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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Financial development and dollarization in Ghana: an empirical investigation

George Tweneboah¹, John Garchie Gatsi^{2*} and Michael Effah Asamoah^{1,3}

Abstract: This study strengthens the frontiers of research on the drivers of dollarization in emerging economies by exploring the case of Ghana using the autoregressive distributed lag modelling framework. The data for the study spanned from January 2002 to March 2016. The evidence suggests that dollarization shares a common stochastic trend with exchange rates, inflation, interest rate differential, real output, and financial development. The analysis points to the important roles of exchange rate depreciation and financial development in the evolution of dollarization. Whereas depreciation induces a switch to the use of foreign currency, financial development diminishes the trend. Some policy recommendations to curtail the rising dollarization of the Ghanaian economy have been provided.

Subjects: Econometrics; International Economics; Development Economics; Business, Management and Accounting

Keywords: dollarization; demand for money; autoregressive distributed lag model; cointegration; Ghana

Jel: E41; F21; F40; F41

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PUBLIC INTEREST STATEMENT

This study strengthens the frontiers of the incumbent literature on the determinants of dollarization in emerging markets. We present further evidence on dollarization in Ghana by exploring the variables that feature in the long-run mechanism of the process. This empirical piece holds instructive relevance for monetary authorities of central banks, development and economic planning bodies in Africa and other emerging market economies. The study draws on the wider implications of dollarization in debates evolving around international finance, exchange rate dynamics, and macroeconomic instability.

1. Introduction

The rising trend of demand for foreign currency¹ in recent years presents a major challenge for policymaking in developing countries. Most of these countries have witnessed the use of other countries' currencies as store of value, unit of account, or medium of exchange. In most extreme instances, the foreign currencies replace the local currencies or used alongside as though such foreign currencies have been given the necessary backing as legal tender for domestic transactions. The phenomenon has generally been triggered by macroeconomic instability manifesting in high and volatile rates of inflation, strong and intractable depreciation of the domestic currencies, underdeveloped capital markets, market imperfections, weak and inadequate regulations which lead to loss of confidence in the local currencies.

The mounting evidence of dollarization in Ghana has been gathered from, among other things, the increasing demand for and use of foreign currency for transactions, quotation of prices of some domestic goods and services in foreign currency (notably the United States dollar), and statements made by leading government officials and economists alluding to the growing phenomenon in the economy. The theme has attracted the interest of policymakers in recent discourse on the stability of the Ghanaian economy and has been in the spotlight given that the incessant depreciation of the cedi has somewhat been attributed to the mounting dollarizing effect in the Ghanaian economy. The debate was further fuelled when the Bank of Ghana instituted what has been described in some circles as “draconian” measures in February 2014 in its bid to avert the rapid depreciation or free fall of the cedi.²

Another branch of the literature has focused on the determinants and characteristics of currency substitution and dollarization in developing countries (for example, Calvo & Vegh, 1992; Canto, 1985; El-Erian, 1988; Melvin, 1988; Ortiz, 1983; Ramirez-Rojas, 1985). Several theories have sought to explain the relationship between macroeconomic fundamentals and dollarization. Empirical modelling of dollarization in developing countries has produced nothing but controversial results, with the direction and statistical significance of the effects of macroeconomic variables on dollarization varying from one study to the other. This makes the subject an interesting empirical adventure and calls for further endeavours to model the evolution of dollarization and the crucial dilemmas it presents to macroeconomic management and policymaking. In the case of Ghana, it has become more imperative especially with the difficulty in proving whether weak macroeconomic fundamentals are the precursor to dollarization as argued by Bawumia (2014) or otherwise.

The rise in demand for foreign currency in Ghana has been described as a remarkable attribute of the financial sector reforms and liberalization that started in the 1980s (Adenutsi & Yartey, 2007). With the aim of integrating domestic financial markets with the rest of the world, capital account controls/restrictions have been relaxed and to some extent have paved way for the conduct of transactions in both domestic and foreign currencies, albeit within some restrictions. Despite some significant improvement in the macroeconomic fundamentals in the last few years, the Ghanaian economy continues to be characterised by relatively high and persistent inflation rates, continuous depreciation of its currency, unbridled recurrent budget deficits, and rising stock of public debt (Bawumia, 2014). Both the World Bank and the International Monetary Fund (IMF) have expressed a worrying response about the deteriorating macroeconomic fundamentals and the challenges engulfing the lower middle-income country.³

It has been argued that macroeconomic stability and fiscal discipline are necessary for curbing dollarization as against direct measures such as compulsory conversion of foreign currency earnings to the domestic currency as it substantially diminishes the government's credibility and hypes the risk perceived by domestic residents (see Berg & Borensztein, 2000). However, the success or failure of such attempts would be based on understanding the true drivers of the process in both the short and long-run. To the best of our knowledge, despite the debate and controversy surrounding the evolution of dollarization in the Ghanaian economy, no study has attempted to establish its driving forces empirically.

This study strengthens the frontiers of the existing literature on the determinants of dollarization in emerging markets. The purpose is to present further evidence on dollarization in Ghana by exploring the long-run determinants of the process using updated available data to March 2016 as most previous studies used quarterly data. Besides, our study does not include the fixed exchange rate regime. Some of the landmark activities during the period are the implementation of the Heavily Indebted Poor Country Initiative (HIPC), adoption of inflation targeting monetary policy, major reforms in the financial sector, redenomination of the domestic currency, among others have been captured in this present study. Due to these developments, the study makes another contribution to the literature by including proxies for financial development and economic activity. We include a proxy for economic activity to encompass potential market failures and fluctuations in aggregate demand not captured by the other measures, such as economic and institutional factors that influence the development of local currency markets (Yeyati, 2006). It is expected that a well-developed financial system would be associated with better management and investment opportunities in domestic currency.

We capture the credibility of macroeconomic policies by including a proxy for inflation targeting. This is because the adoption of explicit (fully fledged) inflation targeting monetary policy in May 2007 was expected to boost the credibility of macroeconomic policies, and therefore the regime is expected to reduce the extent of dollarization in the economy. This would shed light on the pattern of the phenomenon, extract the possible implications for policymaking, and prescribe options to contend with the situation. The Autoregressive Distributed Lag (ARDL) technique is powerful because it has good small sample properties and accepts both I (0) and I (1) variables which justifies its application in most empirical analysis.

The empirical evidence suggests that financial dollarization shares a common stochastic trend with exchange rates, inflation, interest rate differential, real output, and financial development. The long and short-run analysis points to the important role of exchange rates depreciation and financial development in the dollarization process in Ghana. Whereas the depreciation of the cedi induces a switch to the use of foreign currency, financial development diminishes the trend. The remaining sections of the study are structured as follows: Section 2 is a brief review of the literature on the determinants of dollarization. Section 3 presents the properties of the data, data sources, and justification. The theoretical model and estimation technique used to examine the evolution of dollarization are presented in section 4. Section 5 presents the results and analysis, indicating a long-run relationship between the variables within the ARDL bounds testing framework. Section 5 is the conclusion and policy recommendations.

