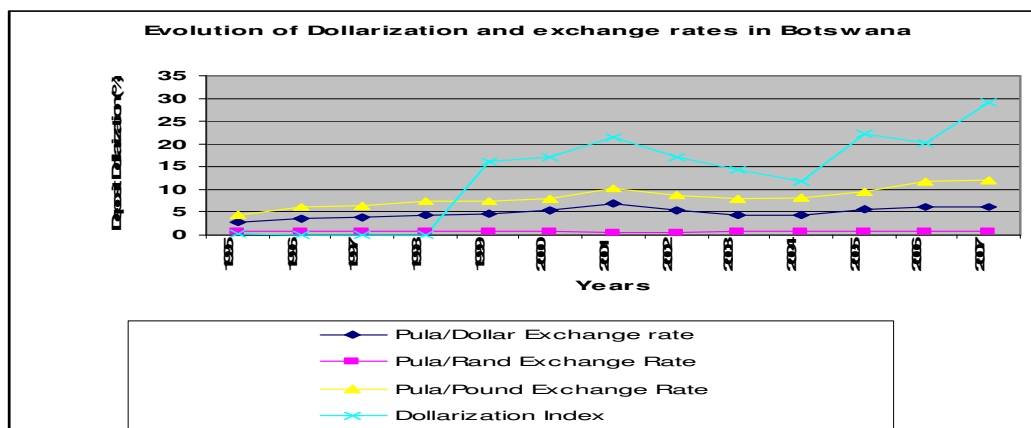


Figure 2: Evolution of Deposit dollarization and Exchange Rates in Botswana (1995-2007)

In Nigeria, the period after the implementation of structural Adjustment Programme (SAP) in 1986 witnessed significant fluctuations in macroeconomic variables which engendered the use of foreign currency as store of value in the domestic banking system. For example, while the institutional framework required to support a deregulated economy was non-existence in 1986, appropriate legal framework, domestic financial instruments, and well-trained bureaucrats for the implementation of the SAP programme were totally absent (Yinusa and Akinlo, 2008a). Aside from this, fiscal indiscipline on the part of the government (Military regime) was at its peak. Hence, the economy was overheated. The main source of the monetary growth was expansionary fiscal operations, financed mainly by the banking system. Fiscal deficits rose from about 8.4 per cent of GDP in 1988 to 11.0 per cent in 1991, but moderated somewhat to 7.2 per cent in 1992 before peaking at 15.5 per cent in 1995. However, fiscal deficit as percentage of GDP has moderated at less than 10 percent since 2000 up to 2006 (see Figure 3).

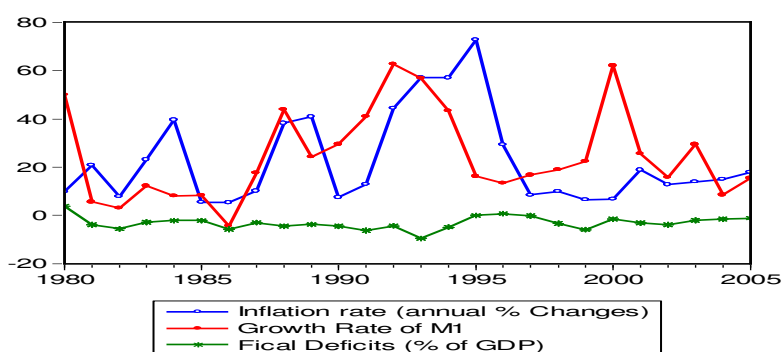


Figure 3: Some Macroeconomic Indicators in Nigeria (1980-2005)

Sequel to these instabilities in the economy, deposit dollarization has been on the increase but generally around 10 percent of broad money after adjusting for domestic currency in circulation.

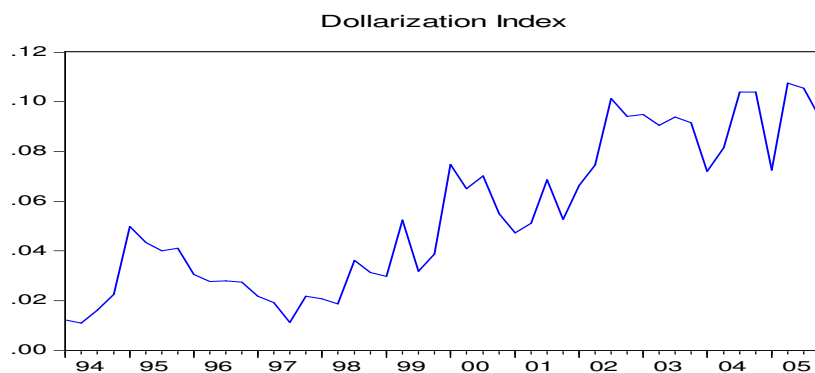


Figure 3: Deposit Dollarization in Nigeria (1994-2005)

Most of the economies in Sub-Saharan Africa displayed similar pattern in terms of deposit dollarization as shown in the Table 1 below:

Table 1: Dollarization Index in Selected African Countries (1992 – 2004)

Year	Countries						
	Angola	Bots	Kenya	Tanzania	Uganda	Malawi	Sudan
1992	-	-	-	-	0.146778	-	0.276000
1993	-	-	-	0.179196	0.127902	-	0.494254
1994	-	-	-	0.211607	0.119407	-	0.454217
1995	0.104497	0.088920	0.097490	0.280649	0.153377	-	0.504014
1996	0.359601	0.100618	0.087987	0.242100	0.137586	0.591890	0.424311
1997	0.577376	0.125868	0.109047	0.260823	0.153440	1.500289	0.435313
1998	0.720895	0.175008	0.112775	0.253141	0.175094	1.027473	0.442672
1999	0.808099	0.159072	0.149161	0.294880	0.219521	1.208839	0.437102
2000	0.834345	0.171876	0.199137	0.302480	0.271000	1.095508	0.405869
2001	0.809553	0.216546	0.201934	0.329007	0.310975	0.871194	0.416153
2002	0.848905	0.170085	0.221097	0.348075	0.272783	0.687986	0.409566
2003	0.731010	0.145289	0.226941	0.363546	0.331592	0.642974	0.378691
2004	-	-	-	-	-	-	-

Source: IFS, IMF, Washington, D.C.

