The Monetary Approach to Exchange Rates in the East African Community

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Abstract

This study investigates the monetary model of exchange rates determination using a panel framework for five East African countries—Kenya, Uganda, Tanzania, Rwanda, and Burundi—over the period 1995–2023. The analysis follows a systematic five-step methodology: cross-sectional dependence test, panel unit root test, panel cointegration analysis, estimation using the Pool Mean Group (PMG) method, and the Dumitrescu–Hurlin causality test. In the long run, our empirical results exhibit that, real GDP and real interest rates have a statistically significant negative impact on nominal exchange rates, while money supply exhibits a positive and significant effect. Causality analysis indicates unidirectional causality from real GDP and money supply to the nominal exchange rate, as well as from the exchange rate to the interest rate. Additionally, reverse causality exists between interest rates and money supply. No causal relationship is observed between real interest rates and real GDP or between real GDP and money supply. From a policy perspective, this study recommends a joint coordination of monetary policies amongst the East African Community member states in order to reduce exchange rate volatility, fostering regional economic stability and resilience.

Keywords: Monetary Model; Exchange Rate; EAC; Panel cointegration; Pool Mean Group
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1.0 Introduction

This study investigates the monetary model of exchange rate determination in a panel framework, comprising five East African countries: Kenya, Uganda, Tanzania, Rwanda, and Burundi. The motivation for this study is threefold. First, previous empirical research that has applied time series data at the country level has generally failed to provide convincing support for the monetary model of exchange rates (Rogoff, 1999; Rapach and Wohar, 2002; Basher and Westerlund, 2007, 2009; Dincer, 2015). Second, while the East African Community (EAC) has expressed its intention to establish a monetary union by 2033, there has been a notable lack of empirical studies investigating exchange rate determinants within the region. Third, the growing body of literature reiterates the presence of significant cross-sectional dependence in panel data, a factor that necessitates the application of cross-sectional dependence tests in order to ascertain the validity, reliability and robustness of estimated results in econometric analysis (Pesaran, 2004, 2007, 2015, 2021). Despite the critical importance of such tests, empirical studies within the EAC region have largely overlooked this issue.

The modeling of exchange rates has been a central topic in international macroeconomics since the advent of flexible exchange rates in the early 1970s. Within this field, three primary models have emerged: the flexible-price monetary model, developed by Frankel (1976), and the sticky-price monetary model, introduced by Dornbusch (1976) and later modified by Frankel (1979) in the real interest differential model and the sticky-price asset model, which incorporates the current account (Hooper and Morton, 1982). These models form the basis of what is known as the monetary approach to exchange rate determination. However, the empirical validity of these models has been widely debated, particularly following the influential work of Meese and Rogoff (1983), who, using post-Bretton Woods exchange rates for major industrial countries, found that a simple random walk model outperformed the monetary models in out-of-sample forecasting, even when future realizations of explanatory variables were considered. While the monetary models showed reasonable performance up until the mid-1970s, subsequent results have been mixed (Rogoff, 2001; Dinçer, 2015).

Despite these challenges, the past three decades have seen a resurgence of interest in applying panel data methods to exchange rate modeling (Mark and Sul, 2001; Jesus *et al.*, 2005; Basher and Westerlund, 2009, Oyakhilome, 2019, Okot *et al*, 2022). Recent studies suggest that panel data approaches offer stronger support for monetary models, particularly in light of global economic and financial integration, which has led to greater interdependence among cross-sectional units (Cerra and Saxena, 2010). The primary motivation for employing panel data in estimating monetary models of exchange rates lies in its multifaceted advantages: it integrates both cross-sectional and time-series information, accounts for country-specific unobserved heterogeneity, facilitates the modeling of dynamic relationships, and effectively addresses endogeneity issues. These advantages lead to more efficient, reliable, and comprehensive models for understanding exchange rate movements and policy impacts.

This study contributes to the existing literature on exchange rate determinants in several ways. First, while much of the previous research on the monetary approach has focused on advanced and emerging market economies, this study examines East African countries, offering a comparative analysis with results from other regions. Second, as the EAC member states aim to achieve a common currency, this study provides empirical evidence on exchange rate determination and thus inform policy towards that direction. Third, our systematic methodological approach contributes to empirical literature on estimation of the monetary model in a panel setting. Many studies in this area take for granted cross-sectional dependence without testing it. If the unobserved components that create interdependencies across cross sections are correlated with the regressors, the estimators will be biased and inconsistent. Fourth, we employ the Westerlund cointegration test, as it offers a robust framework for testing the presence of long-run relationships among variables in panel data settings. This approach is particularly advantageous when dealing with cross-sectional dependence and heterogeneity, as it accounts for these complexities while providing reliable results.