2. Review of literature

Simple money demand and portfolio-balance models have been used in empirical models to determine the dollarization process. The theory predicts that interest rate differentials and exchange rate risks influence agents' decision to demand for foreign currency. These models have been extended to include other macroeconomic and institutional variables since the dollarization process cannot be explained by the models in most countries (see Civcir, 2003; El-Erian, 1988; Yinusa, 2009).

The empirical literature on dollarization can be categorised into a number of different strands such as causes/determinants, benefits/effects and strategies to tackle it. The major determinants have been the existence of high inflation rates, exchange rate volatility, domestic monetary instability, openness of the economy and close economic ties with the U.S. Some of the studies have considered the link between high inflation and dollarization (for example, Bahmani-Oskooee & Domac, 2003; Kamin & Ericsson, 2003; Uribe, 1997). For instance, whereas Kamin and Ericsson (2003) show the negative impact of high inflation on the demand for the domestic money in Argentina, Bahmani-Oskooee and Domac (2003) report that dollarization plays important role in the inflationary dynamics in Turkey.

Another body of the literature has discovered that exchange rate volatility is a significant determinant of dollarization (see, *inter alia*, Arteta, 2002; Berg & Borensztein, 2000; Kesriyeli, Ozmen, & Yigit, 2011; Tobin & Macedo, 1980; Yinusa, 2008). Agenor and Khan (1996), for example, find parallel increases in the extent of dollarization and exchange rate depreciation by deriving the long-run currency ratio from an optimizing model. The study by Lindenberg and Westermann (2012) also finds exchange rate shocks as a determining factor of dollarization. By deriving the determinants of foreign currency holdings from utility maximization, Viseth (2001) also draws a similar conclusion in his case study of Cambodia. Similarly, Shi and Xu (2010) report that the determining factor for firms' decision to dollarize is the exchange rate policy. In line with these studies, Ortiz (1983), Marquez (1987), Rojas-Suarez (1992), Clements and Schwartz (1993) also find related results.

Other factors have also been identified as determinants of dollarization. The instability of domestic monetary system (see, Alvarez-Plata & Garcia-Herrero, 2008; El-Erian, 1987; Wessels, 2004; Zoryan, 2005), openness and close financial links with the U.S. (Edwards & Magendzo, 2003; Galindo, Panizza, & Schiantarelli, 2003; Minda, 2005), and other institutional factors matter for dollarization. Using a sample of Chilean firms, Fuentes (2009) indicates that debt dollarization is driven by the size of the firm and exposure to foreign competition. Also, Frieden, Yeyati, and Sturzenegger (2003) highlight that openness and size of the manufacturing sector are major factors of dollarization. Illicit drug trade has also been found in the dollarization of Bolivia in the study by Melvin and Ladman (1991) as well as dollar debt, firm size, exports and imports as in Gaston (2003).

Aside from the factors mentioned above, weak institutional factors have also been considered as a source of dollarization/currency substitution (see, Bahmani-Oskooee & Domac, 2003; Edwards & Magendzo, 2003; Honig, 2009). Honig (2009) empirically shows that poor government quality that fails to promote long-run currency stability is the main cause of dollarization. Caballero and Krishnamurthy (2003) argue that debt dollarization in emerging economies is triggered by limited financial development.

The only empirical study that considers the issue of dollarization in Ghana is Adenutsi and Yartey (2007). The study generally investigates whether the financial liberalisation programmes undertaken since the 1980s by Ghana are the root of the *de facto* dollarization in the country. Inflation, exchange rates, and financial sector development are found to be the short-run and long-run determinants of dollarization. On the other hand, Tweneboah and Alagidede (2019) investigate the effects of dollarization on inflation and inflation uncertainty in Ghana for the period January 1990 to December 2017 using the exponential Generalized Autoregressive Conditional Heteroskedasticity model together with impulse response and Granger causality tests. The results highlight that dollarization has not played a significant role in the volatility of inflation in Ghana. Also, the authors report that inflation Granger causes dollarization in both the pre- and post-inflation targeting regimes.

Some researchers that report positive impacts on Latin American countries propose dollarization as a solution for exchange rate problems. They argue that dollarization has helped the countries to reduce inflation, to increase output growth and enhanced international integration (see Edwards, 2001; Gruben & McLeod, 2004). A study by Meller and Nautz (2009) also shows a decline in volatility of inflation persistence due to common currency in the Euro area. Similarly, Bleaney and Fielding (2002) and Elbadawi and Majd (1996) have noted lower average inflation rate in Franc Zone area.

Contrary to this argument, some studies have established the negative impact of partial dollarization on macroeconomic variables. Dollarization increases exchange rate and output volatility, lowers growth of economies with floating exchange rate systems, makes countries vulnerable to external shocks, increases financial risk and makes monetary policy less effective (see the studies by Aghion, Bacchetta, & Banerjee, 2000, 2001; Akcay, Alper, & Karasulu, 1997; Benhima, 2012;

Burnside, Eichenbaum, & Rebelo, 2001; Chue & Cook, 2004; De Nicolo, Honohan, & Ize, 2003; Domac & Martinez-Peria, 2003; Yinusa, 2008). As argued by Mengesha and Holmes (2013), these negative effects of dollarization can stifle developing economies, put them in a perpetual state of debt and dependence and adversely affect other aspects of national development in line with earlier positions taken by some studies (for example, Bahmani-Oskooee & Domac, 2003; Girton & Roper, 1981) that dollarization brings about important upshots for exchange rate volatility, inflation and the effectiveness of monetary policy.

On the link between financial development and dollarization, it has been argued that the implementation of financial liberalization encompasses policies aimed at augmenting the maximization of benefits of financial markets via competition, as well as the widening and strengthening of financial systems. These policies led to the availability and improved mobility of myriad financial assets in different currency denominations (Adenutsi & Yartey, 2007). Financial liberalization also promotes increased access to foreign currencies and foreign-denominated financial assets in a domestic economy, which has resulted in increased dollarization and the apparent difficulty on the part of central banks to implement effective monetary policies. This is prevalent in developing and emerging markets, where price and foreign exchange instability and stickiness have for long been a permanent phenomenon.

Thus, among these disincentives associated with financial liberalization is the issue of dollarization. This implies that public access to foreign currencies and financial assets including credit and debit instruments such as bonds denominated in local and foreign currencies have become a more common phenomenon as compared to what prevails under the era of implementing financially repressive policies. Financial dollarization will thus operate in an environment of wearying financial sector. As noted by Caballero and Krishnamurthy (2003), a significant factor for the increasing pace of dollarization in most emerging economies is the lack of a robust financial sector.

