REVISITING MONEY DEMAND FUNCTIONS IN COUNTRIES WITH EMERGING FINANCIAL MARKETS

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Abstract

Numerous studies have been done on the determinants of money demand in developing countries. Some of these studies neglected variables indispensable to macroeconomic management. This paper estimates the nonlinear effects of non-traditional variables with a special focus on renewable energy consumption, and crude oil market shocks on demand for narrow (M1) and broad (M2) balances in emerging countries using the methodology of the nonlinear error correction model (ECM). We found asymmetrical effects of renewable energy consumption on narrow money balances where its demand increases with renewable energy consumption in all countries except Egypt and Chad. There are asymmetrical effects of oil market shocks on M2. The finding that oil price shocks cause some positive reactions in the desire to hold cash balances in local currencies, especially when the reserve balance is low in Africa, is an original contribution to the literature on determinants of money demand. The substitution effect of currency exchange rate fluctuations is significant.

Keywords: Money Demand, Spendable Cash Balances, Crude Oil Market Shocks, Variations in Monetary Policy Rate

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1. INTRODUCTION

Numerous studies have been done on the determinants of money demand in developing countries. Some of these studies focused on traditional variables of real income, inflation, return on financial assets, etc. None of such research attempted to examine the demand for money in response to the sensitivity of renewable energy consumption and, to some extent, deficit financing. A few studies that built-in exchange rates into the money demand equation did it for narrow or broad money demand rather than for both measures. Moreover, most of these studies failed to simultaneously disentangle the effects of non-traditional predictors, such as renewable energy consumption, crude oil market shocks, and deficit financing, on narrow and broad monies in a large sample of African countries (Umoru, Effiong, Ugbaka, Iyaji, Oyegun, Okpara, et al., 2023; Dritsaki & Dritsaki, 2022; Iriabije & Effiong, 2022; Mumba & Ziramba, 2021; Elhassan, 2021). Hence, the number of cross-sections was small even when such researchers failed to analyze the devaluation effect of local currencies, knowing fully well that African currencies are persistently subjected to depreciation by their nations' governments. This paper aims to econometrically x-ray the response of money demand to shocks emanating from renewable energy consumption, budget deficit financing, and oil price variability while controlling for exchange rate movements, real income per head, and the net interest rate differential in Africa using the nonlinear ARDL error correction estimation technique.

The paper's novelty to present-day reality is that it estimates a nonlinear money demand function considering non-traditional variables of deficit financing and renewable energy consumption. Our findings are advantageous to both monetary authorities and economic policymakers. This study contributes to the literature by accommodating such variables as deficit financing and renewable energy consumption. This singular contribution brings to the fore the sensitivity of money demand to deficit financing and renewable energy consumption as against the traditional determinants of demand for money. Also, the study had an expanded scope compared to previous studies in Africa, contributing to the empirical regularity and validity of the research findings. The paper's novelty is also found in estimating a nonlinear autoregressive distributed lag (ARDL) model for both the narrow and broad demand for cash balances in Africa. The nonlinearity is conceivable theoretically, sufficiently empirically, and lifelike owing to the inclusion of both long-term and short-term dynamics of present-day realities in terms of deficit financing, renewable energy consumption, and fluctuations in oil prices, as well as instability in nominal exchange rates. Global oil prices are highly volatile, and these volatilities are most often transmitted via exchange rate pass-through effects, that is, the import price index to domestic prices in African countries. It can affect the volume of foreign exchange reserves accumulated, with implications for money demand, hence the significance of the study.

An additional novelty is situated in the fact that our measure of exchange rate movement (depreciation or appreciation) captures a broader trend in the currencies of countries in our sample by calculating the price of local currency as a weighted average of a basket of currencies and not a single foreign currency. Moreover, by estimating the money demand function with net interest rate differentials, our study contributed to the empirics of the dynamic component of the theory of interest rate parity. Also, the study established the net interest rate differential as a key variable of demand for broad as it relates to pricing currency. Nonetheless, the findings that the oil price shock forces some positive reactions in the desire to hold cash balances in local currencies, especially when the reserve balance is low in Africa, are original contributions to the literature on determinants of money demand in developing countries.

The rest of the paper is structured as follows. Section 2 reviews the literature on money demand and its determinants. Section 3 presents data and methodology. Section 4 provides the research results. Section 5 discusses the main findings. Section 6 concludes the paper.

2. THEORY AND EVIDENCE ON MONEY DEMAND AND ITS DETERMINANTS: A BRIEF REVIEW

The empirical literature on money demand and its determinants is vast, especially when such studies have focused attention on traditional determinants of demand for money. Here, we only reviewed the most recent studies to conclude. Using the pooled ordinary least squares (OLS) estimator, Kipchirchir and Mose's (2024) study discovered that the gross domestic product (GDP) growth rate and ATM availability had a positive impact on demand for money function in the Sub-Saharan Africa (SSA) region, but interest rate had a negative effect. According to Musimbi and Mose (2023), the primary factors influencing money demand were income level, savings, financial innovations, and inflation. Mestiri (2024) validated the theory that there is a negative correlation between the velocity of money and its demand in Tunisia. This is in addition to the ARDL technique's finding that GDP plays a major role in money demand. According to Mverecha (2024), real money demand negatively correlates with inflation, inflation, whereas it positively correlates with real income. The research findings also show that inflation expectations were a fundamental cause of the collapse of money demand in Zimbabwe following a persistent increase in inflation. Similarly, Andree and Herbert (2024) observed that the demand for money balances in the Central African Economic and Monetary Community (CEMAC) countries rose in response to real income but plummeted in reaction to the inflation rate. Fotie and Fotie (2024) reported that the exchange rate result does not support the currency substitution hypothesis for CEMAC countries.

Umoru, Effiong, Ugbaka, Iyaji, Oyegun, et al. (2023) established a significant substitution influence of exchange rate devaluation on demand for local currencies in thirty developing countries. Humbatova and Ramazanova (2022) established that exchange rates, interest rates, and inflation rates negatively impact money demand in Azerbaijan, whereas income is positively related to the demand for money. Also, the authors found that the function of real cash holdings is stable in Azerbaijan. Odeleyea and Akam (2022) found evidence supporting price level as the core variable influencing money demand in SSA. This finding necessitated the authors' call for a price stabilization policy in Africa. Dritsaki and Dritsaki (2022) found one-way causation from manufacturing production to M1, bi-directional causation between M1 and prime lending rate, and a one-way link between industrial output and prime lending rate to M3 in the long run. Roussel et al. (2021) reported that socioeconomic factors, such as household and government, population growth, consumer price index (CPI), and remittances, contribute significantly and positively to the demand for real cash holdings in Pakistan. In their study of money demand in Nigeria, Manasseh et al. (2021) reported that since money's velocity is predictable, a money supply target could be implemented to regulate income and inflation. Boucekkine et al. (2021) found that exchange rate elasticity is significant for Algeria's monetary aggregates M1, M2, and cash balance. Nevertheless, the elasticity of the currency exchange rate is greater for M1 and real cash holdings.

Elhassan (2021) also reported asymmetric effects of the exchange rate on demand for cash balances for the Sudanese economy. Afangideh et al. (2021) found asymmetric effects of exchange rate variability on money demand in Nigeria. According to Adil et al. (2021), financial innovation contributes positively and significantly to India's stability and determination of demand. Overall, the literature has no consensus especially as it relates to traditional factors. Hence, focusing empirical attention on the sensitivity of money demand to non-traditional factors namely renewable energy consumption and crude oil prices is highly desirable.

3. DATA AND METHODOLOGY

3.1. Data

The study employs a quarterly series of twenty African countries from 1980 (Q1) to 2023 (Q4): Nigeria, Tanzania, Namibia, Algeria, Mauritius, Nairobi, Zambia, Morocco, Tunisia, Uganda, Malawi, Ghana, South Africa, Botswana, Sudan, Egypt, Chad, Eswatini, and Swaziland. Exchange rate movements were calculated using the trade-weighted index (TWI). The interest rate differentials, a measure of the size of opportunity cost for acquiring financial assets, were calculated as the difference between domestic and foreign interest rates. The foreign interest rate was measured in terms of the US interest rate. The budget deficit was calculated as the difference between government spending and revenue. The negative sign indicates that the government's income falls short of its expenditure. The share of renewable energy consumed was calculated as the ratio of energy consumed by end users to total energy consumption. The net interest rate differential was measured as the difference between the interest rates on African currencies and the USD. As expected, the net interest rate differential between the two countries' currencies is expected to equal the difference between the current and expected exchange rates between the currencies. Real income per capita (rinc) is a scale variable calculated as real GDP per capita. Crude oil market shocks were measured as crude oil demand and supply gaps based on data from the International Energy Agency. Currency devaluation was measured as a percentage change in local currency units per USD. M1 demand for money was calculated as spending holdings of financial assets in cash and bank deposits, not investments. M2 demand for money was measured as M1 plus time and demand deposits. The data on these variables was obtained from the World Development Indicators (WDI, https://databank.worldbank.org/source/world-development-indicators) and the International Monetary Fund (IMF, https://www.imf.org/en/Data).