Table 1 reveals that deposit dollarization has been on the increase in most African economies since the early 1990s. However, the phenomenon became manifest in the mid 1990s following the introduction and implementation of Structural Adjustment Programme (SAP) in these economies. For example, while deposit dollarization was just about 9% in Kenya in 1995, it rose to about 14% in 1999 and reached a value of about 23% in 2003. A similar pattern can be observed for Tanzania, Uganda and Sudan. A very conspicuous case is the dollarization episode in Angola. The country had dollarization index of about 10% in 1995, rising to about 80% in 2000 and peaked at about 84% in 2002 before decelerating slightly to about 73% in 2003. All these reveal that dollarization is an issue in Africa and its evolution requires adequate attention than currently given in the literature.

3. Literature Review

Deposit dollarization, defined broadly as the act of switching from holding domestic currency into holding foreign currencies by rational economic agents in bank accounts domiciled in domestic banks. The currency substitution literature has tried to explain why some economies use a foreign currency instead of the domestic currency in their everyday transactions and bank deposits². Basic analytical framework has been the consumer's portfolio selection model where dollarization is determined by the relative rates of returns of domestic currency and foreign currency denominated assets. In some cases the rates of return differentials help to explain dollarization trends (see Balino et.al. 1999). However, in other cases the same model is proved to be less successful in explaining swings in dollarization ratios. For example, Civcir, (2003) reports that in Turkey, real rates of return on domestic currency assets have increased significantly relative to foreign currency assets, but dollarization ratio remained persistently high. This suggests that other variables should be incorporated into these models.

Another branch of literature developed by Ortiz (1983), Ramirez-Rojas (1985), Fasano-Filho (1987), Melvin (1988), Calvo and Vegh (1992) and Salvastore (2001b) has focused on the determinants and characteristics of the currency substitution in developing countries. The nature of the currency substitution in these countries is different from the one analysed by the literature on developed nations. In particular, in the LDCs process tends to be asymmetrical because domestic residents usually hold foreign money in their portfolios but there is no foreign demand for domestic currencies.

Currency substitution in developing countries is usually one of the ultimate consequences of high and variable inflation (Mizen and Pentecost, 1996). High inflation, in turn, is the result of the fiscal imbalances, which leads to dollarization and eventually to currency substitution. Institutional factors play a crucial role in the process of currency substitution. When restriction on holding of foreign currency is removed the dollarization process usually begins with the foreign money substituting domestic money as a store of value. As high inflation continues, some prices -particularly of real estates, cars and other "big ticket" items – start to be quoted in foreign currency. After this, some transactions begin

² The terms currency substitution and dollarization have been used to depict the same phenomenon. However, the term "dollarization" indicates that a foreign currency serves as a unit of account or as a store of value, and not necessarily as a medium of exchange. In high inflation countries, foreign currency is first used as a store of value or unit of account and only at the later used as a medium of exchange. That is, currency substitution is normally the last stage of the dollarization process. More importantly, in practice, data on foreign currency circulating in the economy usually does not exist, dollarization ratios are used as an indicator of currency substitution (see Calvo and Vegh 1992).

to be performed in foreign currency especially those involving large transfer of funds. However, domestic money seems to retain its functions as a unit of account and medium of exchange in almost all nondurable goods (see Calvo and Vegh 1992).

Another strand of literature on currency substitution considers dollarization hysteresis. Works by Dornbush and Reynoso (1989), Guidotti and Rodriguez (1992), Kamin and Ericsson (1993), Clements and Schwartz (1993) shows that several Latin American countries have hysteresis in the dollarization ratios. Hysteresis refers to the fact that dollarization phenomenon have stayed high in the face of declining inflation rates and increased real rates of returns on domestic assets. This phenomenon can not be explained by the traditional currency substitution models which, following Calvo and Rodriguez (1977), assume that foreign assets (non interest bearing) compete with domestic money in providing liquidity services. In these models, ratio of foreign to domestic currency denominated assets depends positively on the nominal interest rates (when the domestic interest rates increase liquidity provided by domestic money decreases and liquidity provided by foreign money increases (see Sahay and Vegh 1996). Therefore, a fall in inflation (i.e. a fall in domestic interest rates) should lower the demand for foreign currency relative to domestic currency.

To explain hysteresis in these models, it is necessary to assume that there are some costs associated with the process of currency substitution which make it irreversible. Dornbusch and Reynoso (1989) and Dornbusch, Sturzenegger and Wolf (1990) argue that process of financial adaptation is costly (due to sunk cost and learning by doing), which makes them irreversible. In a related explanation Guidotti and Rodriguez (1992) assume that it is costly to switch between currencies and show that there is a 'band' for the inflation differential above which dollarization continues to occur even if inflation falls. A similar result is derived by Sturzenegger (1997), who emphasises the public good aspect of currency substitution by assuming it is costly to transact in foreign currency but only to the extent that others have not yet begun to use it. Uribe (1997) also emphasises the relation between private cost of transaction and the aggregate degree of dollarization.