Contrary to the virtues of financial development, an ill development financial sector can result in poor governance of the sector, exchange rate misalignment, volatilities in exchange and interest rates, ineffective monetary policies, hyperinflation and lack of confidence in local currencies. Expectations of market players about possible risks and loss of purchasing power drive the populace to store their wealth in foreign currency, leading to dollarization. Thus, although financial development is deemed significant to economic growth (Levine, 2005), the negative effect on the financial sector, through rising dollarization cannot be overlooked. Bannister, Turunen, and Gardberg (2018) contend that on average, dollarization is known to hamper financial deepening and efficiency, and even worse in cases of hyperinflation. Thus, policymakers should strive to decrease the rate of dollarization and sustain the development of the financial sector.

Naceur, Hosny, and Hadjian (2019) concluded that the rise in the demand for foreign currency instruments results from weak financial systems. They further emphasized that dollarization is one mechanism where economic agents hedge against wealth by seeking refuge in foreign currencies. Using data from 21 transition economies, Luca and Petrova (2008) investigated the factors that drive credit dollarization in these countries. They note that the reason for such a phenomenon lies in regulatory failure and that the menace can only be solved when countries have a well-developed domestic exchange rate market. Thus, in a well-functioning financial environment, dollarization will be reduced to its barest minimum.

In summary, whereas the incumbent literature is replete with evidence to suggest that financial development breeds financial dollarization, other studies also claim that dollarization could be linked to the underdeveloped or weak financial markets in some economies (see Asel, 2010; Honohan & Shi, 2002; Reinhart, Rogoff, & Savastano, 2014; Schwartz, 2004). The latter strand argues that underdeveloped capital markets and repressed banking systems in developing markets do not offer alternative assets and leave the US dollar as an alternative asset to hold on. In these countries, thin financial systems, and absence of savings and financial instruments, compel

investors to keep their monetary savings in foreign currency (see Sahay & Végh, 1995). Luca and Petrova (2008) argue that a developed forward foreign exchange market is associated with lower levels of dollarization.

3. Data sources, descriptions, and justifications

3.1. Data sources

The data used in this study include foreign currency deposit in deposit money banks (DMBs), consumer price index (with 2010 base year), nominal Ghana cedi exchange rate against US dollar, broad money supply, the Composite Index of Economic Activity (CIEA) compiled by the Bank of Ghana, the discount rate on 91-day Government of Ghana Treasury bill, discount rate on 91-day U. S. Government Securities (3 months). All the data used in this study are gleaned from the Research Department of the Bank of Ghana and the database of the International Financial Statistics (IFS) prepared by the International Monetary Fund. The empirical evidence is based on the analysis of monthly data from Ghana for the period January 2002 to March 2016. The year 2002 is landmark in the history of central banking in Ghana. The Bank of Ghana Act 612 that established the independence of the Central Bank and defined the parameters of the incumbent inflation targeting monetary policy regime was passed in 2002, although the official adoption of the framework was announced in 2007 (see Tweneboah & Alagidede, 2019).

3.2. Measures of dollarization

The measure of dollarization index was the ratio of foreign currency deposits (FCD) in broad money. In capturing the percentage of foreign currency in broad money, the two series were converted into a common currency by using the exchange rates. This ensures that we do not find the ratio of two series in different currencies. The proportion of FCD in broad money continues to be the most commonly used approach to measure the degree of dollarization in an economy where there has been less restriction on foreign currency holdings in domestic and offshore accounts (see, Rennhack & Nozaki, 2006). However, this measure of foreign currency deposits is considered the lower bound measure of dollarization since data on foreign currency in circulation or held by households as cash and foreign currency deposits held in offshore accounts by residents is difficult to account for due weak regulation and poor data management.

Figure 1 presents the trend of dollarization in Ghana for January 2002 to March 2016. The average proportion of FCD in broad money has been 24% over the period. The highest proportion of FCD in broad money has been 28.83% for October 2000 and the least share was recorded as 17.75% in December 2007. Tweneboah (2016) asserts that the figures portray that there have been sizable and persistent growth rates in FCD and indicate the important role of FCD in domestic banking

Figure 1. Trend of dollarization in Ghana (Jan 2002–Mar 2016).



transactions. The author argued that this could be attributed to the high degree of openness of the Ghanaian economy, higher integration with the rest of the world, or persistent loss of confidence in the domestic currency as a store of value, also partly due to high rates of inflation or persistent depreciation of the local currency [see Tweneboah (2016) for trend of dollarization in Ghana].

3.3. Inflation rate

The process of dollarization has usually been used to reflect economic agents' efforts to protect the value of their wealth and income, in the context of deteriorating macroeconomic fundamentals, that have an adverse effect on the expected return of domestic currency holdings relative to those on foreign balances, as well as in response to changes in institutional, political and external factors that influence expectations regarding the liquidity of domestic versus foreign currency denominated assets (Bahmani-Oskooee & Domac, 2003). To the extent that inflation is ultimately reflected in the nominal exchange rate, expected inflation usually underpins the process of currency substitution. The inflation rate (p) measures the overall macroeconomic stability with the assumption that a fall in the rate of inflation would improve agent's confidence in domestic currency and reduce the demand for foreign currency deposits.

3.4. Domestic and foreign rates of return

The interest rate (r^d) is the rate of return on deposits denominated in Ghana cedi, whereas returns (r^*) is the expected return on U.S. dollar deposits⁴. The theory of asset demand predicts that the desire to hold foreign currency deposits is essentially a choice between domestic and foreign assets influenced by the differences (differential) in rates of return on the assets. When economic agents expect the interest rate on foreign currency deposits to be higher relative to that of local currency deposits, they balance their portfolio holdings by shifting some of their domestic currency deposits to foreign currency deposits. Thus, the sign of the domestic interest rate is expected to be negative in the estimated model since an increase is expected to stimulate domestic savings and discourage the demand for foreign currency holdings. On the other hand, the sign of the returns variable is expected to be positive. Put together, we expect the interest rate differential variable to have a negative sign such that an increase in that would diminish financial dollarization rather than fuelling a surge in the trend. The interest rate differential is defined as the difference between domestic currency interest rates and the returns variable which represents the U.S. dollar interest rates (with the Federal funds rate as proxy) adjusted for exchange rates [see Kessy (2011) for a similar definition]. This paper also follows the assumption that if decisions by economic agents to hold dollar deposits depend on the difference between the rate of returns on FCD and cedi deposits, then widening the differentials would generate a negative effect on deposit dollarization as argued by Basso, Calvo-Gonzalez, and Jurgilas (2011).

3.5. Expected exchange rates

A measure of expected exchange rate (x) is included in the model to capture exchange rate risk. The hypothesis is that major fluctuations in the exchange rate will create uncertainty among economic agents about likely future path of exchange rate, in which case they will feel safer in foreign currency holdings. By way of construction, an increase in the exchange rate reflects a depreciation of the domestic currency or an appreciation of the foreign currency (U.S. dollar). An appreciation of the foreign currency (that is, an increase in expected exchange rates) usually leads to an increase in value of foreign assets measured in terms of domestic currency. However, it has been argued that when the domestic currency depreciates, there could be expectation of further depreciation which may result in an increase in demand for foreign currency or a decrease in the demand for domestic currency.