The remainder of this study is organized as follows. Section 2 reviews the theoretical and empirical literature on the monetary model of exchange rate determination. Section 3 outlines the methodology and empirical strategy. Section 4 presents and discusses the estimation results. Finally, Section 5 concludes with policy implication.

2.0 Literature review

Monetary models of exchange rate determination emerged after the collapse of the fixed exchange rate regime in the early 1970s. These models have evolved into several distinct versions, broadly categorized into three main types: the flexible-price monetary model (Frankel, 1976), the sticky-price model and the real interest rate differential model (Dornbusch, 1976; Frankel, 1979), and the sticky-price asset model, which incorporates the current account (Hooper and Morton, 1982). These models rely on macroeconomic relationships to derive a semi-reduced equation, which presents the exchange rate as a log-linear function of key macroeconomic fundamentals.

The theoretical foundation of the monetary model is grounded in the premise that exchange rates primarily respond to disequilibrium in the money markets. Specifically, holding money demand constant, an increase in the domestic money supply relative to its foreign counterpart will result in a depreciation of the domestic currency. Similarly, an increase in domestic income, ceteris paribus, raises domestic demand for money, leading to an appreciation of the exchange rate, in accordance with the "law of one price." Likewise, an increase in domestic interest rates relative to the foreign rate, assuming other factors remain unchanged, would generate depreciation, Jesus *et al.*, (2005).

More specifically, there are two primary channels through which interest rates affect exchange rates: the money demand channel and the interest rate differential channel. Under the money demand channel, an increase in domestic interest rates raises the opportunity cost of holding money, reducing money demand. This decline in money demand leads to an excess money supply, exerting inflationary pressure and ultimately depreciating the domestic currency. Equally, under the interest rate differential channel, a higher domestic interest rate relative to the foreign interest rate leads to currency depreciation, as elevated interest rates reduce money demand. The resulting excess liquidity raises the price level, which, under the purchasing power parity (PPP) framework, contributes to further depreciation. However, in the short run, tighter monetary policy and higher interest rates can attract capital inflows, leading to currency appreciation, as described in Dornbusch's overshooting model.

The empirical literature on the monetary model of exchange rate determination within a panel framework can be organized around several key debates and nuances, including the validity and robustness of the model across different regions, the role of structural factors, and the influence of cross-sectional dependence. Early works, such as Husted and MacDonald (1998), provided strong evidence for the validity of the monetary model across OECD countries, showing cointegration between exchange rates and monetary fundamentals. Groen (2000) and Mark and Sul (2001) also observed strong support for the model when applied to countries relative to the US Dollar and Deutsche Mark. These studies generally support the idea that monetary fundamentals, such as money supply and output, are central to exchange rate determination in developed economies.

Conversely, studies such as those by Oyakhilome (2018) and Okot *et al*. (2022) on Sub-Saharan Africa highlight mixed support for the monetary model in developing countries. Oyakhilome (2018) found partial support, with relative money supply and real output influencing exchange rates, but the elasticity of money supply was often below unity, suggesting limitations to the model's explanatory power. Similarly, Okot *et al*. (2022) observed that while macroeconomic fundamentals significantly influenced exchange rates, factors like terms of trade and export concentration were also crucial in determining exchange rate volatility and crash risk.

Many studies, including Basher and Westerlund (2009) and Dąbrowski *et al*. (2014), used advanced panel data techniques such as Pooled Mean Group (PMG) and Fully Modified Least Squares (FMOLS) to account for cross-sectional dependence and structural breaks. These innovations have enhanced the robustness of the monetary model by addressing issues like non-stationarity and dependencies between countries, which are often overlooked in simpler country-by-country models. Basher and Westerlund (2009) and Cerra and Saxena (2010) emphasized the importance of incorporating structural breaks when testing the monetary model, particularly in light of changing global economic conditions, such as the end of the Bretton Woods system. Structural breaks were found to affect the relationship between exchange rates and monetary fundamentals, with the purchasing power parity (PPP) relationship being notably influenced by these shifts.

In developed economies, studies such as those by Groen (2005) and Mark and Sul (2001) confirm the central role of monetary fundamentals (money supply, interest rates, and output) in long-run exchange rate determination. Mark and Sul (2001) also demonstrated that monetary fundamentals can be used to predict future exchange rate movements, providing evidence for the forecasting power of the model. Jesus *et al*. (2005) found that the monetary model struggled to explain exchange rate movements in countries experiencing significant productivity differences, particularly when the Balassa-Samuelson effect was considered. This effect, which links exchange rates to differential productivity growth across countries, presents a challenge to the monetary model in certain contexts.