The literature cited above considers currency substitution but not dollarization which is the observable measure of currency substitution. With this observed data dollarization ratio should respond only to differences in real rates of returns between domestic and foreign currency denominated assets (see Sahay and Vegh, 1996). A fall in domestic rate of inflation rate should not affect dollarization ratio unless it affects real rates of returns. Hence, de-dollarization would only result only from the higher real return on domestic currency denominated assets. Conversely, dollarization would be the consequence of very low real

rates of return on domestic currency denominated assets together with the institutional freedom to invest in foreign currency denominated assets at home. In several developing countries, dollarization associated with low real rates of return on domestic currency denominated assets (see Dornbusch and Reynoso, 1989 and Salvatore, 2001b). Civeir (2003) observed that in some countries like Turkey, while real rates of return on the domestic currency denominated financial assets were substantially higher than that of foreign currency assets, the dollarization stayed high. In such cases, real rates of return criterion do not seem to explain the behaviour of the households in the dollarized country. There must be other factors that affect the decision making process by the public. There is an asymmetric substitution process between domestic and foreign currencies, that is, in a dollarized economy the demand for foreign currency rises when the local currency depreciates, but falls by a lesser extent when the local currency appreciates.

Yotopoulos (1997) explains the currency substitution as an asymmetric reputation between hard and soft currencies. Hard currencies have a good reputation of stability, but soft currencies, in contrast, is expected to depreciate in a free currency market since it lacks the reputation of safe haven. Under these circumstances and also when the international financial transactions are present, there is asymmetric demand for domestic residents to hold dollar as a store of value – a demand not offset by Americans' holding of domestic currency as an asset. This asymmetry tends to increase the price of dollar in home country. This encourages dollarization with domestic resident fleeing from domestic currency in exchange for dollar, which causes further depreciations. Expectations of depreciation become self-fulfilling prophecies, in fixed, floating or pegged exchange rate systems.

With the asymmetric reputation still operating, fixed exchange rate had to fend with the tide of domestic currency denominated asset holders in the country who want to hedge their wealth against depreciation of currency by buying dollars. This was done by offsetting this precautionary demand through increasing the supply of speculative short term capital that the banking system borrowed in the international market. There is a causal relationship between dollarization and inflow of hot money in which the latter is lured by high interest rates in an attempt to thwart the former. Asymmetric substitution behaviour of the households can be attributed to cost considerations, once the fixed cost of an investment in new money management techniques are born, the new product or strategy remains in place and is not discarded even though interest rates, inflation or depreciation rates decline. In a high chronicle inflation countries the asymmetric behaviour of the individuals to change (ratchet effect) can be attributed to a costly process of developing, learning, and applying new

strategies to beat inflation or get the highest return on their investment. Such strategies are commonly called financial innovations; inter-alia, rapid switching between demand deposits and saving deposits in domestic currency, the evolution of high yielding or indexed money substitutes, the efficient use of overdrafts, the application of portfolio optimisation methods, and most notably, the flight into foreign currency assets. Over time, an increasing proportion of public resorts to these forms of financial innovations. There are a few incentives for households and enterprises to switch back to domestic currency after the end of instability or when a higher rate of return on the domestic currency is offered. Thus causing a more prolonged -ratchet effect- on the relative demand for foreign and domestic currency. The credibility of the authorities' stabilization effort may shorten or extend the duration of the ratchet effect as well as influence its strength.

Only an expectation of significant decline in inflation or a considerable appreciation of currency or substantial increase in the real rates of return on domestic currency denominated assets can overcome the sunk cost in inflation beating strategies and provide enough incentives for households to eventually revert to traditional domestic money balances.

Oresotu and Mordi (1992), Olomola (1999) Akinlo (2003) and more recently Yinusa and Akinlo (2008b) investigates the existence and determinants of dollarization in Nigeria using the portfolio balance model. The results points to the existence of currency substitution while the major force driving the process was real parallel market exchange rate volatility and the US monetary policy changes.

Elkhafif (2002) uses an error-correction model to examine the dynamics of the currency substitution phenomenon in two Africa's emerging economies: Egypt and South Africa. The study finds a high degree of currency substitution for the Egyptian economy (51%) while the phenomenon was found to be insignificant in South Africa (less than 1% in the early years and about 6% later). Prock, Soydemir and Abugrri (2003), investigated the existence of currency substitution in Argentina, Brazil and Mexico for the period October 1986 and June 2001 using monthly observations within the vector autoregressive framework popularized by Sim (1980). The study found significant presence of currency substitution in Argentina and Brazil. However, they attributed the lack of significant result for currency substitution in Mexico to its credible exchange rate and monetary policy. They argued that Mexico had record of relative financial stability in the recent past. The paper concluded that "policy makers, who wish to adopt another country's currency as a domestic currency, [should] first implement structural reforms to bring their economy in line with the anchor currency country."

Soydan (2003) assessed the implications of currency substitution for the maximization of seigniorage revenue in Turkey following liberalization programme implemented in the economy. The hypothesis of seigniorage maximization was tested using the Cagan (1956) model based on a semi-logarithmic money demand function of inflation and real income adopting cointegration analysis within the framework of Vector Autoregression (VAR). The paper finds that actual inflation (13%) in the Turkish economy was higher than the optimum inflation (11.8%) suggested by the econometric results. Hence, the paper concluded that currency substitution limits the potential of Turkish Central Bank in raising seigniorage revenue and by implication monetary policy through money creation. To this end, an attempt to increase seigniorage revenue may push the economy towards hyperinflationary path thereby generating higher levels of currency substitution in the economy.