3.6. Real output (composite index of economic activity)

The portfolio theory of demand for money predicts that a higher real output or income leads to higher demand for money. Under such conditions, it is not wrong to predict that as economic agents demand for more money, their demand for foreign currencies increases as a store of value or for international transactions. In the case of Ghana where capital controls are more relaxed, economic agents exercise the right to hold foreign currencies. In other studies, the real output has

been used as a measure of market development or market failure, whereby an increase is deemed to reduce the reliance on foreign currency. Income per capita has also been applied as a proxy for economic and institutional factors that influence the development of local currency markets. On the other hand, some authors have documented that dollarization/currency substitution leads to higher rates of growth. According to Dornbusch (2001), dollarized countries tend to grow faster than non-dollarized countries. This has been explained by Edwards and Magendzo (2003) to occur through two channels. First, in a dollarized economy the lower interest rates lead to higher investment, which also induces growth. Second, since dollarized countries alleviate the risk associated with exchange rate volatility, it encourages international trade which results in higher growth rates (Rose, 2000; Rose & Van Wincoop, 2001). Yinusa (2008) also used GDP as a measure of transactions in the economy and possibly accumulation of wealth. This study follows the assumption of Yinusa (2008) and uses a proxy for real output. The Composite Index of Economic Activity (CIEA) compiled by the Bank of Ghana is used to substitute the real output variable. The advantage of this data is that it comes in monthly frequency.

3.7. Financial sector development

In an attempt to capture the role of financial sector development on the trend of dollarization, we include a proxy generally defined as broad money (M2) as a ratio of GDP. The inclusion of this variable highlights the role of financial deepening in the dollarization process. We hypothesize that a highly developed financial market makes available more financial products which can be invested in the domestic currency, to eventually cause a decline in dollarization. The extent of financial sector development presumably does not capture only the diverse investment opportunities available, but also a reflection of a more stable macroeconomic environment. According to Feige (2003) and Ize and Yeyati (2003), underdeveloped domestic financial markets are partly responsible for high levels of financial dollarization in some countries. Shallow financial systems or limited financial deepening provide limited investment opportunities in local currency. In Ghana, the financial system is mainly constituted by banks, which tends to lend to the sovereign or to large companies in order to reduce the risk associated with default. Accordingly, a highly developed financial system would be expected to reduce dollarization.

4. Theoretical model and estimation technique

4.1. Theoretical model

Empirical modelling of dollarization has generally been built on simple money demand functions and portfolio balance models. Within that theoretical framework, the demand for foreign currency by economic agents has been assumed to be driven by differences between returns on domestic currency and returns on deposit denominated in foreign currencies. Based on this assumption, the most widely used determinants have been interest rate differentials, expected exchange rate depreciation, expected inflation rate, institutional factors as well as measures of credibility of macroeconomic policies (see, El-Erian, 1988; Irfan, 2003; Rojas-Suarez, 1992; Yinusa, 2008). In the form of a simple money demand function in a flexible exchange rate regime, the model can be specified as follows:

$$m_t - p_t = \alpha_0 + \beta_1 E(\pi) + \beta_2 y_t + u_t \quad (1)$$

where $m_t - p_t$ represents the real money balances, where m_t is the log of money supply and p_t is the log of price level. $E(\pi)$ is the expected inflation rate and y_t is the log of aggregate income. In this equation, the expected inflation rate is the relevant opportunity cost of holding domestic money balances. The assumption is applicable in the case of a country with thin financial markets in which interest rates do not respond quickly to market dynamics.

The analysis is based on a modified version of the model, using dollarization as dependent variable and other macroeconomic variables as determinants. The dollarization process can be modelled as a function of the following variables:

$$dr_t = F(x_t, p_t, y_t, r_t^d, f_t^d) \quad (2)$$

The variables x_t , p_t , y_t , r_t^d , and f_t^d are defined as the proxy for expected exchange rate depreciation, prices, proxy for real output, interest rate differential, and proxy for financial development, respectively. All the variables are in logarithms except the returns variable. The specific model of the above equation takes the following multiplicative form:

$$dr_t = Ax_t^{\beta_1} p_t^{\beta_2} y_t^{\beta_3} r_t^d{}^{\beta_4} f_t^d{}^{\beta_5} e^{\mu_t} \quad (3)$$

Expressing the above equation in a log-linear form gives the following operational model for the long-run determinants of dollarization in Ghana:

$$\ln dr_t = \alpha_0 + \beta_1 \ln x_t + \beta_2 \ln p_t + \beta_3 \ln y_t + \beta_4 r_t^d + \beta_5 \ln f_t^d + u_t \quad (4)$$

where $\alpha_0 = \ln A$ and u_t is the disturbance term, which is assumed to have zero mean, constant variance and not correlated with the regressors.

4.2. Estimation technique

In order to establish long-run relationships between the variables, we employ the autoregressive distributed lag model proposed by Pesaran and Shin (1995, 1999), Pesaran, Shin, and Smith (2001), and Pesaran and Pesaran (1997). A major advantage of the ARDL bounds test is that it is applicable regardless of the stationarity properties or irrespective of whether the regressors are purely $I(0)$ or $I(1)$, or a mixture of both. The approach avoids the potential bias associated with unit root tests and is robust for cointegration analyses with small samples (Pesaran et al., 2001). In addition to the ARDL technique, various tools were employed to explore the long-run relationships among the variables. These include Dynamic OLS (DOLS) by Stock and Watson (1993), Fully Modified OLS (FMOLS) by Phillips and Hansen (1990), and the canonical cointegration regression (CCR) by Park (1992), to ensure the robustness of the estimates.

Basically, the ARDL approach to cointegration involves estimating the conditional error correction model of the dollarization and its determinants as follows:

$$\begin{aligned} \Delta \ln(dr)_t = & \alpha_0 + \sum_{i=1}^k \varphi_i \Delta \ln(dr)_{t-i} + \sum_{i=0}^k \beta_i \ln x_{t-i} + \sum_{i=0}^k \theta_i \ln p_{t-i} + \sum_{i=0}^k \phi_i \Delta \ln y_{t-i} + \sum_{i=0}^k \Omega_i \Delta r_{t-i}^d + \psi \Delta \ln f_{t-i}^d \\ & + \delta_1 \ln(dr)_{t-1} + \delta_2 \ln x_{t-1} + \delta_3 \ln p_{t-1} + \delta_4 \ln y_{t-1} + \delta_5 r_{t-1}^d + \delta_5 \ln f_{t-1}^d + \mu_t \end{aligned} \quad (5)$$

where dr , r , r^* , x and p are dollarization (defined as foreign currency deposits as a share of total deposit or broad money), rate of return on assets denominated in domestic currency, rate of return on foreign currency-denominated assets, exchange rate, and prices, respectively. Δ is the first difference operator, k is the optimal lag length, \ln is the natural logarithm, and μ_t is a white noise disturbance error term.