In contrast, Okot *et al*. (2022) and Simone & Maxwell (2018) found that factors such as international market conditions, terms of trade, and export prices played a pivotal role in determining exchange rate volatility and crash risks in lower-income African countries, underscoring the complexity of exchange rate dynamics in these regions. These studies suggest that while monetary fundamentals matter, external shocks and structural characteristics also significantly affect exchange rate outcomes. Simone & Maxwell (2018) focused on the East African Community (EAC), evaluating the convergence of exchange rate regimes in the region and offering insights into the optimal exchange rate framework for a future monetary union. Their findings suggest that a coherent exchange rate management framework will be crucial for successful integration in the region, where monetary policies need to be harmonized for sustained economic stability and growth.

In summary, the empirical literature reveals a significant regional variation in the effectiveness of the monetary model for exchange rate determination. While the model performs robustly in developed economies, its applicability to developing regions like Sub-Saharan Africa is more nuanced. Structural factors, external shocks, and institutional contexts play a larger role in shaping exchange rate dynamics in these countries. Furthermore, the use of advanced panel techniques, including those addressing cross-sectional dependence and structural breaks, has enhanced the credibility and accuracy of the findings. While the aforementioned studies have made significant contributions, most have focused on developed or transition economies, where the economic structures differ markedly from those in East Africa. This study aims to fill this gap by empirically examining the validity of the monetary model of exchange rate determination within the East African Community (EAC). By utilizing data from the EAC countries, we provide a regional perspective on exchange rate determination, which has been largely underexplored in the empirical literature.

3.0 Methodology

3.1 Monetary Model

This study utilizes the standard monetary model of exchange rate determination, which is derived from the money demand functions of both the domestic and foreign economies (Jesus *et al.*, 2005; Dincer *et al.*, 2015). Consistent with common assumptions in the literature, it is presumed that all goods are tradable and that the law of one price prevails.[1] The relationship of demand for money between two countries is given as follows:

$$m_t^D - p_t = \varphi_0 y_t - \varphi_1 r_t \quad (1)$$

$$m_t^{D*} - p_t^* = \varphi_0 y_t^* - \varphi_1 r_t^* \quad (2)$$

Note that $\varphi_0, \varphi_1 > 0$, m_t^D denotes money demand, p denotes the price level, y is real gross domestic product, r is the interest rate. The asterisk denotes the foreign country. All variables, except for the interest rate, have been transformed into natural logarithms. For analytical simplicity, the income elasticity φ_0 and the interest semi elasticity φ_1 are assumed to be identical across both countries. Furthermore, it is assumed that money market equilibrium is continuously maintained in each country, as represented by equations (3) and (4).

$$m_t^D = m_t^S = m_t \quad (3)$$

[1]The bonds are assumed to be perfect substitutes. The law of one price states that the price of an identical asset or commodity will have the same price globally, regardless of location, when certain factors are taken into account.

$$m_t^{D*} = m_t^{S*} = m_t^* \quad (4)$$

Where m_t^S stands for money supply. Plugging equations (1) and (2) into equations (3) and (4) respectively, and further re-arrangement yields the following:

$$p_t - p_t^* = m_t - m_t^* - \varphi_0(y_t - y_t^*) + \varphi_1(r_t - r_t^*) \quad (5)$$

Moreover, the analysis assumes that the theory of Purchasing Power Parity (PPP) holds, implying that the nominal exchange rate (s_t) equals the relative price levels between countries.

$$s_t = p_t - p_t^* \quad (6)$$

Accordingly, substituting equation (6) in equation (5) and adding the stochastic term ϵ_t, equation (5) is thus re-written as follows:

$$s_t = m_t - m_t^* - \varphi_0(y_t - y_t^*) + \varphi_1(r_t - r_t^*) + \epsilon_t \quad (7)$$

Equation (7) illustrates that, under the *ceteris paribus* assumption, an increase in the domestic money supply relative to its foreign counterpart leads to a rise in the domestic price of foreign currency, thereby causing a depreciation of the exchange rate. Notably, changes in output levels or interest rates typically affect the exchange rate indirectly through their influence on money demand. Specifically, an increase in domestic income relative to foreign income, all else equal, raises the demand for money, resulting in an appreciation of the exchange rate. Similarly, an increase in the domestic interest rate relative to the foreign interest rate, all else being equal, would generate depreciation, Jesus *et al*., (2005).