Recently, Friedman and Verbetsky (2001) used dynamic money in the utility function model, in which money services are produced both by domestic and foreign money balances to empirically investigate the existence of currency substitution between Russian Rubles and the US dollar and analyzed some implications of dollarization for the Russian economy. Using 2SLS-Generalized Method of Moments (GMM) estimation methodology on the data between 1995 and 2000, the authors estimated the various parameters of their equations for the Russian economy. Based on the estimated parameters, the implications of dollarization were simulated. This was achieved by analyzing the influence of dollarization on seigniorage revenue and welfare. Overall, their result points to a significant presence of currency substitution in Russia while the estimates also indicate a significant welfare loss as a result of dollarization. Also, this study demonstrated quantitatively that dollarization might limit the ability of domestic central banks in using inflationary policy for stabilization purposes since “dollarization may have a large negative effects on the revenue from seigniorage” (Friedman and Verbetsky, 2001; p.23). This means that with dollarization, the potency of domestic monetary policy in achieving stability in the dollarized economy may be seriously impaired. In terms of welfare effects of dollarization/de-dollarization, their result indicates that welfare may suffer negatively following de-dollarization efforts unless certain precautions are taking. According to the authors, inflation stabilization (less than or equal to 1% per month) must first be the priority before attempting de-dollarization policies. The value of this welfare loss was estimated at about 1-2 percent of GDP, which is comparable with actual revenue from seigniorage. They therefore concluded that sufficient macroeconomic stability (in particular price stability) is the surest way to reduce the negative implications of currency substitution.

According to Gruben and McLeod (2004, p.6), dollarization is propelled by “globalization of currency and the banking services.” As such, “making their currencies more competitive” will make dollarizing countries suffer serious price instability. To them, globalization leads to increased capital inflows which serve to increase the domestic money supply beyond that forecasted by monetary authorities when initial policies are being formulated and “inappropriate” Central Bank responses to capital inflow (for whatever reasons), leads to high inflationary spiral which ultimately ignite the process of dollarization. Hence, they seem to agree with the suggestion of inflation stabilization as put forward by Friedman and Verbetsky (2001). The paper concludes that causality runs one-way from dollarization to inflation. This article differs in that we present evidence for Sub-Saharan African countries for which there has not been a cross country study with greater scope for generalisation on the key determinants of dollarization.

4. Methodology

This section briefly describes the methodology adopted in this study to assess the effects of macroeconomic fluctuations on deposit dollarization in Sub-Sahara Africa. In what follows, the empirical model employed in this article, econometric procedure and data and variable measurements are presented.

4.1 Model Specification

Following from standard money demand function in a flexible exchange rate environment the equation estimated is of the form³:

$$DI_{it} = \alpha + \beta_1 i_{it} + \beta_2 i_{it}^* + \beta_3 e_{it}^e + \beta_4 \pi_{it} * CAR + \beta_5 \pi_{it} * (1 - CAR) + \beta_6 y_{it} + \beta_7 ERV_{it} + \beta_8 PR_{it} + u_i + e_{it}. \quad (1)$$

where all variables except interest rates are expressed in logarithms. DI_{it} is dollarization index, i_t the domestic policy interest rate, i_t^* denotes foreign rate of interest, proxy by Federal Funds rate, e_t^e , the expected change in the exchange rate, π_{it} is a measure of domestic inflation computed from price of the domestic consumer’s consumption bundle, CAR is a dummy to capture capital account restriction while (1-CAR) represents absence of

³ To conserve space, no theoretical discussions on the relationship between higher exchange rate variability and currency substitution are presented here. For the same reason, we do not discuss the theoretical effects of domestic interest rate, expected exchange rate, foreign rate of interest, domestic price level and output. A treatment of this issue can be found in Brandson and Henderson (1985), Cuddington (1983), and Mizen and Pentecost (1996).

restrictions in the domestic economy, CAR and (1-CAR) were allowed to interact with domestic inflation. This enables us test the hypothesis that inflation in a closed economy tends to stimulate increased dollarization. y_{it} is the PPP value of domestic output, measured by GDP at PPP values, ERV_t is a measure of exchange rate volatility, PR is political terror scale used as a proxy for political risk factor in the model to explain dollarization and u_t is the error term.

In this paper, exchange rate volatility was extracted via a state-space model (a form of signal to noise extraction) of the form:

$$Z_t = \sigma \varepsilon_t e^{\frac{1}{2}h_t}; \text{-----} iid(0,1) \text{.....} (2)$$

where,

$$h_{t+1} = \lambda h_t + \mu_t \text{-----} NID(0, \sigma_\mu^2) |\lambda| \leq 1 \text{.....} (3)$$

Z_t is the exchange rate. The term σ^2 is a scale factor and subsumes the effect of a constant in the regression of h_t . λ , is a parameter, μ_t is a disturbance term that is uncorrelated with ε_t , ε_t is an $iid(0,1)$ which are random disturbances symmetrically distributed about zero. The h_t equation is a transition equation in autoregressive form where the absolute value of π is less than unity to ensure that the process in equation (2) is stationary (Ndung'u, 2001; Yinusa, 2008). These equations generate the conditional volatility of exchange rate used in equation (1) for estimation purpose.

4.2 Econometric Procedure

This article employed both Pool Ordinary Least Squares (POLS) and Panel Least Squares for a group of 18 Sub-Saharan economies between 1980 and 2004. A serious empirical challenge in the estimation of cross-country regressions concerns how to decide whether to use random or fixed effect model. In other to resolve this dilemma, Hausman (1978) test was employed. The Hausman (1978) test statistic supports fixed effect model. Hence, the pool OLS models were estimated with cross-section effects and corrected for cross-section correlation, period arbitrary serial correlation and time varying variances in the disturbances, and observation specific heteroskedasticity. However, the key assumption made for the OLS is the orthogonality between the error term and regressors. Under conditional homoskedasticity and the assumption that all the regressors are exogenous, OLS is an

efficient Generalised Method of Moments (GMM) estimator. In addition to pooled OLS, panel least squares estimation approach was also employed.