The long-run relationship between the variables under consideration can be deduced based on the Wald (F -statistic) test by imposing restrictions on the estimated long-run coefficients of one period lagged level of the variables to be zero. The null hypothesis is $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$, against the alternative hypothesis $H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. The F -test has a non-standard distribution which depends on (i) whether variables included in the model are $I(0)$ or $I(1)$, (ii) the number of regressors, and (iii) whether the model contains an intercept and/or a trend. Given that our sample size is large enough and meet the small sample size requirement to suggest the application of the critical values reported by Narayan (2004). Two sets of critical values are generated for $I(1)$ series (upper bound critical values) and $I(0)$ series (lower bound critical values). If the F -statistic exceeds the respective UB critical values, there is evidence of cointegration between the variables regardless of the order of integration of the variables, whereas if the test statistic is below the LB critical value, the null hypothesis of no cointegration cannot be rejected. If it lies between the two bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors. In that case, further evidence would be required to

guide the interpretation. Alternatively, Kremers, Ericsson, and Dolado (1992) and Banerjee, Dolado, and Mestre (1998) have demonstrated that in an error correction model, significant lagged error-correction term is a relatively more efficient way of establishing cointegration. So, the error correction term can be used when the F-test is inconclusive.

After testing for this cointegration and evidence of a long-run relationship has been established, the following long-run model will be specified:

$$\ln(dr)_t = \alpha_1 + \sum_{i=0}^k \varphi_{1i} \ln(dr)_{t-i} + \sum_{i=0}^k \beta_{1i} \ln x_{t-i} + \sum_{i=0}^k \theta_{1i} \ln p_{t-i} + \sum_{i=0}^k \lambda_{1i} \ln y_{t-i} + \sum_{i=0}^k \phi_{1i} r_{t-i}^d + \sum_{i=0}^p \psi_{1i} \ln f_{t-i}^d + \mu_t \quad (6)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SIC) as discussed in Lutkepohl & Reimers, (1992), before the selected model is estimated by ordinary least squares. In this study, the Schwarz Bayesian Criterion is employed. The ARDL specification of the short-run dynamics can therefore be derived by constructing an error correction model of the following form:

$$\Delta \ln(dr)_t = \alpha_2 + \sum_{i=0}^k \varphi_{2i} \Delta \ln(dr)_{t-i} + \sum_{i=0}^k \beta_{2i} \Delta \ln x_{t-i} + \sum_{i=0}^k \theta_{2i} \Delta \ln p_{t-i} + \sum_{i=0}^k \lambda_{2i} \Delta \ln y_{t-i} + \sum_{i=0}^k \phi_{2i} \Delta r_{t-i}^d + \sum_{i=0}^k \psi_{2i} \Delta \ln f_{t-i}^d + \eta ECT_{t-1} + v_t \quad (7)$$

where ECT_{t-1} is the error correction term, defined as

$$ECT_t = \ln(dr)_t - \alpha_1 - \sum_{i=0}^k \varphi_{1i} \ln(dr)_{t-i} - \sum_{i=0}^k \beta_{1i} \ln x_{t-i} - \sum_{i=0}^k \theta_{1i} \ln p_{t-i} - \sum_{i=0}^k \lambda_{1i} \ln y_{t-i} - \sum_{i=0}^k \phi_{1i} r_{t-i}^d - \sum_{i=0}^k \psi_{1i} \ln f_{t-i}^d \quad (8)$$

All coefficients of the short-run equation relate to the short-run dynamics of the model's convergence to equilibrium. The coefficient of the error correction term represents the speed of adjustment. The statistical significance of the ECT indicates that deviations due to shocks to the system are temporal and the system gravitates to a long-run equilibrium state.

In addition, we adopt an innovation accounting by simulating forecast error variance decomposition and impulse response functions (IRFs) for further inferences. The tools are used for evaluating the dynamic interactions and strength of causal relations among variables in the system. The decompositions indicate the percentages of a variable's forecast error variance attributable to its own innovations and innovations in other variables. Thus, from the decompositions, we can measure the relative importance of real exchange rate, interest rates, and price fluctuations in accounting for fluctuations in the dollarization variable. Moreover, the IRFs trace the directional responses of a variable to a one standard deviation shock of another variable. This means that we can observe the direction, magnitude, and persistence of dollarization to variations in the independent variables. The Granger causality tests (Granger, 1969) will be used to augment the short-run analysis.

5. Empirical results and analysis

5.1. Unit root and long-run analysis

In order to explore the data generating process of the variables under consideration and confirm that none of the variables is $I(2)$, we employ three different tests for unit root and integration—Augmented Dickey Fuller (ADF) test (originally implemented by Dickey and Fuller (1979)) with critical value estimates based on MacKinnon (1991, 1996); Dickey-Fuller Test with GLS detrending (DFGLS) test (Elliot, Rothenberg, & Stock, 1996) and KPSS test (Kwiatkowski, Phillips, Schmidt, &

Shin, 1992). The results (available upon request from authors) clearly indicate that none of the variables is integrated of order 2 indicating applicability of the bounds testing methodology.

Following the unit root and stationarity tests, the ARDL model was estimated so that we can proceed to test the cointegration hypothesis. The model selected based on Schwarz Bayesian Criterion is of the form ARDL (1, 0, 0, 2, 0, 1). The model includes one lag for the dependent variable (dollarization index) and financial sector development, and two lags of real output. No lag was selected for exchange rate, interest rate differential, and inflation. The result of the bounds test for cointegration between dollarization and its determinants is also not reported but available upon request. We find that the null hypothesis of no long-run relationship (cointegration) is rejected when dollarization index is used as the dependent variable in the model. Given that the calculated *F*-statistics (6.70) exceeds the upper bound critical values at the 1% significance level (4.68) or 99% confidence level, we reject the null hypothesis of no level relationship and conclude that there is a strong evidence of a long-run steady-state relationship between dollarization and its covariates. This suggests that exchange rates, inflation, interest rate differential, real output, and financial development are the long-run forcing determinants of dollarization in Ghana.

The results of the long-run dollarization models are presented in Table 1. Baring few instances, all the models provide consistent results demonstrating the robustness of the long-run estimates. In some instances, whereas the ARDL and DOLS give similar findings, the FMOLS and CCR are also consistent in terms of direction and magnitude. In terms of significance, exchange rates and financial development are the only important variables in the long-run evolution of dollarization. Changes in exchange rate are by far the most significant driving factor of dollarization in the long-run followed by changes in financial development. Going by the estimates of the ARDL model, all other factors held constant, a percentage point increase in exchange rate increases dollarization by close to 0.5%. On the other hand, a percentage increase in financial development reduces dollarization averagely by 0.3%.