3.2. Methodology

The study uses the methodology of the nonlinear ARDL error correction model (ECM). We commenced a specification of the nonlinear ARDL (NARDL) models for desires to hold African currencies for narrow (M1) and broad (M2) spendable balances by specifying the long-run static demand for money equations as follows:

$$lnM1_t = \varphi_0 + \varphi_1 rnerc + \varphi_2 bdfc + \varphi_3 oilms + \varphi_4 exrmv + \varphi_5 rhead + v_{1t} \tag{1}$$

$$lnM2_t = \delta_0 + \delta_1 rnerc + \delta_2 bdfc + \delta_3 oilms + \delta_4 exrmv + \delta_5 rhead + v_{2t} \tag{2}$$

where *rnerc* is renewable energy consumption, *bdfc* is budget deficits, *oilms* is oil price variations, *exrmv* is nominal effective exchange movements, *rhead* is the real income per head, and interest rate differentials is a measure of opportunity cost for holding financial assets. The model of asymmetry that separates the effects of increase and decrease in the non-traditional variables based on the economic theory of money demand can be specified as follows:

$$lnM1_t = \varphi_0 + \varphi_1^- rnerc^- + \varphi_1^+ rnerc^+ + \varphi_2^- bdfc^- + \varphi_2^+ bdfc^+ + \varphi_3^- oilms^- + \varphi_3^+ oilms^+ + \varphi_4^- exrmv^- + \varphi_4^+ exrmv^+ + \varphi_5 rhead + v_{1t} \tag{3}$$

$$lnM2_t = \delta_0 + \delta_1^- rnerc^- + \delta_1^+ rnerc^+ + \delta_2^- bdfc^- + \delta_2^+ bdfc^+ + \delta_3^- oilms^- + \delta_3^+ oilms^+ + \delta_4^- exrmv^- + \delta_4^+ exrmv^+ + \delta_5 rhead + v_{2t} \tag{4}$$

where $rnerc^-_{t-i}$ is the fractional totality of negative change (decline) in renewable energy consumption, $rnerc^+_{t-i}$ is the fractional totality of positive change (increase) in renewable energy consumption, $bdfc^-_{t-i}$ is the fractional sum of negative change in the budget deficit, $bdfc^+_{t-i}$ is the fractional sum of positive change (increase) in budget deficits, $oilms^-_{t-i}$ is the fractional sum of negative change (decrease) in oil prices, $oilms^+_{t-i}$ is the fractional sum of positive change (increase) in oil prices, $exrmv^-_{t-i}$ is the fractional sum of negative change (appreciation) in nominal effective exchange movement, $exrmv^+_{t-i}$ is the fractional sum of positive change (devaluation) in nominal effective exchange movement. These positive and negative changes are further defined as follows.

$$rnerc_{t-i}^{-} = \sum_{j=1}^{t} \Delta rnerc_j^{-} = \sum_{j=1}^{t} min(\Delta rnerc_j, 0)$$
$$rnerc_{t-i}^{+} = \sum_{j=1}^{t} \Delta rnerc_j^{+} = \sum_{j=1}^{t} max(\Delta rnerc_j, 0) \quad (5)$$

$$bdfc_{t-i}^{-} = \sum_{j=1}^{t} \Delta bdfc_j^{-} = \sum_{j=1}^{t} min(\Delta bdfc_j, 0)$$
$$bdfc_{t-i}^{+} = \sum_{j=1}^{t} \Delta bdfc_j^{+} = \sum_{j=1}^{t} max(\Delta bdfc_j, 0) \quad (6)$$

$$oilms_{t-i}^{-} = \sum_{j=1}^{t} \Delta oilms_j^{-} = \sum_{j=1}^{t} min(\Delta oilms_j, 0)$$
$$oilms_{t-i}^{+} = \sum_{j=1}^{t} \Delta oilms_j^{+} = \sum_{j=1}^{t} max(\Delta oilms_j, 0) \quad (7)$$

$$exrmv_{t-i}^{-} = \sum_{j=1}^{t} \Delta exrmv_j^{-} = \sum_{j=1}^{t} min(\Delta exrmv_j, 0)$$
$$exrmv_{t-i}^{+} = \sum_{j=1}^{t} \Delta exrmv_j^{+} = \sum_{j=1}^{t} max(\Delta exrmv_j, 0) \quad (8)$$

The nonlinear long-run asymmetric augmented models of M1 and M2 are so specified accordingly:

$$\begin{aligned} \Delta lnM1_t = {} & \varphi_0 + \beta \ln M\,1_t + \varphi_1^{-} rnerc^{-} + \varphi_1^{+} rnerc^{+} + \varphi_2^{-} bdfc^{-} + \varphi_2^{+} bdfc^{+} + \varphi_3^{-} oilms^{-} + \varphi_3^{+} oilms^{+} \\ & + \varphi_4^{-} exrmv^{-} + \varphi_4^{+} exrmv^{+} + \varphi_5 rhead + \ell_6 intrd + \sum_{i=0}^{m} \phi_i^{-} \Delta rnerc_{t-i}^{-} + \sum_{i=0}^{m} \phi_i^{+} \Delta rnerc_{t-i}^{+} \\ & + \sum_{i=0}^{m} \lambda_i^{-} \Delta bdfc_{t-i}^{-} + \sum_{i=0}^{m} \lambda_i^{+} \Delta bdfc_{t-i}^{+} + \sum_{i=0}^{m} \gamma_i^{-} \Delta oilms_{t-i}^{-} + \sum_{i=0}^{m} \gamma_i^{+} \Delta oilms_{t-i}^{+} \\ & + \sum_{i=0}^{m} \alpha_i^{-} \Delta exrmv_{t-i}^{-} + \sum_{i=0}^{m} \alpha_i^{+} \Delta exrmv_{t-i}^{+} + \sum_{i=0}^{m} \varpi_i \Delta \ln M\,1_{t-i} + \sum_{i=0}^{m} \theta_i \Delta \ln r\,head_{t-i} \\ & + \sum_{i=0}^{m} \eta_i \Delta intrd_{t-i} + v_{1_t} \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta lnM2_t = {} & \delta_0 + \rho \ln M\,2_t + \delta_1^{-} rnerc^{-} + \delta_1^{+} rnerc^{+} + \delta_2^{-} bdfc^{-} + \delta_2^{+} bdfc^{+} + \delta_3^{-} oilms^{-} + \delta_3^{+} oilms^{+} \\ & + \delta_4^{-} exrmv^{-} + \delta_4^{+} exrmv^{+} + \delta_5 rhead + \partial_6 intrd + \sum_{i=0}^{m} \mu_i^{-} \Delta rnerc_{t-i}^{-} + \sum_{i=0}^{m} \mu_i^{+} \Delta rnerc_{t-i}^{+} \\ & + \sum_{i=0}^{m} \sigma_i^{-} \Delta bdfc_{t-i}^{-} + \sum_{i=0}^{m} \sigma_i^{+} \Delta bdfc_{t-i}^{+} + \sum_{i=0}^{m} \xi_i^{-} \Delta oilms_{t-i}^{-} + \sum_{i=0}^{m} \xi_i^{+} \Delta oilms_{t-i}^{+} \\ & + \sum_{i=0}^{m} \zeta_i^{-} \Delta exrmv_{t-i}^{-} + \sum_{i=0}^{m} \zeta_i^{+} \Delta exrmv_{t-i}^{+} + \sum_{i=0}^{m} \varsigma_i \Delta \ln M\,2_{t-i} + \sum_{i=0}^{m} \Theta_i \Delta \ln r\,head_{t-i} \\ & + \sum_{i=0}^{m} \tau_i \Delta intrd_{t-i} + v_{2_t} \end{aligned} \quad (10)$$

The NARDL ECM linked to the asymmetric co-integration formulation is specified thus:

$$\begin{aligned} \Delta lnM1_t = {} & \varphi_0 + \beta ecm_{t-1} + \sum_{i=0}^{m} \phi_i^{-} \Delta rnerc_{t-i}^{-} + \sum_{i=0}^{m} \phi_i^{+} \Delta rnerc_{t-i}^{+} + \sum_{i=0}^{m} \lambda_i^{-} \Delta bdfc_{t-i}^{-} + \sum_{i=0}^{m} \lambda_i^{+} \Delta bdfc_{t-i}^{+} \\ & + \sum_{i=0}^{m} \gamma_i^{-} \Delta oilms_{t-i}^{-} + \sum_{i=0}^{m} \gamma_i^{+} \Delta oilms_{t-i}^{+} + \sum_{i=0}^{m} \alpha_i^{-} \Delta exrmv_{t-i}^{-} + \sum_{i=0}^{m} \alpha_i^{+} \Delta exrmv_{t-i}^{+} \\ & + \sum_{i=0}^{m} \varpi_i \Delta \ln M\,1_{t-i} + \sum_{i=0}^{m} \theta_i \Delta \ln r\,head_{t-i} + \sum_{i=0}^{m} \eta_i \Delta intrd_{t-i} + v_{1_t} \end{aligned} \quad (11)$$

where

$$\begin{aligned} ecm_{1t-1} = {} & lnM1_t - (\varphi_1^{-} rnerc^{-} + \varphi_1^{+} rnerc^{+} + \varphi_2^{-} bdfc^{-} + \varphi_2^{+} bdfc^{+} + \varphi_3^{-} oilms^{-} + \varphi_3^{+} oilms^{+} + \varphi_4^{-} exrmv^{-} \\ & + \varphi_4^{+} exrmv^{+} + \varphi_5 rhead + \ell_6 intrd)/\beta \end{aligned}$$

$$\Delta lnM2_t = \delta_0 + \rho ecm_{t-1} + \sum_{i=0}^{m} \mu_i^- \Delta rnerc_{t-i}^- + \sum_{i=0}^{m} \mu_i^+ \Delta rnerc_{t-i}^+ + \sum_{i=0}^{m} \sigma_i^- \Delta bdfc_{t-i}^- + \sum_{i=0}^{m} \sigma_i^+ \Delta bdfc_{t-i}^+ + \sum_{i=0}^{m} \xi_i^- \Delta oilms_{t-i}^- + \sum_{i=0}^{m} \xi_i^+ \Delta oilms_{t-i}^+ + \sum_{i=0}^{m} \zeta_i^- \Delta exrmv_{t-i}^- + \sum_{i=0}^{m} \zeta_i^+ \Delta exrmv_{t-i}^+ + \sum_{i=0}^{m} \varsigma_i \Delta \ln M2_{t-i} + \sum_{i=0}^{m} \Theta_i \Delta \ln r\,head_{t-i} + \sum_{i=0}^{m} \tau_i \Delta intrd_{t-i} + v_{2t} \quad (12)$$

where

$$ecm_{2t-1} = lnM2_t - (\delta_1^- rnerc^- + \delta_1^+ rnerc^+ + \delta_2^- bdfc^- + \delta_2^+ bdfc^+ + \delta_3^- oilms^- + \delta_3^+ oilms^+ + \delta_4^- exrmv^- + \delta_4^+ exrmv^+ + \delta_5 rhead + \partial_6 intrd)/\rho$$

The asymmetric long-run parameters for M1 and M2 equations are given in Table 1.