Another major consideration in econometric analysis concerning time series data is the non-stationarity of underlining data. If non-stationarity is not accounted for in the estimation process, it may lead to spurious regression with serious negative consequences for public policy. In this respect, unit root tests within a panel framework was conducted using Im, Pesaran and Shun (1997, 2003), augmented Dickey and Fuller (1979), Phillips and Perron (1988), Levin and Lin (1992, 1993) tests.

The next step involves testing for cointegration among the variables. There are different methods for testing cointegration in panels. The first method takes the null hypothesis of no cointegration and uses residuals derived from the panel regression of Engle and Granger (1987) method. Pedroni (1995, 1997), McCoskey and Kao (1998) panel cointegration tests are based on this method. Another approach is to take the null of cointegration and is the basis of the tests proposed by Harris and Inder (1994), Shin (1994), Leybourne and MacCabe (1994) and Kwiatowski *et. al.* (1992). All the panel data cointegration tests allow for heterogeneity in the cointegrating coefficients. But one drawback related with these tests is that the null and alternative hypotheses imply that either all the relationships are cointegrated or all the relationships are not cointegrated. Except the Fisher (1932) test, there is no allowance for some relationships to be cointegrated and others not. Initially developed panel cointegration tests applied panel unit root tests directly to the residuals from an Engle Granger type two-step methodology. But the recent opinion in the literature suggested that the test statistics using this approach would be biased towards accepting stationarity. Pedroni (1995) shows that applying panel unit root tests directly to regression residuals is inappropriate for several reasons like the lack of exogeneity of the regressors and the dependency of the residuals on the distribution of the estimated coefficients (see Pedroni (1995,1997) for details). For these reasons it is important to have a test procedure for cointegration which is robust to the presence of heterogeneity in the alternative. Since the cointegration test proposed by Pedroni allows for considerable heterogeneity, it is preferred in this study.

4.3 Data, Variable Definition and Measurement

Annual data spanning the period 1980-2004 was used for this study. Dollarization index (DI) is measured as the ratio of FCD and M2. M2 is money supply broadly defined less domestic currency in circulation. We subtracted money in circulation from M2 so as not to

under-estimate the relative weight of foreign currency deposits in the banking system. FCD is foreign currency deposits in domestic banking sector. This is the sum of FCD in commercial and merchant banks in countries where universal banking is not the practice. It is our measure of deposit dollarization from the store of value perspective. π is a measure of domestic inflation, y is a measure of transactions in the economy and possibly accumulation of wealth. Real Gross Domestic Product (GDP) was used to measure this variable. i is the treasury bill rate. This is used as a measure of opportunity cost of holding money and an alternative wealth allocation to money holdings. i^* is a measure of return on foreign money proxy by Federal Funds rate plus expected exchange rate depreciation. This is measured as bilateral rate of exchange between the various country currencies and US dollar. e^e measures the expected change in exchange rate. The hypothesis that capital account restriction stimulates dollarization was tested by using capital account dummy computed from IMF survey on features of exchange arrangements and regulatory frameworks for current and capital transactions in member countries, various years. Dummy takes the value 1 when a restriction is in place and 0 otherwise.

Econometric studies on dollarization have used different proxies for expected depreciation of the exchange rate. Ortiz (1983) used the difference between the official and real exchange rate for expected exchange rate depreciation. Cuddington (1983) used the ratio of the difference between forward and spot exchange rate to spot rate as a proxy for expected depreciation of the exchange rate. Ramirez-Rojaz (1985) used the same measure for Mexico, the current differential between inflation rates in Argentina and U.S. for Argentina, and the differential between the domestic interest paid on the deposit denominated domestic currency and the domestic interest paid in foreign currency deposits for Uruguay. Clements and Schwartz (1993) used inflation rate differential between U.S. and Bolivia. Selcuk (1994) used trade weighted real exchange rate index and TL per \$ nominal exchange rate as a proxy for expected depreciation of the exchange rate for Turkey, and Akcay et al (1997) used estimated exchange rate volatility based on the estimation of PPP for Turkey. Boero and Tullio (1996) in their German money demand function used interest rates differential between Germany and U.S. and percentage deviation of the Mark and Dollar rate from PPP to measure the currency substitution. In this paper the expected depreciation is proxied by the actual annual changes in the real exchange rate. This is calculated as the difference between current and one-year-lagged values of the nominal exchange rate between the various currencies and

dollar. The data were sourced mainly from International Financial statistics (various years) supported with data from statistical bulletin from respective countries.

5. Empirical Results

Empirical results from the study are presented here. Unit root tests were conducted followed by panel cointegration tests before the empirical model was estimated.

5.1 Panel Unit Root and Cointegration Results

The panel unit root test results reported in Table 2 of the appendix shows evidence of non-stationarity in levels. According to LLC and IPS test results, the null of non-stationarity is accepted for all the critical values at lag order 4. One of the ways to deal with I (1) variables is to investigate the cointegration relationship between variables.