3.2 Unit Root Tests

This study utilizes second-generation unit root tests, which account for cross-sectional dependence within panel data. In contrast, first-generation unit root tests operate under the assumption that cross-sectional dependence is absent. Cross-sectional dependence arises when the units comprising the panel are correlated through the error terms in the panel data model. Consequently, the presence of cross-sectional dependence implies that applying first-generation panel unit root tests would yield unreliable or spurious results.

The study uses Im-Pessaran-Shin (IPS), (2003) and Karavias and Tzavalis, CSDA (2014) unit root tests. After establishing the stationarity of the panel, the Westerlund (2007) cointegration test is carried out. This approach allows parameters to vary across panel members, thereby accounting for heterogeneity among cross-sectional units. Upon confirming the presence of cointegration among the variables, the Pooled Mean Group (PMG) estimator, as proposed by Pesaran *et al*. (1999), is employed to estimate both the long-run and short-run coefficients. The dynamic form of the PMG estimation is illustrated in Equation (8)

$$S_{i,t} = \delta_i + \sum_{j=i}^{p} \vartheta_{ij} S_{i,t-j} + \sum_{j=0}^{q} \theta_{ij} X_{i,t-j} + \epsilon_{it} \quad (8)$$

Where, $i = 1, 2 \dots \dots N$, denotes the number of cross-sections, $t = 1, 2, 3, \dots \dots T$, indicates time (year), j is the number of time lag, X_i is the vector of independent variables, $(m_t - m_t^*), (y_t - y_t^*),$ $and\ (r_t - r_t^*)$ and δ_i is the fixed effect. Further reparameterization of equation (8) yields equation (9) as follows:

$$\Delta S_{i,t} = \delta_i + \alpha_i S_{i,t-1} + \beta_i X_{it} + \sum_{j=i}^{p-1} \vartheta_{ij}^* \Delta S_{i,t-j} + \sum_{j=0}^{q-1} \vartheta_{ij}^* \Delta X_{i,t-j} + \epsilon_{it} \quad (9)$$

Where;

$$\alpha_i = -1\left(-\sum_{j=1}^{p} \vartheta_{ij}\right); \beta_i = \sum_{j=0}^{q} \theta_{ij}\Bigg)$$

Further manipulation and re-arrangement of equation (9) yields the following Error Correction Mechanism (ECM) in equation (10):

$$\Delta S_{i,t} = \sum_{j=1}^{p-1} \vartheta_{ij} \Delta S_{it-j} + \sum_{j=0}^{q-1} \theta_{ij} \Delta X_{it-j} + \delta_i [S_{it-1} - \beta_i X_{it=1}] + \mu_i + \epsilon_{it} \quad (10)$$

The coefficient δ_i of an ECM measures the speed of adjustment of nominal exchange rate, $S_{i,t}$ to its long-run equilibrium arising from any change in X_i. The condition $\delta_i < 0$ ensures the existence of a long-run relationship. Any significant and negative value of δ_i is considered as evidence of cointegration between $S_{i,t}$ and explanatory variables.

Equation (10) is estimated by using the Pooled Mean Group (PMG) estimator, a framework developed by Pesaran, *et al* (1999), which integrates both pooling and averaging techniques. This intermediate approach permits heterogeneity in the intercept, short-run coefficients, and error variances across groups, while imposing homogeneity on the long-run coefficients (Edward & Mark, 2007). By pooling data across countries, the PMG estimator ensures efficient and consistent parameter estimates.

The estimation concludes with the application of the Dumitrescu–Hurlin (D-H) panel causality test (2012) to examine the direction of causality among the variables. The D-H model is specified in equation (11) as follows:

$$Y_{it} = \alpha_i + \sum_{i=1}^{k} \gamma_i Y_{i,t-k} + \sum_{i=1}^{k} \delta_i X_{i,t-k} + \epsilon_{i,t} \quad (11)$$

The null and alternative hypotheses are specified as follows:

$H_0: \delta_i = 0$ for all i
$H_1: \delta_i < 0, i = 1, \dots, N_1, \delta_i = 0, i = N_1 + 1, N_1 + 2, \dots, N \quad 0 < N_1 \le N$

The alternative hypothesis of the Dumitrescu–Hurlin (D-H) panel causality test allows for variation in $\delta_i$across units, in contrast to the homogeneous alternative in the Levin, Lin, and Chu (2002) test, which assumes $\delta_i = \delta < 0$ for all i. The null hypothesis posits the absence of Granger causality across all cross-sections, indicating non-homogeneous causal relationships. The alternative hypothesis, on the other hand, suggests the presence of at least one causal relationship among the variables in the panel data.