For the direction, all the models give consistent estimates except for prices. Whereas ARDL and DOLS give a negative estimate of prices, FMOLS and CCR give positive estimates. With magnitude and significance, exchange rate and financial development have been consistently significant, whereas prices and output have consistently been insignificant. DOLS, FMOLS, and CCR give significant estimates of interest rate differential but find real output insignificant in all instances although the dynamic and static models give different directions.

The coefficient of the exchange rate variable, which measures expected exchange rate risk, is also significant at the 5% confidence level and positive as expected. This indicates that in the long run, a depreciation of the domestic currency will lead to an increase in dollarization. This is consistent with the hypothesis that uncertainties regarding the future path of exchange rate lead economic agents to feel safer in holding foreign currencies. The highly significant positive

Table 1. Estimated long-run dollarization models (Dependent variable: dollarization ratio)

	ARDL	DOLS	FMOLS	CCR
Exchange rate	0.479** (0.095)	0.431** (0.000)	0.355** (0.073)	0.350** (0.078)
Prices	-0.224 (0.205)	-0.053 (0.728)	0.042 (0.124)	0.068 (0.129)
Real output	0.214* (0.116)	0.019 (0.821)	-0.055 (0.080)	-0.050 (0.091)
Interest rate differential	0.001 (0.002)	0.002 (0.043)	0.003** (0.001)	0.004** (0.001)
Financial development	-0.305** (0.154)	-0.275** (0.015)	-0.297** (0.091)	-0.309** (0.100)

Notes: ** and * indicate significance at the 5% and 10% confidence levels, respectively. Standard errors are in (). DOLS, FMOLS, and CCR stand for Dynamic Ordinary Least Squares, Fully Modified Least Squares, and Canonical Cointegrating Regression, respectively.

relationship between the exchange rate variable and the dollarization index suggests that the exchange rate has played a key role in influencing the level of dollarization in Ghana, mainly through the significant effect on import and export earnings.

Another finding is that there is a statistically significant negative relationship between financial development and the measure of dollarization. To establish the stability of the specified model, tests for serial correlation, normal distribution, functional form, and heteroskedasticity are performed. The results of tests for serial correlation, functional form, normality, and heteroskedasticity confirm the stability of the model. Additional diagnostic tests based on the CUSUM and CUSUM square tests are also used to test the stability of residual variance. The CUSUM and CUSUM square tests presented in Figure 2. As with the CUSUM test, movement outside the critical lines is suggestive of parameter or variance instability. This suggests that the residual variance is somewhat stable as the curve is generally within the 5% significance lines.

5.2. Short-run drivers of dollarization

The error correction representation for the selected ARDL model is presented in Table 2. In terms of significance, exchange rate, real output, and financial development are relevant in driving dollarization in the short-run. In terms of direction, the results point out that an increase in exchange rate leads to an increase in dollarization, whereas output and financial development cause a decline in dollarization. This brings to fore the case that promoting real output growth would serve as an effective strategy in the fight against dollarization in the short run. However, since a high percentage of our consumption basket is composed of imported goods, in the long run, output growth brings about high demand for foreign currency suggesting that Ghana cannot be successful in fighting dollarization whilst promoting growth through a strategy that is import-driven.

Figure 2. CUSUM and CUSUM square of residuals.

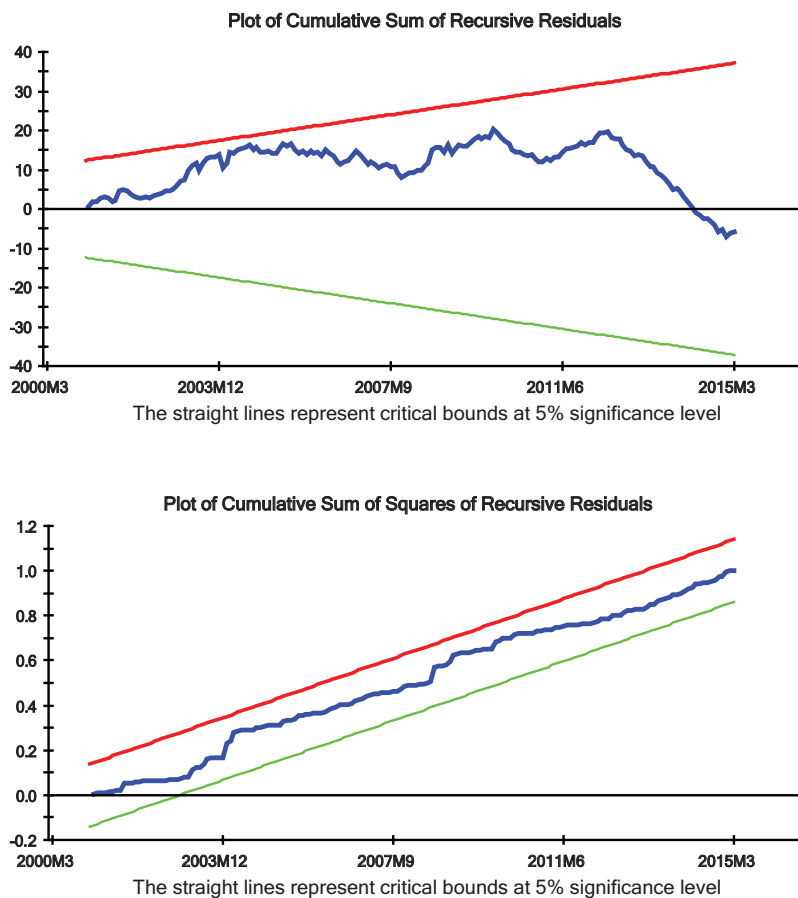


Table 2. Error correction representation for the selected ARDL model (1,0,0,2,0,1)

Differenced Regressor	Coefficient	Standard error	Probability
Exchange rate	0.146**	0.332	0.000
Prices	-0.061	0.057	0.288
Real output	-0.515**	0.096	0.000
Interest rate differential	0.001	0.000	0.590
Financial development	-0.683**	0.080	0.000
Error correction term	-0.300**	0.049	0.000

Notes: ** indicates significance at the 5% confidence level. Standard errors are in (). ARDL (1,0,0,2,0,1) selected based on Schwarz Bayesian Criterion. Newey-West adjusted SEs Bartlett weights applied with a truncation lag of 12.

5.2.1. Speed of adjustment and short-run dynamics

The error correction model has cointegration relations built into the specification that restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term, known as the *error correction* term (ECT), corrects deviation from long-run equilibrium gradually through a series of partial short-run adjustments. The results of the error correction representation of the selected ARDL from Table 2 show that the error correction term is negative and statistically significant at the 1% level. The negative sign and significance of the correction term are a confirmation of the long-run relationship between the variables. It implies that, although there may be deviations in the short run, the long-run equilibrium relationship is always restored. This ensures the attainment of long-run convergence to the steady state following disequilibrium in the system due to a shock. The coefficient of ECT_{t-1} measures the speed of adjustment of the dollarization process with respect to changes in the other variables.