Table 2: Panel Unit Root Tests

(Individual effects, individual linear trends)													
Variables	Method												
	LLC	P-value	Breitung	P-value	IPS	P-value	ADF	P-value	PP	P-value	Hadri Z-stat	P-value	
di	0	-103.92	0.00	-2.01	0.02	-55.04	0.00	298.79	0.00	337.87	0.00	15.54	0.00
	1	-45.57	0.00	-7.10	0.00	-11.28	0.00	552.79	0.00	985.13	0.00	36.28	0.00
	2	-36.75	0.00	-10.71	0.00	-11.73	0.00	705.46	0.00	3575.66	0.00	45.71	0.00
eexr	0	-123.10	0.00	-6.16	0.00	-40.06	0.00	825.74	0.00	1242.01	0.00	11.97	0.00
	1	-71.97	0.00	-9.33	0.00	-31.99	0.00	1216.98	0.00	5480.57	0.00	13.60	0.00
	2	-16.53	0.00	-11.46	0.00	-23.72	0.00	996.26	0.00	11153.50	0.00	34.37	0.00
erv	0	-16.11	0.00	1.14	0.87	2.83	1.00	451.71	0.00	626.60	0.00	24.54	0.00
	1	-22.81	0.00	-7.29	0.00	-6.05	0.00	697.14	0.00	873.85	0.00	3.82	0.00
	2	-11.98	0.00	-12.27	0.00	-7.56	0.00	1059.80	0.00	5616.17	0.00	9.32	0.00
y	0	2.03	0.98	14.36	1.00	3.73	1.00	150.30	0.86	125.04	1.00	15.38	0.00
	1	-19.27	0.00	-9.33	0.00	-19.37	0.00	672.32	0.00	772.28	0.00	8.88	0.00
	2	-30.74	0.00	-19.36	0.00	-33.32	0.00	1268.39	0.00	6391.62	0.00	26.70	0.00
r	0	-0.20	0.42	-4.55	0.00	-9.47	0.00	369.05	0.00	330.94	0.00	4.24	0.00
	1	-200.70	0.00	-11.97	0.00	-32.63	0.00	848.49	0.00	1434.25	0.00	94.68	0.00
	2	-147.37	0.00	-12.19	0.00	-37.00	0.00	1028.92	0.00	6014.24	0.00	95.97	0.00
usffr	0	-30.19	0.00	-3.02	0.00	-24.94	0.00	869.39	0.00	158.76	0.87	12.04	0.00
	1	-27.31	0.00	-26.03	0.00	-23.14	0.00	803.90	0.00	1045.73	0.00	23.80	0.00
	2	0.13	0.55	-31.21	0.00	-23.70	0.00	836.92	0.00	9263.38	0.00	98.38	0.00
inf	0	24.07	1.00	-0.41	0.34	-20.13	0.00	588.62	0.00	701.05	0.00	9.35	0.00
	1	-988.44	0.00	-8.62	0.00	108.82	0.00	1043.03	0.00	2932.80	0.00	40.39	0.00
	2	-469.51	0.00	-9.64	0.00	-72.90	0.00	1370.00	0.00	9793.99	0.00	46.82	0.00

The Pedroni panel cointegration test was employed. Except for panel variance and panel ADF statistics, all of the panel cointegration test statistics developed by Pedroni rejects the null of no cointegration at 5 percentage significance level (see Table 3). Since there is a cointegration relationship between the variables, the Engle and Granger two-step method can be used. According to Engle and Granger (1987), if the variables are cointegrated, the stable long-run relationship can be estimated by standard least-squares techniques.

Table 3: Pedroni Residual Cointegration Test

Series: DI R USFFR Y PR EEXR INF ERV

Lag selection: Automatic SIC with max lag of 0 to 1

Newey-West bandwidth selection with Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic		Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	0.277527	0.3839	0.050413	0.3984
Panel rho-Statistic	1.794898	0.0797	1.799970	0.0790
Panel PP-Statistic	-5.071379	0.0000	-5.362630	0.0000
Panel ADF-Statistic	-3.392631	0.0013	-3.665363	0.0005

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	2.573689	0.0145
Group PP-Statistic	-6.017267	0.0000
Group ADF-Statistic	-3.870287	0.0002

Null Hypothesis: No cointegration Sample: 1980 2004; Cross-sections included: 18; Included observations: 450.

5.2 Determinants of Dollarization: Pooled OLS-Fixed Effects Results

Table 4 presents the results on the effect of macroeconomic fluctuation on deposit dollarization in selected Sub-Saharan African countries. I present POLS fixed effects (FE) estimation results. Figures in brackets are t-statistics and the * shows the level of significance. Specifically, the model was estimated for the periods 1980-1990, 1991-2000, 2001-2004 and 1980-2004. This allows inter-temporal comparison of effect of macroeconomic fluctuations on dollarization in Africa under different robust estimation techniques.

First three columns of Table 4 contain the results for the full sample (i.e. 1980-2004) and attempts to examine the relative importance of expected exchange rate changes and exchange rate volatility in explaining dollarization in Sub-Saharan Africa. The summary statistics are quite satisfactory with the value of adjusted R-squared ranging between 0.90 and 0.97. This shows that between 90% and 97% of the variation in dollarization is explained by

the identified explanatory variables. The Durbin-Watson statistic shows no evidence of autocorrelation and the f-statistic reveals that the explanatory power of the model is good. Looking at the coefficients of all independent variables, the first three columns of Table 4 shows that all identified explanatory variables are significant determinants of dollarization with expected signs except domestic deposit rate of interest which is insignificant but with expected negative sign. As expected, the last three columns show that high inflation interacting with capital account restriction is positively and significantly related to dollarization in the 1980s while the effect is negative and insignificant in the 1990s and 2000s. For the total sampled period, the overall effect is positive and significant in column one but insignificant for column two and three when expected exchange rate changes was replaced with exchange rate volatility as an alternative measure of uncertainty. This tends to suggest that the effect of high inflation plus capital account restriction was particularly relevant in determining dollarization in the 1980s and seem to dominate its effect post 1980s.

Table 4: Determinants of Dollarization in Sub-Sahara Africa (1980-2004).