Table 1. Long-run parameters

Asymmetric long-run parameters for the M1 model	*Asymmetric long-run parameters for the M2 model*
$\varphi^+ = \phi_1^+/\beta$	$\mu^+ = \delta_1^+/\rho$
$\varphi\text{-} = \phi_1^-/\beta$	$\mu\text{-} = \delta_1^-/\rho$
$\lambda^+ = \phi_2^+/\beta$	$\sigma^+ = \delta_2^+/\rho$
$\lambda^- = \phi_2^-/\beta$	$\sigma\text{-} = \delta_2^-/\rho$
$\gamma^+ = \phi_3^+/\beta$	$\xi^+ = \delta_3^+/\rho$
$\gamma\text{-} = \phi_3^-/\beta$	$\xi\text{-} = \delta_3^-/\rho$
$\alpha^+ = \phi_4^+/\beta$	$\zeta^+ = \delta_4^+/\rho$
$\alpha\text{-} = \phi_4^-/\beta$	$\zeta\text{-} = \delta_4^-/\rho$

The Wald test statistic was deployed to test for asymmetry in the long and short run. The underlying long-run hypothesis for the M1 equation is stated as follows:

$$H_o: \varphi^+ = \varphi\text{-}(symmetry)\ vs.\, H_1: \varphi^+ \neq \varphi\text{-}(asymmetry)$$
$$H_o: \lambda^+ = \lambda\text{-}(symmetry)\ vs.\, H_1: \lambda^+ \neq \lambda\text{-}(asymmetry)$$
$$H_o: \gamma^+ = \gamma\text{-}(symmetry)\ vs.\, H_1: \gamma^+ \neq \gamma\text{-}(asymmetry)$$
$$H_o: \alpha^+ = \alpha\text{-}(symmetry)\ vs.\, H_1: \alpha^+ \neq \alpha\text{-}(asymmetry)$$

The underlying long-run hypothesis for the M2 equation is stated as follows:

$$H_o: \mu^+ = \mu\text{-}(symmetry)\ vs.\, H_1: \mu^+ \neq \mu\text{-}(asymmetry)$$
$$H_o: \sigma^+ = \sigma\text{-}(symmetry)\ vs.\, H_1: \sigma^+ \neq \sigma\text{-}(asymmetry)$$
$$H_o: \xi^+ = \xi\text{-}(symmetry)\ vs.\, H_1: \xi^+ \neq \xi\text{-}(asymmetry)$$
$$H_o: \zeta^+ = \zeta\text{-}(symmetry)\ vs.\, H_1: \zeta^+ \neq \zeta\text{-}(asymmetry)$$

The underlying short-run hypothesis for M1 equation for every i = 0..., m - 1, is stated as follows:

$$H_o: \sum_{i=0}^{m-1} \varphi_i^+ = \sum_{i=0}^{m-1} \varphi_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \varphi_i^+ \neq \sum_{i=0}^{m-1} \varphi_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \lambda_i^+ = \sum_{i=0}^{m-1} \lambda_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \lambda_i^+ \neq \sum_{i=0}^{m-1} \lambda_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \gamma_i^+ = \sum_{i=0}^{m-1} \gamma_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \gamma_i^+ \neq \sum_{i=0}^{m-1} \gamma_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \alpha_i^+ = \sum_{i=0}^{m-1} \alpha_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \alpha_i^+ \neq \sum_{i=0}^{m-1} \alpha_i^+\ (asymmetry)$$

The underlying short-run hypothesis for M2 equation for every i = 0..., m - 1), is stated as follows:

$$H_o: \sum_{i=0}^{m-1} \mu_i^+ = \sum_{i=0}^{m-1} \mu_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \mu_i^+ \neq \sum_{i=0}^{m-1} \mu_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \sigma_i^+ = \sum_{i=0}^{m-1} \sigma_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \sigma_i^+ \neq \sum_{i=0}^{m-1} \sigma_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \xi_i^+ = \sum_{i=0}^{m-1} \xi_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \xi_i^+ \neq \sum_{i=0}^{m-1} \xi_i^+\ (asymmetry)$$
$$H_o: \sum_{i=0}^{m-1} \zeta_i^+ = \sum_{i=0}^{m-1} \zeta_i^+\ (symmetry)\ vs.\, H_1: \sum_{i=0}^{m-1} \zeta_i^+ \neq \sum_{i=0}^{m-1} \zeta_i^+\ (asymmetry)$$

There are other estimation methods for estimating the determinants of money demand. These include generalized method of moments (GMM); quantile regression techniques; vector error correction methods; structural vector autoregression (SVAR) methods; etc. We estimated our demand functions with the NARDL method because it allows us to test for asymmetry and also acquires both the short- and long-term effects of our predictive variables in influencing the demand for money. The study used monthly data for 1980:Q1 to 2023:Q4 to cater for the assumption of several periods less than several cross sections. To guarantee robust estimates, the data set of the variables used was dynamically log-transformed to avoid serially connected problems.

4. RESULTS

All preliminary tests including Wald test results are not reported to minimize the number of words required by the journal. Tables A.1–A.5 (see Appendix) presents the main results of the nonlinear ARDL model for money demand function for all the countries in our sample. Notably, *** denotes significance at 0.01 level, and ** represents significance at 0.05 level.

Table 2 reports the MeanF, SupF, and Lc are the three Gregory and Hansen's (1996) stability test results of the money demand functions of all the countries in our sample.

Table 2. Hansen stability test results

Country	***SupF***	***MeanF***	***Lc***
Nigeria	15.677***	16.167***	6.380***
	10.1323***	13.134***	5.393***
Tanzania	14.349***	14.321***	9.287***
	9.122***	12.981***	5.120***
Namibia	16.546***	14.287***	8.134***
	12.491***	15.491***	5.265***
Algeria	11.391***	15.112***	4.256***
	12.387***	19.127***	6.189***
Mauritius	1.568	1.587	5.122***
	13.472***	12.089***	9.102***
Namibia	1.087	1.254	0.387
	13.109***	13.221***	6.289***
Zambia	15.389***	14.292***	6.123***
	12.324***	13.220***	7.409***
Kenya	17.139***	15.289***	5.422***
	11.229***	11.278***	4.567***
Morocco	14.287***	12.271***	5.281***
	11.297***	11.278***	6.890***
Tunisia	15.211***	12.309***	6.321***
	12.390***	14.190***	5.302***
Uganda	14.281***	13.298***	7.389***
	11.233***	16.211***	8.289***
Malawi	13.029***	10.189***	5.234***
	13.154***	14.221***	6.209***
Ghana	10.192***	14.289***	8.179***
	12.117***	10.123***	4.287***
South Africa	1.267	1.014	0.222
	10.219***	16.235***	8.162***
Botswana	1.119	1.125	1.281
	19.263***	21.382***	6.113***
Sudan	15.392***	13.398***	6.238***
	12.290***	14.355***	9.287***
Egypt	11.348***	18.201***	5.289***
	19.113***	8.176***	6.328***
Chad	12.320***	12.289***	5.209***
	16.321***	11.137***	9.871***
Eswatini	11.202***	18.293***	6.216***
	12.331***	14.289***	6.543***
Swaziland	14.324***	16.392***	6.553***
	13.224***	19.234***	6.791***

5. DISCUSSION

The NARDL estimates for M1 and M2 shown in Tables A.1–A.5 above are relatively similar, especially in the coefficient sign. The coefficients have contradictory signs. A 1% increase in renewable energy consumption stimulated demand for M1 by 0.903% in Nigeria, 0.12% in Tanzania, 0.011% in Namibia, 0.049% in Algeria, 0.201% in Mauritius, 0.222% in Nairobi, 0.011% in Zambia, 0.46% in Kenya, 0.1035 in Morocco, 0.121% in Tunisia, 0.024% in Uganda, 0.578% in Malawi, 0.112% in Ghana, 0.461% in South Africa, 0.952% in Botswana, 0.327% in Sudan, 0.053% in Eswatini, and 0.407% in Swaziland have significant t-values indicating that 1% appreciation in the exchange rates of the emerging countries increases the demand for MI and M2 money holding, respectively. It generated a reduction in the demand for M1 by 1.031% and 0.179% in Egypt and Chad, respectively. Similarly, a 1% upsurge in energy consumption increased the demand for M2 in all countries in the study except Namibia, Kenya, and Sudan, where demand for M2 dropped by 0.023%, 0.091%, and 0.13%, respectively.

On the other hand, a 1% decline in renewable energy consumption resulted in a reduction in the demand for M2 by 0.001% in Namibia, 0.003% in Algeria, 0.021% in Mauritius, 0.308% in Nairobi, 0.061% in Zambia, 0.446% in Kenya, 0.761% in Morocco, 0.281% in Tunisia, 0.005% in Uganda, 0.246% in Malawi, 0.045% in Ghana, 0.591% in South

Africa, 0.924% in Botswana, 0.056% in Sudan, 0.011% in Egypt, and 0.031% in Chad, respectively. Apart from Malawi, where a 1% drop in renewable energy reduced the demand for M1 by 0.236%, its effect on M1 in other countries was positive. The effect was different for Nigeria, Tanzania, Eswatini, and Sudan, where it induced an increase in demand for M2 by 0.695% in Nigeria, 0.308% in Tanzania, 0.473% in Eswatini, and 0.986% in Sudan, respectively. In effect, renewable energy consumption has asymmetrical effects on African money demand. Demand for narrow money balances increases with renewable energy consumption in all emerging African countries in our sample, whereas demand for M2 decreases with renewable energy consumption for developing African economies.