The magnitude suggests that 30% of deviations from the steady state are corrected at every stage of the readjustment process until all the errors have been corrected (that is, to re-establish equilibrium). This has implications for restoration of equilibrium state. The estimate of the *ECT* for the model indicates an average correction of 30% of the deviations in the subsequent period. This faster pace suggests that the system takes a very short time to revert to the equilibrium state. It means errors have the tendency to disappear quickly and return the system to its original state. The finding underscores that exchange rate, output growth, and financial development play significant roles in the adjustment process.

5.2.2. Impulse response functions

To be able to ascertain the response of the dynamic interactions of the variables to shocks in the other variables and also measure the contributions of the variables to the movements of other variables, we employ impulse response functions and variance decomposition within vector autoregression models to augment the short-run dynamics. We decompose the dynamics of dollarization and analyse the contribution of the driving forces to the process. While impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the system, the forecast error variance decomposition separates the movements in the dollarization process into component shocks to the other variables. Thus, the variance decomposition provides information about the relative importance of a random innovation to the driving factors of dollarization. It indicates the proportion of the movements due to its “own” shocks and shocks due to the other variables.

The essence of the impulse response functions is to trace the effects of a shock to one endogenous variable on the other variables in the VAR. We compute the first 60 impulse responses, which correspond to a time span of 5 years for monthly data. The generalized impulse response approach recommended by Peseran and Shin (1998) is applied. Unlike traditional impulse response analysis (such as Lutkepohl & Reimers, 1992), which considers orthogonalised shocks based on the Cholesky decomposition, the new approach desirably yields unique impulse response functions that are invariant to the ordering of variables. The responses of dollarization to its own

shocks and innovations in exchange rates, prices, and interest rates are indicated. For the sake of brevity, only the graphs are reported. With that, we report only the direction of movement to innovations rather than the extent or its significance.

Figure 3 presents plots the response of the dollarization index with respect to innovations in the endogenous variables of interest over a horizon of 60 months. We observe that consistent with our expectations, a one-percent innovation in the exchange rate causes a positive movement in the measure of dollarization. In a similar manner, an innovation in interest rates on foreign currency deposits has a positive effect on the movement of the dollarization index albeit lower than that caused by a shock to exchange rates. On the other hand, shocks to both prices and returns on deposits denominated in local currency have a negative effect on dollarization. Again, we can see that the effect of inflation on dollarization in the short run is not consistent with the theoretical postulations. Although this finding is in agreement with some aspect of the literature, it beats our understanding particularly when it confirms that the relationship between inflation and exchange rates has not been strong in the case of Ghana. This argument has been propounded by Adu and Marbua (2011). Ghana experienced single-digit inflation consecutively for 31 months from June 2010 to December 2012, yet the cedi was seen depreciating against the major trading currencies which led to some debate on the link between inflation and exchange rates in Ghana.

5.2.3. Variance decomposition

The results from variance decompositions (reported in Table 3) suggest that, over a 60-month horizon, 45% of the forecast error variance of dollarization can be accounted by shocks to exchange rates. The contribution of own (dollarization) shocks to the dynamics of dollarization is

Figure 3. Response of dollarization to shocks.

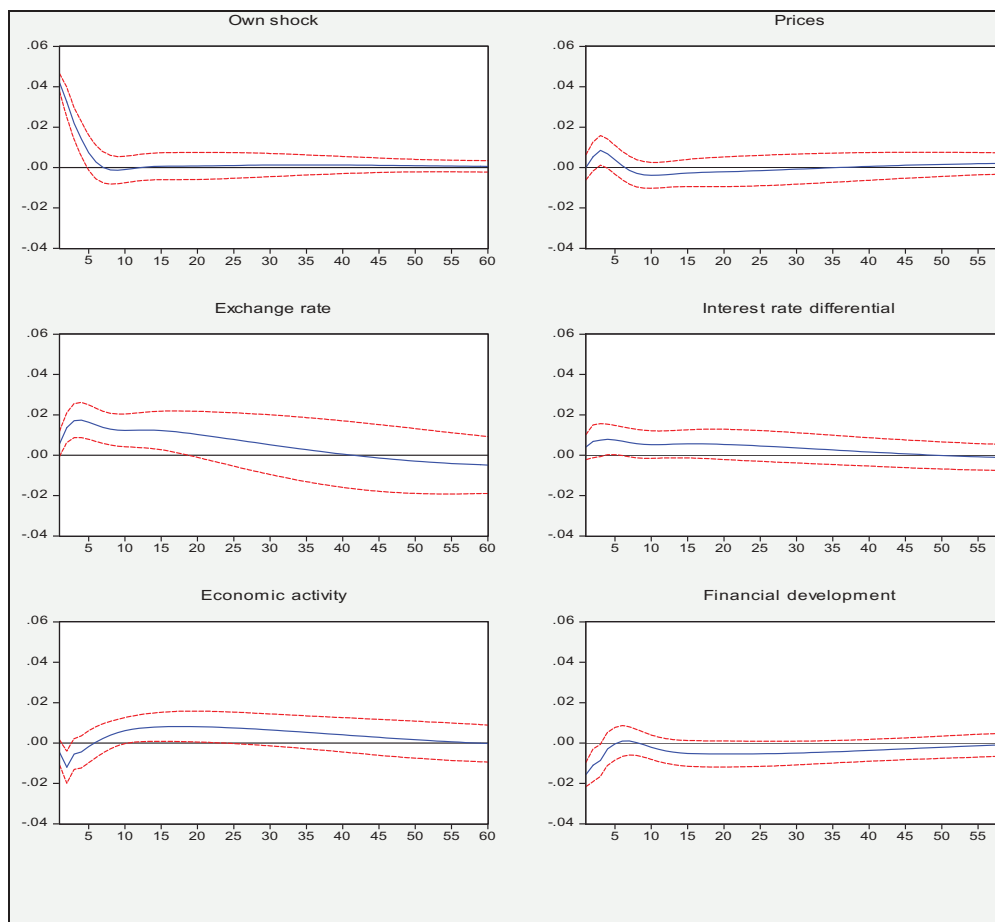


Table 3. Variance decomposition of endogenous variables

Period	S.E.	Dollarization	Prices	Exchange rate	Interest rates	Real output	Financial development
1	0.040	70.786	0.752	1.9163	0.335	0.001	26.207
6	0.067	43.071	1.060	31.293	1.340	1.714	21.519
7	0.069	39.749	1.954	35.194	1.557	1.690	19.854
8	0.072	36.667	3.143	38.165	1.760	1.827	18.436
9	0.075	33.891	4.418	40.418	1.947	2.127	17.196
12	0.084	27.469	7.521	44.645	2.439	3.680	14.243
24	0.107	17.120	10.859	48.562	4.151	10.317	8.989
36	0.116	14.544	11.332	47.027	5.374	14.083	7.637
48	0.118	14.013	11.324	45.701	5.933	15.656	7.370
60	0.119	13.997	11.231	45.435	6.034	15.925	7.375

overtaken by the proportion contributed by shocks to exchange rates within 8 months highlighting the important role of exchange rates. The role of interest rates on foreign currency deposits in the dollarization process is reflected in its contribution of less than 3% in 12 months. Also, over the whole 60 months, shocks on inflation contributed a little over 11% to the movement in dollarization. Thus, we argue that the impact of inflation has not been very important in the evolution of dollarization in Ghana. Going by economic theory, greater dollarization or currency substitution makes the domestic currency less attractive. The resultant switch to foreign currency holdings makes the control of money challenging, which leads to higher rates of inflation. However, our results seem to support that it is the reverse that is being experienced in Ghana. Rising depreciation of the cedi puts pressure on prices to rise. The importance of the exchange rate variable in the dollarization process is again underscored by the dominance of its contribution to dollarization.