Estimation Technique:	POLS: Cross-section Fixed Effects-White period					
Dependent Variable: Dollarization Index (DI)	1980-2004	1980-2004	1980-2004	1980-1990	1991-2000	2001-2004
Constant	-3.19* (-2.29)	0.21 (1.35)	-0.43 (-0.30)	-4.16* (-4.79)	4.48* (2.21)	-2.82* (-3.70)
Deposit Rate of Interest (r %)	-0.20 (-0.36)	-0.20 (-0.46)	-0.26 (-0.36)	-0.49 (-0.88)	-0.16 (-0.43)	0.16*** (1.59)
US Federal Funds Rate (USFFR %)	0.17* (2.10)	-0.29 (-0.49)	0.1208 (1.10)	0.19* (2.72)	0.24* (3.35)	-0.12 (-0.90)
Expected Exchange Rate Depreciation (EEXR)	0.48** (1.99)	-	0.34 (1.98)	0.15* (3.70)	0.13** (1.88)	0.19 (0.41)
Domestic Inflation Rate (INF*CAR)	0.24** (2.72)	0.37 (0.50)	0.15 (0.81)	0.19** (1.99)	-0.31 (-1.05)	0.13 (1.24)
Domestic Inflation Rate (INF*(1-CAR))	0.15* (2.41)	-0.56 (-0.99)	-0.59 (-0.65)	0.33** (1.99)	0.63* (2.56)	-0.75 (-0.88)
Economic Growth (log(GDP))	2.51* (4.59)	-3.08 (-1.30)	0.66 (0.35)	2.20* (2.56)	2.0* (2.26)	0.97 (1.19)
Political Risk factor (PR)	-0.14** (-1.84)	-0.22** (-1.99)	-0.17* (-2.08)	-0.19** (-1.85)	-0.21** (-1.98)	-0.19 (-0.25)
Exchange Rate Volatility (ERV)	-	0.35 (2.72)	0.46 (2.09)	-	-	-
Summary Statistics						
Adj. R-Square	0.93	0.90	0.92	0.94	0.95	0.97
Durbin-Watson Statistic	1.99	1.69	2.95	2.08	1.99	2.03
F-Statistic	97.41	72.83	69.72	67.61	87.35	91.85
Prob(F-statistic)	0.00	0.00	0.00	0.00	0.00	0.00
Cross sections included	18	18	18	18	18	18
Observations	450	450	450	198	198	90

* Indicates significant at the 1% level, ** significant at 5% level and *** significant at the 10% level.

This could be so given that the 1980-1990 represented the last phase of financial repression in most African countries with its residual effect on dollarization. However, the insignificance of the coefficient on this variable in the 1990s and beyond may be due to significant progress made in most economies in liberalizing their economies especially capital account liberalization that has made off-shore banking and financial transfer much more easier than ever before. Another reason could be the significant effort of most governments in fighting inflation in recent years which tend to reduce dollarization (see Gruben and McLeod, 2004).

Political risk factor was found to have negative sign in all the models. However, the coefficients are generally statistically significant except for the period 2001-2004. This suggests that in African economies where political factors are important, deposit dollarization may not be significant. The negative sign found in this article supports our a priori expectation because economic theory suggests that deposit dollarization in domestic banking system tend to decrease in economies where political risk factors are important. Fear of political persecution and possible confiscation of assets denominated in foreign currency may drive financial resources off-shore except in countries where capital account restrictions are in place.

The relevance of domestic inflation in explaining deposit dollarization in African countries characterized by closed and open capital accounts was tested by including and interaction term between domestic inflation and capital account openness and restrictions. The result indicates that the coefficient on inflation in economies with closed capital accounts is positively significant in all periods except 1991-2000. Although the coefficients for all periods are positive, they are generally insignificant at 5% levels. Conversely, domestic inflation in countries with relatively opened capital accounts tend to increase deposit dollarization except for the period 2001-2004. The negative sign indicates that as domestic inflation increases coupled with open capital accounts in African economies, asset holders tend to move their assets off-shore in order to avoid domestic inflation thereby reducing deposit dollarization. However, for most of the periods and indeed the entire sample period, domestic inflation interacting with open capital accounts actually led to increased deposit dollarization rather than decreasing it.

Domestic economic growth seem to be an important factor in explaining deposit dollarization. Although positively related with dollarization in the period 1980-2004, the sign changed when exchange rate volatility was used as a measure of macroeconomic uncertainty and expected exchange rate changes was dropped. Also, economic growth was positively

related to deposit dollarization during the 1980s and 1990s as shown in the 4th and 5th columns of Table 4.

In all, it could be argued that the main determinants of dollarization in Sub-Saharan African countries are: changes in US monetary policy, expected exchange rate changes, actual volatility in exchange rate, interaction term between domestic inflation, capital account restrictions and political risk factor.

5.3 Determinants of Dollarization: Panel Least Squares Results

The results of panel least squares in error correction form are presented in Table 5 since Pedroni (1995) tests support the existence of cointegration. Generally, results from error correction panel least squares seem to support results from pooled OLS. The key determinants of dollarization in Sub-Saharan Africa remain changes in US monetary policy, expectations about future changes in exchange rate, domestic inflation coupled with capital account restrictions and exchange rate volatility. The error correction term is rightly signed and significant at 1% level. It corrects 37-53 percent of the errors in case of any shock to the models in the long run.

The negative sign on the coefficient of political risk factor supports our earlier result under pooled OLS and indicate that in countries where political risk is relevant and important, dollarization tends to be low. This is because asset holders will be afraid of forced conversion of their assets held in foreign currency to local currency. Hence, this fear may drive assets off-shore instead of keeping them in domestic banks in foreign currency denominated form.