Regarding the long-term impact of changes in budget deficits on the demand for M1 and M2, the same positive coefficient sign was obtained for both. For M1, the coefficients of and are 1.203 and 0.073 for Nigeria, 0.083 and 0.016 for Tanzania, 0.02 and 0.011 for Namibia, 0.041 and 0.033 for Algeria, 0.569 and 0.031 for Mauritius, 0.013 and 0.019 for Nairobi, 0.498 and 0.011 for Zambia, 0.255 and 0.033 for Kenya, 0.563 and 0.045 for Morocco, 0.011 and 0.015 for Tunisia, 0.03 and 0.044 for Uganda, 0.111 and 0.098 for Malawi, 0.123 and 0.011 for Ghana, 0.061 and 0.012 for South Africa, 0.156 and 0.012 for Botswana, 0.092 and 0.014 for Sudan, 0.1 and 0.051 for Egypt, 0.066 and 0.017 for Chad, 0.246 and 0.013 for Eswatini, and 0.545 and 0.009 for Swaziland with significant t-values, respectively. Similarly, with M2 demand for money, the coefficients of and are 0.011 and 1.031 for Nigeria, 0.05 and 0.282 for Tanzania, 0.055 and 0.091 for Namibia, 0.021 and 0.015 for Algeria, 0.768 and 0.942 for Mauritius, 0.005 and 0.112 for Nairobi, 0.051 and 0.293 for Zambia, 0.013 and 0.715 for Kenya, 0.014 and 1.019 for Morocco, 0.423 and 0.452 for Tunisia, 0.012 and 0.188 for Uganda, 0.224 and 0.195 for Malawi, 0.594 and 1.091 for Ghana, 0.025 and 0.17 for South Africa, 0.012 and 0.16 for Botswana, 0.446 and 0.681 for Sudan, 0.015 and 0.236 for Egypt, 0.025 and 0.13 for Chad, 0.18 and 0.154 for Eswatini, and 0.034 and 0.01 for Swaziland with significant t-values, respectively.

The effect of budget deficits on money demand is symmetric. It implies that demand for narrow and broad money balances rises with an increase or decrease in the budget deficit. Based on the results obtained, the positive coefficients could reveal cyclical deficits, with the implication that these emerging African economies are weak economies where tax revenues fall as the prospects for business profits and domestic income decline amid high unemployment levels. Most worrisome is that these African governments do not incur a deficit to finance long-term programs such as infrastructure projects, namely, roads, bridges, and education required to boost the productive capacity of their economies. The results can also be explained by the fact that African governments mostly borrow or print money to finance the deficit. However, this frequently resulted in hyperinflation, causing devaluation in the purchasing power of the local currency. Realistically, Africa's current outstanding government debt is the accumulated deficit from previous years.

The results show the asymmetrical effects of oil market shocks on M2, while a symmetric effect was established for M1. A positive shock to the global oil market had serious implications for the desire to hold local currencies in form for spendable motives. Indeed, demand for local currency is significantly and negatively correlated with oil price shocks. Positive patterns were observed concerning crude oil market shocks. In other words, rising shocks from the crude oil market increase the demand for money in Africa. Accordingly, oil market shock forces some positive (opposing) reactions in the desire to hold narrow and broad spendable balances in local currencies, especially when the reserve balance is low in Africa, indicating a currency substitution effect. It could be attributed to the fact that transactions demanding money are driven by USD in Africa. For example, African countries that export crude oil only accept payments in USD, while those that import it pay for it in USD. It explicitly raises the desire to hold the global reserve currency, the American greenback, after reducing the desire to hold domestic currency. Moreover, the crude oil market-induced inflationary pressures during business cycles that result in high volatility in the oil market render the exchange rate of local currencies worthless. Hence, the negative reactions of narrow and broad money holdings to crude oil market shocks.

In the long run, results reveal that the reported negative coefficients denote exchange rate devaluation for M1 and M2. These coefficients, namely -0.612 and -0.765 for Nigeria, -0.011 and -0.019 for Tanzania, -0.018 and -0.007 for Namibia, -0.021 and -0.001 for Algeria, and -0.022 and -0.101 for Mauritius, -0.002 and -0.004 for Nairobi, -0.594 and -0.643 for Zambia, -0.941 and -0.506 for Kenya, -0.043 and -0.054 for Morocco, -0.022 and -0.013 for Tunisia, -0.012 and -0.009 for Uganda, -0.035 and -0.019 for Malawi, -0.711 and -0.820 for Ghana, -0.045 and -0.0122 for South Africa, -0.012 and -0.053 for Botswana, -0.035 and -0.021 for Sudan, -0.034 and -0.051 for Egypt, -0.013 and -0.02 for Chad, -0.014 and -0.013 for Eswatini, -0.007 and -0.066 for Swaziland have significant t-values, indicating that a 1% devaluation in the exchange rates of the emerging countries decreases the demand for MI and M2 money holdings, respectively.

Also, results indicate that appreciation in the currency as denoted by conveys positive coefficients of 0.113 and 0.106 for Nigeria, 0.112 and 0.116 for Tanzania, 0.318 and 0.567 for Namibia, 0.421 and 0.389 for Algeria, 0.139 and 0.111 for Mauritius, 0.15 and 0.469 for Nairobi, 0.3 and 0.478 for Zambia, 0.121 and 0.119 for Kenya, 0.1 and 0.234 for Morocco, 0.198 and 0.112 for Tunisia, 0.153 and 0.16 for Uganda, 0.14 and 0.105 for Malawi, 0.15 and 0.114 for Ghana, 0.11 and 0.192 for South Africa, 0.173 and 0.126 for Botswana, 0.108 and 0.102 for Sudan,0.81 and 0.614 for Egypt, 0.21 and 0.12 for Chad, 0.103 and 0.624 for Eswatini, 0.166 and 0.5 for Swaziland have significant t-values indicating that 1% appreciation in the exchange rates of the emerging countries increases the demand for MI and M2 money holding respectively. These coefficients all passed the significance test, even at the 1% level. In effect, exchange rate appreciation increased to M1 and M2, respectively. The negative coefficient of the exchange rate establishes the substitution effect of devaluation in the exchange rate, whereby demand for foreign currency substitutes for demand for local currency, while positive coefficients signify the wealth effect. With these, the study established the asymmetrical effects of exchange rate movements on demand for

M1 and M2 in Africa. The absolute values of estimated coefficients and the wealth effect of currency exchange rate fluctuation exceeded the substitution effect, except in the cases of Nigeria, Kenya, Ghana, and Zambia. By implication, economic agents would only prefer to hold local currency when it appreciates, while their preference for foreign currency would rise once the local currency devalues. The results laid credence to findings obtained by Umoru, Effiong, Ugbaka, Iyaji, Okpara, et al. (2023) for thirty emerging nations, where it was established that as additional units of the local currency are exchanged for a unit of foreign currency such as the dollar, residents of domestic economies are disheartened to increase demand for money in local money and rather hold fewer local currencies. The results also supported those found for the Tunisian economy by Neifar and Kammoun (2022) and Mahmood and Alkhateeb (2018) in Saudi Arabia.

The coefficients of currency devaluation are negative for both narrow and broad money holdings, implying that devaluation reduces demand for domestic currency holdings but raises the desire to hold foreign currencies. Hence, the devaluation of African currencies results in the reduced holding of local currencies for M1 and M2 purposes, respectively. This is a validation of currency substitution in line with the findings of Azim et al. (2010), and Kole et al. (2020) for South Africa and the long-run negative effect of currency devaluation on money demand by Bahmani-Oskooee and Gelan (2009) for 21 African countries. Overwhelmingly, the less favourable exchange rate devaluation is met with money demand for foreign currencies to cover up the increased price effect on the domestic economy from the rising cost of manufacturing, transportation, and other economic activities. It is because the devaluation effect of the local currencies exacerbates domestic inflation by weakening the local money's purchasing power.

The short-run estimates are significant. In all models of money demand (linear and nonlinear), the $ecm_{(t-1)}$ coefficients are all negative and significantly different from zero. It provides evidence supporting linear and nonlinear adjustments from the short run to the long run and the relative convergence of short-term disequilibrium in money demand towards long-run equilibrium. For example, 78% (60%), 98% (50%), 81% (60%), 53% (62%), 55% (69%), 70% (68%), 59% (60%), 90% (40%), 51% (54%), 61% (90%), 67% (46%), 82% (66%), 61% (55%), 79% (60%), 57% (42%), 46% (80%), 58% (50%), 65% (49%), 52% (49%), and 68% (82%) of the variations or disequilibrium in M1 is adjusted and made to converge to equilibrium quarterly in Nigeria, Tanzania, Namibia, Algeria, Mauritius, Nairobi, Zambia, Kenya, Morocco, Tunisia, Uganda, Malawi, Ghana, South Africa, Botswana, Sudan, Egypt, Chad, Eswantini, and Swaziland, respectively.

The results uphold negative relationships between money holdings and net interest rate differentials. A 1% increase in net interest rate differentials reduces the desire to hold domestic currencies in the form of narrow and broad spendable holdings in Nigeria by 0.038% and 0.002% in Nigeria, by 0.011% and 0.003% in Tanzania, 0.012% and 0.046% in Namibia, 0.016% and 0.011% in Algeria, 0.08% and 0.001% in Mauritius, 0.012% and 0.003% in Nairobi, 0.112% and 0.046% in Zambia, 0.016% and 0.014% in Kenya, 0.011% and 0.003% in Morocco, 0.014% and 0.012% in Tunisia, 0.034% and 0.022% in Uganda, 0.015% and 0.056% in Malawi, 0.051% and 0.004% in Ghana, 0.012% and 0.01% in South Africa, 0.004% and 0.062% in Botswana, 0.026% and 0.016% in Sudan, 0.021% and 0.002% in Egypt, 0.011% and 0.01% in Chad, 0.012% and 0.032% in Eswantini, and 0.016% and 0.116% in Swaziland respectively in the in long-run. The result is in line with the theory.

The Keynesian economic theory situates interest rate variations as an instrument for swaying consumer spending. Accordingly, the interest rate varies depending on how much disposable income consumers tend to spend or save in terms of marginal propensity to consume (MPC) or marginal propensity to save (MPS) (Keynesian economics). The currency of the country whose interest rate is higher is frequently bought to benefit from higher returns, while the currency of the country with a lower interest rate is sold out. When the Federal Reserve starts to tighten monetary policy, inflation normally rises and emerging market production declines. Consumer prices in the Gulf Co-operation Council (GCC) countries, except for Bahrain and Kuwait, respond favourably to exchange rate shocks, as well as to price shocks for oil and foreign partners, as well as to domestic credit, and domestic inflation is significantly and persistently impacted by supply and interest rate shocks in the Euro Area. Also, our findings corroborate the short-run findings of Kole et al. (2020) for South Africa, whereby a 1% rise in interest rate considerably shrinks M3 by 1.9%. It validates the fact that a higher interest rate induces lower money demand expectations as individuals prefer to hold interest-bearing assets over money.