5.2.4. *Granger causality tests*

We augment the short-run analysis with pairwise Granger causality tests (results not reported but available upon request). This is aimed at determining the direction of causality and the predictive power of the shocks due to other variables. According to the evidence which is available upon request from the authors, we reject the null hypothesis that exchange rates, real output, and financial deepening do not Granger-cause dollarization at the 5% significance levels. This implies that shocks to these variables matter for dollarization in the short run. Again, the returns variables are found to be insignificant in the prediction of dollarization in Ghana.

5.3. *On the effects of inflation targeting and redenomination on dollarization*

In this section, we explore the effects of two important developments in the monetary policy framework in Ghana within the past decade. These are the adoption of inflation targeting monetary policy in 2002 (but officially in May 2007) and the redenomination of the currency in July 2007. The redenomination entailed knocking four zeros off the existing denominations. Arguments that were raised to suggest that this operation would have any consequences for the value of the domestic currency were refuted blatantly by the Bank of Ghana. Indeed, the value of the currency was expected to remain the same as old currency denominations were exchanged for their equivalents in the new currency without any losses. However, the debate continues on the effects of the redenomination exercise on the depreciation of the Ghanaian cedi. This study makes another contribution to the literature on dollarization by exploring the effects that the redenomination has had on the demand for foreign currency. We capture the adoption of the inflation targeting regime by creating a dummy variable that takes 0 before 2002 and the value 1 after 2002. The redenomination is also captured by a dummy variable that takes the value 0 before May 2007 and 1 after May 2007. The results of this estimation produce no significant effect of the two variables on the level of dollarization in Ghana, both in the long-run and in the short-run. Similar to the earlier findings, exchange rate and financial development are significant in the long-run whilst the same variables in addition to real output are significant in the short-run.

6. **Conclusions and policy recommendations**

This paper explored the rising trend of dollarization in Ghana. The phenomenon holds crucial implications for the economy of Ghana and policymaking authorities of which no empirical investigation has been conducted. The empirical analysis has been based on the ARDL model and other techniques to examine the macroeconomic determinants of dollarization. The study confirmed the important role played by exchange rates in explaining demand for foreign currency in both the short-run and long-run. The evidence suggests that dollarization is generally driven by the loss of confidence in the cedi due to the deteriorating macroeconomic fundamentals and a desire by economic agents to hedge against inflation and exchange rate risks. By ensuring low rates of inflation and stable exchange rates, the Central Bank can reduce the demand for foreign currency deposits. This provides some support for Bawumia (2014) that stabilising the cedi would bring down the levels of dollarization. However, there is no guarantee that stabilising the cedi will stop the trend of dollarization due to the irreversible behaviour of the phenomenon. The policy prescription here is that the monetary authorities should take steps to tackle the causes of the weakening domestic

currency, which most often is driven by the excessive supply of the domestic currency given high import dependence, the high marginal propensity to consume imported goods and fiscal indiscipline, which most often than not lead to fiscal deficit and current account overruns.

Based on the finding that economic agents seek foreign currency deposits as a hedge, an effort directed towards developing a vibrant financial market with increased range of investment outlets becomes indispensable. Additional financial and banking sector reforms aimed at deepening and broadening the domestic financial markets would be a worthwhile endeavour to pursue. Advancing such strategies could provide alternative investment opportunities to foreign currency deposits in order to avert the challenges posed by under-developed capital markets and lack of competing investment instruments.

In conclusion, the Bank of Ghana needs to restore confidence and credibility in the domestic currency and institutions by ensuring long-term macroeconomic stability, coupled with the development of domestic risk hedging instruments and financial markets in order to reverse the trend of dollarization in Ghana. There is, therefore, an urgent need to deal with the different forms of dollarization appropriately by pursuing feasible and applicable policies that ensure the effectiveness of the cedi as a store of value, as a unit of account, and as a legal tender for transactions in Ghana. Achieving stable exchange rates and prices as well as developing the financial markets can enhance the chances of succeeding in that quest. Alternatively, the government can resort to taxation on foreign currency transactions so as to enhance the effectiveness of the Ghana cedi as the legal tender for transactions, especially when the international transactions are of a speculative nature.

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Notes

1. The phenomenon whereby residents of one country use foreign currency for domestic transactions has been loosely referred to as “dollarization” in the literature. The term has somehow been used synonymously as currency substitution. Financial dollarization, also defined as asset substitution, consists of domestic investors holding financial assets or liabilities in foreign currencies (see, De Nicolò, Honohan, & Ize, 2005; Ize & Parrado, 2002). In general, one can argue that dollarization and currency substitution have somewhat alternative meanings in the literature. However, Calvo and Vegh (1992) slightly distinguish between the terminologies by defining currency substitution as transfer of medium of exchange function of domestic currency, whereas

dollarization is described as the transfer of the store of value and unit of account functions. In this study, the term dollarization will be applied to refer to the definition of Calvo and Vegh (1992).

2. According to the Bank of Ghana, the attempts to enforce restrictions on foreign exchange transactions were meant to halt the free fall of the Cedi. In a statement issued on Friday, 08/08/2014, the Bank reversed almost all the directives. It stated that the reversal had been based on consultations with stakeholders and the general public as well as analysis of the available data and the fact that it has observed some implementation challenges, which indicated that the rules have had limited effect and confirmed the position of those who had argued earlier that the directives were inappropriate.
3. Ghana reached a US\$1bn bailout agreement with the IMF in February 2014 to shore up the economy and bring about fiscal consolidation in order to ensure stability of the cedi and further give credibility to government policies.
4. This variable is defined simply as the sum of the interest rate on dollar deposits r^* and the expected appreciation (depreciation) of the dollar (cedi). The expected depreciation is given as $(e_{t+1} - e_t)/e_t$, where the spot monthly exchange rate (amount of cedi required to purchase one unit of dollar) is denoted by se_t and the expected exchange rate for the next 12-month period by e_{t+1} . Therefore, the expected return on foreign currency deposits can be denoted as $r^* + (e_{t+1} - e_t)/e_t$.

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