The coefficient on inflation in countries with capital account restrictions is positively signed as expected in all periods. The positive sign confirms the fact that inflation plus capital account restrictions tend to increase dollarization while capital account openness interacting with domestic inflation tend to reduce it. This is the case in all periods covered in this article.

In general, Growth in domestic economic activity is not a significant determinant of dollarization in Sub-Saharan Africa. In fact the coefficients on economic growth variable is negatively signed which points to the fact that it may even reduce dollarization. This is an interesting result because a growing and active economy tends to have a strong productive base to support the local currency. Therefore, all things being equal, a growing economy in real terms with adequate policy in place should not experience dollarization episodes.

Table 5: Determinants of Dollarization in Sub-Sahara Africa (1980-2004).

Estimation Technique: <i>Dependent Variable: Dollarization Index (DI)</i>	Panel Least Squares: Error Correction Models			
	1980-2004	1980-2004	1980-1999	2000-2004
Constant	-6.65* (-2.19)	-2.89 (-1.58)	-4.81 (-0.60)	1.25 (4.50)
Deposit Rate of Interest (r %)	-0.42 (-1.04)	-0.11** (-1.92)	-0.44 (-0.82)	0.37 (0.62)
US Federal Funds Rate (USFFR %)	0.60 (1.45)	-0.21* (2.01)	1.54*** (1.78)	1.08* (3.19)
Expected Exchange Rate Depreciation (EEXR)	0.31*** (1.81)	-	0.40*** (1.59)	0.66* (3.89)
Domestic Inflation Rate (INF*CAR)	0.49** (2.02)	0.59** (1.99)	0.11 (0.08)	0.45* (3.96)
Domestic Inflation Rate (INF*(1-CAR))	-0.31* (-2.98)	-0.12* (2.09)	-0.06 (-0.37)	-0.19 (-0.33)
Economic Growth (log(GDP))	-0.92 (-1.22)	-1.89 (-1.09)	-0.66 (-0.61)	2.50 (-1.55)
Political Risk factor (PR)	-0.83** (-2.04)	-0.16*** (1.89)	-1.50 (-0.55)	-0.37* (-0.59)
Exchange Rate Volatility (ERV)	-	0.11* (2.50)	-	-
ECM(-1)	-0.37* (-2.78)		-0.40* (-2.54)	-0.53* (-5.04)
Summary Statistics				
<i>Adj. R-Square</i>	0.24	0.23	0.23	0.34
<i>Durbin-Watson Statistic</i>	2.08	1.99	2.22	2.05
<i>F-Statistic</i>	67.01	107.59	49.43	66.12
<i>Prob(F-statistic)</i>	0.00	0.00	0.00	0.00
<i>Cross sections included</i>	18	18	18	18
<i>Observations</i>	450	450	360	90

* Indicates significant at the 1% level, ** significant at 5% level and *** significant at the 10% level.

Sequel to the above, it could be concluded that dollarization episodes in Sub-Sahara African countries are fall-out of high inflation coupled with capital account restrictions, changes in US monetary policy, political risk factor, expectations about exchange rate changes and exchange rate volatility.

6.0 Policy Implications of Result

Given the fact that deposit dollarization is driven by macroeconomic fluctuations in Sub-Saharan African countries, it is important to consider policy implications of this development for Africa and other developing economies. The first policy consideration may be to analyse the implication of deposit dollarization for monetary policy management in general and financial system stability in particular. The second may involve the implications of deposit dollarization for exchange rate regime choice in Africa. Deposit dollarization

complicates monetary policy management and renders it ineffective. This is based on the fact that monetary aggregates becomes unpredictable and more sensitive to expected exchange rate depreciation. This result corroborates studies by Yinusa and Akinlo, (2008a, 2008b), Eichengreen and Hausmann (2005) and Ize and Yeyati (2003). Further deposit dollarization may engender higher exchange rate pass-through to domestic prices and weakens monetary transmission. This derives from the fact that interest rates on dollars and quantity of dollar inflows are not under the control of monetary authorities. As such, the effectiveness of the interest rate channel of monetary policy transmission is weakened when most intermediation is in foreign currency. Increases in domestic interest rate may become an impotent tool for controlling credit expansion even when it is desired (Reinhart, Rogoff and Savastano, 2003).

Given the above, what policy actions should African countries whose currencies are being substituted implement to reduce the negative effects of this dollarization? Since deposit dollarization has its roots in macroeconomic fluctuations orchestrated by inappropriately sequenced macroeconomic reforms (capital account liberalization) coupled with weak domestic macroeconomic imbalances, especially, exchange rate volatility, the most powerful tool to reduce it would be restoration of sustained confidence in the domestic currency and more broadly macroeconomic stability because obviously, liberalization process cannot be reversed. As such, macroeconomic policies that ensure long periods of low inflation and exchange rate stability become the most powerful policy option that could help stabilize or reduce dollarization in Africa.

7.0 Conclusion

The main focus of this study was to identify key determinants of dollarization in selected Sub-Sahara African countries. A sample of 18 countries for which data is available was used to test various hypotheses about the determinants of dollarization using both pooled OLS and panel least square estimation techniques. The results indicate that inflation interacting with capital accounts restrictions, expectations about exchange rate changes is very crucial in explaining dollarization in Sub-Sahara Africa. Also, Inflation in economies with opened capital accounts tends to depress dollarization. While political risk factors are important in the 1980 and 1990s, it is unimportant in the 2000s. Results from both pooled and panel data indicates that political risk factor will reduce deposit dollarization. This is consistent with the a priori expectations. In all, it could be concluded that dollarization in sub-Sahara Africa is determined by inflation, political risk factor, changes in US monetary policy, domestic rate of interest, exchange rate volatility, and expected exchange rate.

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