Given that interest rates are fixed by monetary authorities, usually the central banks, in response to macroeconomic conditions, in the emerging African countries considered in our sample, macroeconomic adjustment is inversely correlated with net interest rate differentials, and increased output and booms in a year cause the interest rate to weaken in the next year. It, in turn, reduces demand for money that would have otherwise stemmed from rising economic conditions, as households and firms would prefer to use money in the real sector than hold it in banks for low interest rates a confirmation of Tobin's portfolio theory. The underdevelopment of financial markets and information asymmetry in these developing economies are likely causes of money demand directly responding to variations in the monetary policy rate. Interest rate targeting would also be weak within these economies, given the direct relationship. Nevertheless, monetary authorities can use monetary policy rates as short-term interventions to control money demand and boost the real sector of the economy. The results of both the short-run and long-term relationship between real income per head and money demand are positive. It implies, throughout the study, that a rise in per capita income raises the desire to hold local currencies for narrow and broad uses. It validates the economic theory.

Nigeria, Tanzania, Namibia, Algeria, Zambia, Kenya, Morocco, Tunisia, Ghana, Sudan, Egypt, Eswatini, and Swaziland all have unstable money demand, according to the findings in Tables A.1–A.5. This outcome is consistent with those that Dell'Anno and Adu (2020), Ehiedu et al. (2020), Etim and Daramola (2020), and Medina et al. (2017) reported and discussed. MeanF, SupF, and Lc — the three Gregory and Hansen's (1996) parameter stability tests

— strongly contradict the null prediction at the 5% level that the money demand function is stable in 17 of 20 nations with low-sized equity market capitalization. The low gross national income (GNI) per capita, which ranges from $1,086 to $4,255 (WDI, https://databank.worldbank.org/source/world-development-indicators), and the fact that these nations are part of the lower middle-income cohort may be highlighted by such money demand instability. Malawi, Uganda, Chad, and Sudan are low-income nations that since 2023 had GNPs per capita of $640, $930, $1,940, and $1,110, respectively, according to the World Bank (2024). The dominance of the banking industry and the low level of business are two recurring features of the majority of Africa's immature financial markets. For instance, the banking industry in Chad accounts for about 87% of the total assets of the financial industry, indicating that the country's financial sector is immature (IMF, https://www.imf.org/en/Data). Due to their insignificant size, lack of corporate listings, low market capitalization, insufficient liquidity, and inadequate regulation to mitigate financial hazards and hence mobilize capital into profitable investments, the markets are less efficient.

Malawi's financial innovation as a percentage of real GDP growth in 2023 is 1.5%. As a proportion of nominal GDP, market capitalization stands at 17.8% in Nigeria, 9.5% in Nairobi, 6% in Swaziland, 8.84% in Tanzania, 16% in Egypt, 6.75% in Eswantini, 0.9% in Sudan, and 8.8% in Ghana as of December 2023 as against 10.5% in 2022. In 2022, Namibia's market capitalization as a proportion of GDP was 17.18%, whereas Zambia's was 15.6%, Kenya's was 14.2%, Tunisia's was 17.39%, and Uganda's was 10%. As of 2021, Malawi's market capitalization stood at 14.7% of GDP (World Bank, 2024). These statistics depict the low sizes of the equities markets of the nations that make up our sample. Essentially, the entire market worth of all publicly traded companies in Africa is precisely small. In actuality, just a negligible percentage of total GDP is represented by the market value of all traded enterprises in the country. Accordingly, each of the above low- and middle-income countries has a very fragile equities market in relation to its GDP. Despite the reforms implemented to increase the effectiveness of regulatory frameworks, there are regrettably insufficient attempts to integrate capital markets through encouraging cross-border listings and technology exchange. Nigeria, for instance, has a GNI per capita of $1,930 as of 2023 (WDI, https://databank.worldbank.org/source/world-development-indicators). The GNI for 2022 was 10.65% higher than this income level. As the cash-in-advance theory posits, the high rates of inflation and currency devaluation heighten the negative consequences of ineffective monetary policy on cash holdings. All things considered, Africa's low-income nations are extremely susceptible to external threats, notably disruptions in the supply of crude oil and international epidemics. These further exacerbate the instability of money demand. This is exclusively noticeable in Nigeria, which depends heavily on imports. As a result, changes in foreign policy and external volatility in oil prices worsen the demand for money, which in turn fluctuates the money demand function.

The volatility of money demand in the African countries can be taken as an indication of the economic difficulties the citizens of these countries have faced. These include prolonged job loss, extensive poverty, constrained access to financial services, ineffective leadership, unequal earnings, insufficient food supply, explosive population, and the effects of global warming. Additionally, issues with excessive local currency depreciation, a heavy reliance on imports, weak management of monetary and macroeconomic policies, supply-side interruptions, and high inflation rates all play a major role in the instability of money demand function. The swings of inflation rates and local currency exchange serve as an example of Africa's clumsy economic policy management.

A significant amount of economic activity, transactions, payments, and exchanges take place outside of the official financial arena in those previously mentioned low and middle-income economies, which are typified by a sizable informal sector (Dell'Anno & Adu, 2020; Ehiedu et al., 2020; Etim & Daramola, 2020; Medina et al., 2017). This significantly reduces tax revenue and increases the volatility of money demand by reducing access to government services (Altshuler, 2023; Vusal & Zohrab, 2024). Given that it impacts the traditional banking system less, the low dependence on the digital currency market also adds to this volatility (World Bank, 2024). Botswana is an upper middle-income country; as a percentage of GDP, Botswana's market capitalization stands at 18.2% (IMF, https://www.imf.org/en/Data). Nonetheless, Botswana's money demand function was found to be extremely unstable. This can be attributed to continuous electricity shortages, which slowed the country's financial innovation to real GDP growth ratio from 1.9% in 2022 to 0.6% in 2023 (IMF, https://www.imf.org/en/Data). Sound execution of fiscal and monetary policies is, however, credit for the stability of upper-middle-income nations like Namibia, Mauritius, and South Africa.

6. CONCLUSION

This paper empirically examined the role played by budget deficits, renewable energy consumption, crude oil market shocks, net interest rate differentials (difference between domestic and foreign interest rates), and exchange rate movements on demand for money in twenty African countries using 1980:Q1 to 2023:Q4 data. The NARDL estimation technique was utilized as an econometric tool in analyzing the data. The study highlights that past levels of money demand formed significant increases in demand in subsequent periods with significant differences. It implies that the demand to hold money rises in subsequent periods following rising inflation, reduced real income, and consumption levels. Also, exchange rate movements' asymmetrical effects on demand for M1 and M2 exist. The negative effect of currency devaluation on money demand is a pointer: devaluation reduces the desire to hold local currencies for narrow and broad purposes in Africa. Rather, a preference for foreign currency is made manifest. What this implies is that in Africa, economic agents would only prefer to hold local currency when it appreciates, while their preference for foreign currency would rise once the local currency devalues. This could be attributed to the fact that transactions demanding money are mostly driven by USD in developing African countries. Devastatingly, the less favorable effect of currency devaluation is met with the demand for foreign currencies to cover up the increased price effect on the domestic economy from the rising cost of manufacturing, transportation, and other economic activities. It is because the devaluation effect of the local currencies exacerbates domestic inflation by weakening the local money's purchasing power.

Our research finding also upholds that an increase in renewable energy consumption increased the demand for M2 and M1 in all countries except Namibia, Kenya, and Sudan for M2 and Egypt and Chad for M1. The study also established that oil price shocks cause some positive reactions in the desire to hold narrow and broad spendable balances in local currencies, especially when the reserve balance is low in Africa. Increased oil price variation in rising price changes from demand exceeding supply has an inflationary impact on African economies. It discourages the desire to hold local currencies for M1 and M2 motives. While the shocks may raise money demand in the short run for transactional motivation, inflationary pressure continues in the long run, causing money demand to decline in a longer-term period. Therefore, regulatory authorities can stimulate money demand by reducing variations in the short-term interest rate and by implementing exchange rate policies that appreciate the local currencies. It would cause increased investment in African countries. In sum, monetary authorities can use monetary policy rates as short-term interventions to control the desire to hold domestic currencies and boost the real sector of the economy. The findings of this paper are limited to African countries. There is a need to embark on a comparative study of money demand between the generality of developing countries and the advanced nations using the same non-traditional variables of demand for both narrow and broad monies in an expanded money demand model that makes provision for control variables.

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APPENDIX

Table A.1. NARDL results for Nigeria, Tanzania, Namibia, Algeria

Variables	***Nigeria***		***Tanzania***		***Namibia***		***Algeria***	
	lnM1	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***
$lnexrmv^{-}$	-0.612** (-11.37)	-0.765** (-2.084)	-0.011** (-2.437)	-0.019** (-2.309)	-0.018*** (-10.987)	-0.07** (-2.089)	-0.021** (-1.940)	-0.001*** (-4.080)
$lnexrmv^{+}$	0.113** (2.347)	0.106** (2.346)	0.120** (2.309)	0.116*** (6.206)	0.318** (2.489)	0.567** (2.990)	0.421*** (7.809)	0.398*** (12.550)
$lnrnerc^{-}$	0.123** (9.497)	0.695** (3.289)	0.089** (2.097)	0.308** (1.999)	0.958*** (10.137)	-0.001** (-1.898)	0.566** (2.965)	-0.003*** (-6.058)
$lnrnerc^{+}$	0.903** (2.481)	0.031** (-14.162)	0.12*** (5.024)	0.481** (-3.200)	0.011** (2.586)	-0.023** (-9.081)	0.049*** (7.109)	0.091*** (-8.099)
$lnbdfc^{-}$	1.203** (3.598)	0.011*** (2.490)	0.083*** (7.034)	0.005** (2.267)	0.020*** (7.287)	0.055*** (3.000)	0.041** (2.700)	0.021*** (2.000)
$lnbdfc^{+}$	0.073** (5.081)	1.031*** (2.656)	0.016*** (9.020)	0.282** (2.940)	0.011** (2.910)	0.091** (1.962)	0.033** (2.081)	0.015*** (2.091)
$lnoilms^{-}$	0.002 (1.787)	-0.035** (2.701)	0.002** (2.001)	-0.035** (2.701)	0.001*** (3.408)	-0.004** (2.861)	0.009 (1.783)	-0.052*** (2.001)
$lnoilms^{+}$	1.023*** (27.467)	1.011*** (19.021)	0.003** (2.011)	1.011*** (19.021)	0.291** (2.092)	0.001*** (3.790)	0.024** (2.059)	0.021** (1.871)
$lnrhead$	0.011*** (2.963)	0.014*** (5.223)	0.020** (1.994)	0.012** (2.301)	0.230*** (2.003)	0.010** (2.803)	0.045*** (2.309)	0.008** (1.930)
$intrd$	-0.038** (-3.400)	-0.002** (-2.039)	-0.011** (-2.300)	-0.003** (-1.990)	-0.01*** (-4.580)	-0.046** (-1.932)	-0.016** (-2.480)	-0.011** (-2.270)
Constant	0.038 (1.235)	1.348*** (9.357)	0.005*** (12.890)	0.389*** (12.039)	0.011** (2.391)	0.081*** (2.001)	0.038 (1.235)	1.348*** (9.357)
$\Delta lnexrmv^{-}_{t-1}$	-0.011 (-1.047)	-0.125** (-3.084)	-0.006** (-2.130)	-0.100** (-2.074)	-0.090 (-0.097)	-0.085** (-2.789)	-0.011* (-7.097)	-0.065** (-2.040)
$\Delta lnexrmv^{+}_{t-1}$	-0.159** (-7.256)	-0.138** (-1.978)	-0.015** (-2.481)	-0.220** (-1.998)	-0.004*** (-6.021)	-0.116** (-5.081)	-0.112** (-2.890)	-0.009*** (-1.998)
$\Delta lnrnerc^{+}_{t-2}$	0.003** (2.990)	-0.001** (-2.100)	0.001** (1.967)	-0.099** (-3.020)	0.012*** (4.100)	-0.006** (-3.978)	0.012** (2.098)	-0.00*** (-6.000)
$\Delta lnrnerc^{-}_{t-2}$	0.013** (2.897)	-0.001** (-2.019)	0.016*** (8.392)	-0.005** (-2.000)	0.042** (2.001)	-0.005** (-2.349)	0.015** (2.098)	-0.022*** (-6.089)
$\Delta lnbdfc^{-}_{t-1}$	0.130** (3.000)	0.011*** (4.560)	0.019** (2.376)	0.023** (2.300)	0.109 (1.000)	0.012*** (3.450)	0.110** (2.900)	0.017*** (5.660)
$\Delta lnbdfc^{+}_{t-1}$	0.002 (1.050)	-0.031** (2.799)	0.001*** (4.579)	-0.089** (2.900)	0.001*** (5.220)	-0.009** (2.135)	0.0013** (2.049)	-0.091*** (8.119)
$\Delta lnoilms^{-}_{t-1}$	0.019*** (16.012)	-0.003 (1.489)	0.011** (2.018)	-0.014** (2.098)	0.019 (1.357)	-0.001** (2.089)	0.012*** (3.022)	-1.023 (1.049)
$\Delta lnoilms^{+}_{t-1}$	0.100** (2.850)	0.130*** (7.065)	0.016** (2.028)	0.200*** (6.098)	0.210*** (4.650)	0.100** (4.891)	0.211** (3.570)	0.007*** (3.009)
$\Delta lnrhead$	0.139*** (17.410)	0.018** (2.035)	0.019*** (4.209)	0.011** (2.790)	0.100** (1.980)	0.014** (2.035)	0.150** (1.890)	0.012** (2.975)
$\Delta intrd$	-0.037** (-13.546)	-0.350** (-2.378)	-0.019** (-1.809)	-0.009** (-2.800)	-0.011*** (-9.061)	-0.14** (-2.406)	-0.037** (-2.422)	-0.34*** (-5.568)
ecm_{t-1}	-0.780** (-6.090)	-0.600** (-2.098)	-0.980** (-2.309)	-0.560** (-2.057)	-0.810** (-2.330)	-0.674** (-1.991)	-0.531** (-6.990)	-0.62** (-4.872)
$\Delta lnM1_{t-1}$	0.920*** (15.871)	-	0.101** (2.490)	-	1.790*** (10.600)	-	0.240*** (3.760)	-
$\Delta lnM2_{t-1}$	-	0.020*** (3.064)	-	1.011*** (5.904)	-	0.170** (1.994)	-	0.008*** (2.09)
	F-stat. = 102.489, ARCH = 0.302, LM = 0.067		F-stat. = 134.0, ARCH = 0.231, LM = 0.045		F-stat. = 146.0, ARCH = 0.311, LM = 0.057		F-stat. = 130.0, ARCH = 0.223, LM = 0.060	

Table A.2. NARDL results for Mauritius, Nairobi, Zambia, Kenya

Variables	***Mauritius***		***Nairobi***		***Zambia***		***Kenya***	
	lnM1	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***
$lnexrmv$-	-0.022** (-1.927)	-0.101** (-2.484)	-0.002** (-2.039)	-0.004*** (-9.990)	-0.594** (-1.987)	-0.643** (-2.089)	-0.941*** (-5.780)	-0.506*** (-2.560)
$lnexrmv^+$	0.139** (2.378)	0.111*** (3.026)	0.150** (2.657)	0.469*** (5.590)	0.300** (1.847)	0.478** (2.084)	0.121*** (6.894)	0.119** (2.460)
$lnrnerc^-$	0.004** (5.756)	-0.021** (-1.966)	0.019** (2.009)	0.308** (1.999)	0.004** (9.657)	-0.061** (-1.898)	0.147** (2.3945)	-0.446*** (-4.041)
$lnrnerc^+$	0.201** (2.691)	0.551** (2.402)	0.222*** (2.024)	0.571** (6.000)	0.011** (2.586)	0.023** (9.081)	0.460** (2.109)	-0.091*** (-8.099)
$lnbdfc$-	0.569** (2.978)	0.768** (2.090)	0.013*** (3.904)	0.005** (2.167)	0.498** (2.487)	0.051*** (2.010)	0.255*** (6.666)	0.013*** (9.201)
$lnbdfc^+$	0.031** (2.489)	0.942*** (1.930)	0.019** (2.070)	0.112** (2.940)	0.011** (2.910)	0.293** (1.962)	0.033** (2.081)	0.715*** (2.091)
$lnoilms$-	0.002 (1.787)	-0.035** (1.938)	0.002** (2.001)	-0.035** (2.6831)	0.001*** (3.238)	-0.004** (2.281)	0.013*** (5.896)	-0.004** (1.998)
$lnoilms^+$	0.073** (2.760)	0.011** (1.978)	0.145*** (6.420)	0.031*** (10.350	0.222** (4.681)	0.002*** (3.461)	0.099** (2.006)	0.021** (3.001)
$lnrhead$	0.01** (1.790)	0.099** (2.456)	0.005** (2.894)	0.011** (2.870)	0.200*** (5.690)	0.010** (1.983)	0.115*** (4.780)	0.567** (2.990)
$intrd$	-0.08** (-2.600)	-0.001** (-2.378)	-0.012** (-2.779)	-0.003** (-2.680)	-0.112** (-2.568)	-0.046** (-1.932)	-0.016** (-2.110)	-0.014** (-2.100)
Constant	0.183*** (19.46)	0.127*** (6.007)	0.013** (14.60)	0.132*** (7.031)	0.021** (2.390)	0.011*** (5.141)	0.024** (2.019)	0.312*** (4.607)
$\Delta lnexrmv_{t-1}^-$	-0.023** (-2.091)	-0.110** (-2.014)	-0.001** (-2.776)	-0.230 (-1.074)	-0.012** (-2.480)	-0.010** (-2.724)	-0.010* (-4.581)	-0.017** (-2.452)
$\Delta lnexrmv_{t-1}^+$	-0.100** (-2.096)	-0.119** (-1.998)	-0.012** (-2.770)	-0.220** (-1.998)	-0.001* (-2.013)	-0.120** (-5.011)	-0.012** (-2.911)	-0.001*** (-2.28)
$\Delta lnrnerc_{t-2}^-$	0.011** (1.998)	-0.022** (-2.480)	0.014** (2.082)	-0.008** (-3.000)	0.099** (2.335)	-0.003** (-2.900)	0.011** (2.011)	-0.024*** (-6.387)
$\Delta lnrnerc_{t-2}^+$	0.001** (2.340)	-0.002 (-1.100)	0.023*** (8.378)	-0.012** (-1.973)	0.012*** (5.210)	-0.001** (-3.478)	0.016** (1.934)	-0.002** (-2.456)
$\Delta lnbdfc_{t-1}^-$	0.120** (2.347)	0.029*** (3.589)	0.012** (2.346)	0.045** (1.980)	0.769*** (3.760)	0.042*** (9.050)	0.120** (2.110)	0.018*** (5.560)
$\Delta lnbdfc_{t-1}^+$	0.003*** (5.980)	-0.029** (2.700)	0.001** (2.179)	-0.089** (2.900)	0.001*** (3.020)	-0.012** (2.145)	0.0013** (2.076)	-0.071*** (6.100)
$\Delta lnoilms_{t-1}^-$	0.017*** (10.032)	-0.011** (2.009)	0.011** (2.018)	-0.014** (2.098)	0.001 (1.47)	-0.011** (2.001)	0.011*** (3.023)	-1.023 (1.049)
$\Delta lnoilms_{t-1}^+$	0.250** (3.980)	0.440 (2.065)	0.016** (2.028)	0.200*** (2.034)	0.210*** (2.110)	0.240** (2.721)	0.334*** (5.890)	0.033*** (2.865)
$\Delta lnrhead$	0.144*** (16.922)	0.011** (2.389)	0.014*** (7.419)	0.081** (2.880)	0.540** (9.880)	0.015** (7.085)	0.009** (2.760)	0.042** (2.350)
$\Delta intrd$	-0.012** (-1.987)	-0.176** (-2.662)	-0.019** (-1.999)	-0.009** (-2.800)	-0.013** (-2.938)	-0.187** (-5.086)	-0.099** (-2.087)	-0.244*** (-7.068)
ecm_{t-1}	-0.550** (-3.561)	-0.691** (-2.769)	-0.700** (-2.076)	-0.680** (-3.447)	-0.590** (-2.367)	-0.604** (-2.891)	-0.903** (-2.080)	-0.401** (-1.992)
$\Delta lnM1_{t-1}$	1.023*** (1.997)	-	0.0678** (6.789)	-	0.981*** (3.870)	-	0.340*** (9.7896)	-
$\Delta lnM2_{t-1}$	-	0.001*** (2.450)	-	0.094*** (4.582)	-	0.543** (2.568)	-	0.234*** (2.405)
	F-stat. = 106.12, ARCH = 0.245, LM = 0.041		F-stat. = 114.0, ARCH = 0.223, LM = 0.046		F-stat. = 152.1, ARCH = 0.356, LM = 0.049		F-stat. = 240.0, ARCH = 0.345, LM = 0.056	

Table A.3. NARDL results for Morocco, Tunisia, Uganda, Malawi

Variables	*Morocco*		*Tunisia*		*Uganda*		*Malawi*	
	lnM1	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***
$lnexrmv$-	-0.043 (-0.147)	-0.054** (-1.940)	-0.022** (-2.048)	-0.013*** (-26.094)	-0.012** (-3.445)	-0.009** (-2.947)	-0.035*** (-4.566)	-0.019*** (-5.230)
$lnexrmv^{+}$	0.100** (2.987)	0.234** (2.768)	0.198** (2.647)	0.112*** (4.561)	0.153** (2.890)	0.160** (2.550)	0.140*** (6.892)	0.105** (2.770)
$lnrnerc^{-}$	0.146** (3.217)	-0.761** (-1.890)	0.091** (2.358)	-0.281** (-3.291)	0.128*** (4.357)	-0.005** (-2.048)	-0.236** (-2.500)	-0.246*** (-8.021)
$lnrnerc^{+}$	0.103** (2.001)	0.055** (2.335)	0.121*** (2.074)	0.009** (3.776)	0.024*** (40.600)	0.031** (2.091)	0.578 (0.007)	0.143** (2.076)
$lnbdfc$-	0.563** (2.768)	0.014** (2.091)	0.011*** (5.024)	0.423*** (9.001)	0.030*** (5.187)	0.012*** (8.000)	0.111*** (6.780)	0.224*** (3.510)
$lnbdfc^{+}$	0.045** (1.945)	1.019*** (4.689)	0.015*** (5.000)	0.452** (2.355)	0.044*** (6.7032)	0.188** (2.451)	0.098*** (6.891)	0.195*** (4.621)
$lnoilms$-	0.002** (2.098)	-0.024** (2.889)	0.023*** (3.781)	-0.115** (2.235)	0.111*** (3.788)	-0.004** (2.461)	0.019** (2.589)	-0.021** (2.451)
$lnoilms^{+}$	0.043** (2.117)	0.061 (1.055)	0.561** (2.761)	0.023*** (4.561)	0.091** (2.034)	0.036*** (4.567)	0.014** (1.879)	0.0461** (2.485)
$lnrhead$	0.056** (3.061)	0.012** (2.463)	0.056*** (7.890)	0.0111** (2.341)	0.104** (2.683)	0.130** (2.001)	0.044*** (2.569)	0.023** (4.190)
$intrd$	-0.011** (-2.900)	-0.003** (-2.011)	-0.014** (-2.256)	-0.012** (-2.440)	-0.034** (-1.890)	-0.022** (-2.890)	-0.015** (-2.065)	-0.056** (-2.088)
Constant	0.048*** (6.780)	0.340*** (2.450)	0.003*** (11.240)	0.376** (2.768)	0.067** (2.988)	0.012*** (4.971)	0.045*** (5.890)	0.32*** (4.561)
$\Delta lnexrmv_{t-1}^{-}$	-0.021 (-1.076)	-0.123 (-1.405)	-0.007** (-2.789)	-0.230** (-2.041)	-0.450** (-1.997)	-0.012** (-2.138)	-0.034** (-2.4679)	-0.011** (-2.350)
$\Delta lnexrmv_{t-1}^{+}$	-0.109** (-2.780)	-0.122** (-2.078)	-0.012** (-2.091)	-0.110** (-2.038)	0.004** (2.341)	-0.123** (-2.451)	-0.140** (-2.023)	-0.001*** (-23.418)
$\Delta lnrnerc_{t-2}^{-}$	0.012** (2.037)	-0.006** (-3.012)	0.015*** (8.768)	-0.001** (-2.670)	0.052** (2.451)	-0.003** (-2.546)	0.011*** (5.774)	-0.035** (-2.761)
$\Delta lnrnerc_{t-2}^{+}$	0.003** (2.768)	-0.122** (-1.980)	0.025** (2.347)	-0.003** (-1.997)	0.015** (2.459)	-0.001** (-1.45)	0.016 (1.4567)	-0.233 (-1.000)
$\Delta lnbdfc_{t-1}^{-}$	0.230** (2.561)	0.023** (2.560)	0.123** (2.114)	0.020** (2.771)	0.219*** (2.457)	0.013*** (2.455)	0.122** (3.459)	0.014*** (2.781)
$\Delta lnbdfc_{t-1}^{+}$	0.013** (2.579)	-0.012** (2.139)	0.014*** (4.839)	-0.012** (2.691)	0.001*** (6.679)	-0.039** (3.568)	0.021** (2.509)	-0.011*** (5.099)
$\Delta lnoilms_{t-1}^{-}$	0.012** (1.966)	-0.011** (2.489)	0.011** (2.018)	-0.014** (2.098)	0.019 (1.357)	-0.001** (2.089)	0.012*** (3.022)	-1.023 (1.049)
$\Delta lnoilms_{t-1}^{+}$	0.100** (2.850)	0.134 (1.0595)	0.034** (2.548)	0.660*** (4.578)	0.120*** (4.562)	0.576** (4.251)	0.200** (2.092)	0.013*** (2.119)
$\Delta lnrhead$	0.122** (2.462)	0.019** (2.560)	0.023*** (4.940)	0.011** (2.045)	0.210** (2.348)	0.016** (2.022)	0.053** (3.060)	0.032** (2.115)
$\Delta intrd$	-0.08** (-1.789)	-0.001** (-2.098)	-0.010** (-2.439)	-0.001** (-2.240)	-0.017** (-2.461)	-0.112** (-2.566)	-0.031** (-2.256)	-0.110** (-2.368)
ecm_{t-1}	-0.510** (-3.589)	-0.540** (-2.998)	-0.610*** (5.789)	-0.900** (-2.118)	-0.670** (-2.578)	-0.468** (-2.670)	-0.824** (-1.960)	-0.663** (-2.692)
$\Delta lnM1_{t-1}$	0.123** (2.457)	-	0.461** (2.552)	-	0.458*** (6.824)	-	0.130*** (3.231)	-
	F-stat. = 52.57, ARCH = 0.221, LM = 0.0524		F-stat. = 11.0, ARCH = 0.246, LM = 0.024		F-stat. = 166.5, ARCH = 0.234, LM = 0.023		F-stat. = 140.2, ARCH = 0.334, LM = 0.051	

Table A.4. NARDL results for Ghana, South Africa, Botswana, Sudan

Variables	***Ghana***		***South Africa***		***Botswana***		***Sudan***	
	lnM1	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***	***lnM1***	***lnM2***
$lnexrmv$-	-0.711** (-2.440)	-0.820** (-2.340)	-0.045*** (-8.471)	-0.022** (-1.823)	-0.012** (-2.784)	-0.053*** (-3.672)	-0.035*** (-2.098)	-0.021*** (-4.080)
$lnexrmv^+$	0.150** (2.011)	0.114** (2.003)	0.110** (3.516)	0.192*** 7.048)	0.173** (2.891)	0.126** (2.799)	0.108*** (2.791)	0.102** (2.140)
$lnrnerc^-$	0.168** (2.789)	-0.045** (-2.980)	0.034** (2.078)	-0.591** (-2.210)	0.143*** (2.765)	-0.924** (-2.874)	0.826** (2.240)	-0.056*** (-2.562)
$lnrnerc^+$	0.112** (2.001)	0.0238* (2.646)	0.461*** (2.014)	0.012** (3.167)	0.952** (2.235)	0.261 (1.091)	0.327 (0.024)	-0.130** (-2.786)
$lnbdfc$-	0.123** (2.230)	0.594** (2.091)	0.061*** (2.014)	0.025*** (2.001)	0.156*** (6.186)	0.012** (2.000)	0.092*** (4.120)	0.446*** (3.261)
$lnbdfc^+$	0.011** (1.054)	1.091*** (2.729)	0.012** (2.000)	0.170** (2.005)	0.012*** (2.732)	0.160** (2.571)	0.014*** (2.091)	0.681*** (2.098)
$lnoilms$-	0.013** (2.046)	-0.02** (2.129)	0.013*** (2.900)	-0.112** (2.001)	0.011*** (3.256)	-0.004** (2.126)	0.018** (2.567)	-0.011** (2.567)
$lnoilms^+$	0.012** (2.256)	0.013*** (3.769)	0.116** (2.091)	0.012*** (6.578)	0.041** (2.000)	0.016*** (4.117)	0.014** (2.619)	0.0612** (2.745)
$lnrhead$	0.0116** (3.000)	0.012** (2.782)	0.016*** (5.678)	0.091** (1.884)	0.200** (2.343)	0.960** (3.001)	0.011*** (2.129)	0.026*** (7.100)
$intrd$	-0.051** (-2.090)	-0.004** (-2.441)	-0.012** (-2.136)	-0.010** (-2.150)	-0.004** (-1.970)	-0.062** (-2.790)	-0.026** (-2.015)	-0.016** (-2.098)
Constant	-0.018*** (-4.780)	0.140*** (2.230)	0.001 (1.040)	0.300** (2.106)	0.061** (2.008)	0.012*** (2.271)	0.015*** (3.190)	0.112*** (3.561)
$\Delta lnexrmv_{t-1}^-$	-1.020 (-9.016)	-0.124** (-2.605)	-0.002** (-2.001)	-0.140** (-2.011)	-0.010** (-2.207)	-0.016** (-2.131)	-0.014** (-2.019)	-0.019** (-2.300)
$\Delta lnexrmv_{t-1}^+$	-0.112** (-2.051)	-0.012** (-2.028)	-0.066** (-2.351)	-0.130** (-2.024)	0.024** (2.878)	-0.126** (-2.041)	-0.130** (-2.011)	-0.004*** (-23.218)
$\Delta lnrnerc_{t-2}^-$	0.056** (2.045)	-0.023** (-2.452)	0.015** (2.768)	-0.001** (-2.620)	0.022** (2.121)	-0.003** (-2.167)	0.011** (2.174)	-0.013** (-2.001)
$\Delta lnrnerc_{t-2}^+$	0.042** (2.556)	-0.132** (-2.480)	0.025** (2.347)	-0.012** (-3.627)	0.012*** (4.729)	-0.024*** (-6.892)	0.026** (2.895)	-0.212*** (-8.000)
$\Delta lnbdfc_{t-1}^-$	0.230** (2.091)	0.003** (2.124)	0.230** (2.144)	0.045** (2.731)	0.296*** (2.780)	0.016*** (2.487)	0.112** (3.051)	0.019*** (2.001)
$\Delta lnbdfc_{t-1}^+$	0.013** (2.567)	-0.017** (2.120)	0.015*** (4.229)	-0.012** (2.241)	0.001*** (6.278)	-0.019** (3.028)	0.044** (2.109)	-0.021*** (2.019)
$\Delta lnoilpv_{t-1}^-$	0.015** (2.566)	-0.012** (2.924)	0.089** (2.015)	-0.013** (2.071)	0.012 (1.311)	-0.001** (2.013)	0.023*** (3.059)	-0.023** (2.789)
$\Delta lnoilpv_{t-1}^+$	0.789** (2.570)	0.178*** (9.076)	0.045 (1.098)	0.090*** (3.528)	0.110*** (4.262)	0.176 (1.051)	0.256 (0.766)	0.014*** (6.081)
$\Delta lnrhead$	0.145** (2.760)	0.011** (2.240)	0.021*** (2.790)	0.071** (2.990)	0.010** (2.008)	0.019** (2.000)	0.013** (2.040)	0.012** (2.144)
$\Delta intrd$	-0.011** (-2.700)	-0.024** (-2.056)	-0.056** (-2.891)	-0.001** (-2.780)	-0.017** (-2.121)	-0.112** (-2.16)	-0.031** (-2.780)	-0.560** (-2.118)
ecm_{t-1}	-0.610** (-2.760)	-0.552** (-2.080)	-0.791*** (5.356)	-0.600** (-2.452)	-0.570** (-2.328)	-0.429** (-2.400)	-0.460** (-2.589)	-0.803** (-2.222)
$\Delta lnM1_{t-1}$	0.453** (1.937)	-	0.031*** (5.689)	-	0.158*** (2.957)	-	0.211*** (2.145)	-
$\Delta lnM2_{t-1}$	-	0.016** (2.570)	-	0.240*** (5.560)	-	0.176** (2.076)	-	0.012*** (2.013)
	F-stat. = 150.57, ARCH = 0.324, LM = 0.0550		F-stat. = 161.0, ARCH = 0.239, LM = 0.0256		F-stat. = 171.5, ARCH = 0.243, LM = 0.025		F-stat. = 145.2, ARCH = 0.324, LM = 0.061	

Table A.5. NARDL results for Egypt, Chad, Eswatini, Swaziland

Variables	Egypt		Chad		Eswatini		Swaziland	
	lnM1	lnM2	lnM1	lnM2	lnM1	lnM2	lnM1	lnM2
$lnexrmv^-$	-0.034*** (-10.550)	-0.051** (-2.660)	-0.013*** (-4.569)	-0.020** (-2.340)	-0.014** (-2.171)	-0.013** (-1.997)	-0.007** (-2.012)	-0.066*** (-7.000)
$lnexrmv^+$	0.810** (2.456)	0.614** (1.985)	0.210** (2.596)	0.120*** (2.452)	0.103** (1.491)	0.624** (2.175)	0.166*** (3.523)	0.500** (1.999)
$lnrnerc^-$	0.112** (2.304)	-0.011 (-1.385)	0.031** (2.378)	-0.003** (-2.135)	0.113*** (2.460)	0.473** (2.564)	0.146** (2.560)	0.986*** (3.500)
$lnrnerc^+$	-1.031** (3.769)	0.091** (2.024)	0.179** (6.345)	0.014** (3.450)	0.053** (2.247)	0.235 (2.671)	0.407*** (3.604)	0.320** (2.556)
$lnbdfc^-$	0.100** (2.560)	0.015** (2.456)	0.066** (2.243)	0.025** (2.567)	0.246*** (6.970)	0.018*** (4.890)	0.545** (1.1450)	0.034*** (3.431)
$lnbdfc^+$	0.051** (2.451)	0.236** (2.349)	0.017** (3.000)	0.130** (2.115)	0.013*** (2.452)	0.154** (2.446)	0.009*** (2.121)	0.010*** (2.013)
$lnoilms^-$	0.014** (2.053)	-0.013** (2.124)	0.243*** (2.456)	-0.113** (2.251)	0.013*** (3.356)	-0.032** (2.176)	0.019** (2.455)	-0.0251** (2.567)
$lnoilms^+$	0.011** (2.245)	0.012** (3.723)	0.164** (2.0241)	0.012*** (2.562)	0.0467** (2.077)	0.015*** (4.230)	0.012** (2.355)	0.0635** (2.746)
$lnrhead$	0.016*** (4.650)	0.013** (2.110	0.193*** (9.345)	0.011 (0.454)	0.200** (2.546)	0.041*** (3.722)	0.044*** (4.569)	0.016*** (4.199)
$intrd$	-0.021** (-2.011)	-0.002** (-2.451)	-0.011** (-2.190)	-0.010** (-2.114)	-0.012** (-1.450)	-0.032** (-2.451)	-0.016** (-2.245)	-0.116** (-2.013)
Constant	-0.012** (-2.560)	0.111** (2.076)	0.001*** (3.890)	1.200** (2.996)	0.0501** (2.345)	0.014*** (2.246)	0.012*** (3.156)	0.142*** (3.251)
$\Delta lnexrmv^-_{t-1}$	-0.045 (-2.343)	-0.004*** (-2.565)	-0.003** (-2.351)	-0.156** (-2.3341)	-0.045** (-2.245)	-0.024** (-2.561)	-0.032** (-2.456)	-0.017** (-2.446)
$\Delta lnexrmv^+_{t-1}$	-0.134** (-2.240)	-0.011** (-2.011)	-0.016** (-2.681)	-0.10** (-2.561)	0.213** (2.455)	-0.006** (-2.021)	-0.120** (-2460)	-0.056** (-2.678)
$\Delta lnrnerc^-_{t-2}$	0.024** (1.978)	-0.056*** (-3.672)	0.013** (2.578)	-0.024** (-2.660)	0.012** (2.135)	-0.018** (-2.168)	0.031** (2.157)	-0.0243** (-2.056)
$\Delta lnrnerc^+_{t-2}$	0.022** (2.561)	-0.143** (-2.410)	0.015** (2.389)	-0.034** (-3.457)	0.012*** (4.119)	-0.014** (-2.562)	0.023** (2.125)	-0.012** (-2.340)
$\Delta lnbdfc^-_{t-1}$	0.130** (2.692)	0.014** (2.145)	0.260** (2.134)	0.042** (2.562)	0.006*** (2.240)	0.016*** (2.123)	0.144** (2.451)	0.013*** (2.551)
$\Delta lnbdfc^+_{t-1}$	0.0124** (2.324)	-0.112** (2.679)	0.012*** (4.911)	-0.010** (2.451)	0.020*** (6.651)	-0.011** (2.018)	0.020** (2.455)	-0.041*** (2.022)
$\Delta lnoilms^-_{t-1}$	0.012** (2.341)	-0.012** (2.004)	0.019** (2.111)	-0.012** (2.171)	0.013 (1.038)	-0.023** (2.346)	0.013*** (3.013)	-0.013** (2.115)
$\Delta lnoilms^+_{t-1}$	0.719** (2.240)	0.122** (2.786)	0.012** (2.480)	0.011*** (4.778)	0.234*** (5.782)	0.046** (2.561)	0.578 (1.568)	0.012*** (2.763)
$\Delta lnrhead$	0.251** (3.660)	0.021** (3.570)	0.011*** (2.560)	0.044** (2.750)	0.0340** (2.578)	0.012** (2.680)	0.016** (2.450)	0.345 (1.763)
$\Delta intrd$	-0.021** (-2.100)	-0.049** (-2.566)	-0.021** (-2.451)	-0.013** (-2.560)	-0.099** (-2.461)	-0.112** (-2.561)	-0.051** (-2.240)	-0.430** (-2.468)
ecm_{t-1}	-0.580** (-2.250)	-0.502** (-2.035)	-0.651*** (3.524)	-0.490** (-2.052)	-0.520** (-2.346)	-0.490** (-2.231)	-0.680** (-2.341)	-0.829** (-2.451)
$\Delta lnM1_{t-1}$	0.053** (2.790)	-	0.121*** (2.763)	-	0.468*** (2.886)	-	0.046*** (3.565)	-
$\Delta lnM2_{t-1}$	-	0.012** (2.345)	-	0.567*** (5.246)	-	0.567** (2.089)	-	0.054*** (2.045)
	F-stat. = 178.90, ARCH = 0.333, LM = 0.0556		F-stat. = 134.0, ARCH = 0.327, LM = 0.026		F-stat. = 180.0, ARCH = 0.240, LM = 0.068		F-stat. = 190.2, ARCH = 0.334, LM = 0.050	