3.5 Data

Our annual dataset, compiled from the World Development Indicators (WDI, 2024), spans from 1995 to 2023. During this period, all countries in the sample operated under a managed floating exchange rate regime. According to Adam *et al*. (2012), the adoption of managed floating in Kenya, Tanzania, and Uganda was part of a broader reform agenda initiated in the early 1990s, aimed at establishing unified, market-determined exchange rates. This involved dismantling foreign exchange rationing and creating an inter-bank market for foreign exchange, Epaphra & Kazungu (2021).

The variables in the dataset include the nominal exchange rate against the US Dollar (expressed as local currency units per US Dollar), Broad Money Supply (M2), real GDP, and real interest rates. Broad money supply, real GDP and real interest rates were expressed in relative variables, meaning the difference between home (EAC countries) and foreign (US). All variables, except for real interest rates, are expressed in natural logarithms. Table 6 in Appendix 1 presents summary statistics of variables.

4. Empirical Results

4.1 Cross-sectional dependence (CD) test

Table 1 presents results of cross-sectional dependence tests under the null hypothesis of weak cross-section independence. Three different cross-sectional dependence tests were performed including Pesaran (2015, 2021) test; Juodis & Reese (2021) test, Frees (1995, 2004) and Pesaran and Xie (2021) test. In the table these tests are abbreviated in the column headings as CD, CDw, CDw+ and CD* respectively. As seen in the table, the p-values for all the variables across cross-sectional dependence tests are close to zero, which imply the presence of strong cross-sectional dependence, i.e., data strongly correlated across panel groups. The presence of cross-sectional dependence warrants proceeding with unit root tests, cointegration test and model estimation.

Table 1: Results of cross-sectional dependence test

Variable	CD	CDw	CDw+	CD*
Nominal exchange rate (s)	16.210***	-3.170***	48.090***	2.590**
Relative real GDP $(y_t - y_t^*)$	14.950***	-2.670***	44.600***	1.410
Relative real interest rate $(r_t - r_t^*)$	3.580***	-0.160	11.170***	3.530***
Relative broad money $(m_t - m_t^*)$	16.590***	-3.320***	49.130***	1.990**

*** p<0.01, ** p<0.05, * p<0.1

4.2 Panel unit root test results

Unit root test was implemented using two different tests: Im-Pessaran-Shin (IPS) and Karavias and Tzavalis, CSDA (2014). Results in Table 2 indicates that some variables (relative exchange rate, relative real GDP and relative broad money supply) are not stationary at level. These variables are stationary at first difference. Further, results show that relative interest rate is stationary at level. Both unit root tests confirm that the variables are a mixture of I (0) and I (1).

Table 2: Results of panel unit root test

Variable	Im-Pessaran-Shin (IPS) test		Karavias and Tzavalis test (CSDA)		Order of integration
	Level	Fist difference	Level	Fist difference	
Nominal exchange rate (s)	2.5577	-4.2571***	0.0141	-0.1972***	I(1)
Relative real GDP $(y_t - y_t^*)$	1.0875	-4.4357***	-0.0347	-0.4073***	I(1)
Relative real interest rate (r-r*)	-4.0371***		-14.4699***		I(0)
Relative broad money (m-m*)	2.5577	-5.1357***	0.0361	-0.6267**	I(1)

*** p<0.01, ** p<0.05, * p<0.1

4.2 Cointegration test results

Panel cointegration tests were implemented using Westerlund test as it imposes fewer restrictions and can be used when the variables are a mix of I(0) and I(1) (Arsova and Örsal, 2021). The null hypothesis is that there is no cointegration between the variables specified in the model. The results of cointegration tests in Table 3 shows that the test is statistically significant at p<0.01, implying that the variables proposed for the model have a long-run relationship.

Table 3: Results of Westerlund cointegration test

Without trend		With trend	
Variance ratio:	-0.1270	Variance ratio:	2.6020***
Number of panels:	5	Number of panels:	5
Number of periods:	29	Number of periods:	29
Cointegrating vector: Panel specific		Cointegrating vector: Panel specific	
Panel means: Included		Panel means: Included	
Time trend: Not included		Time trend: Included	
AR parameter: Panel specific		AR parameter: Panel specific	

*** p<0.01, ** p<0.05, * p<0.1

4.3. Results of PMG estimation

Table 4 presents the results from the Pooled Mean Group (PMG). The results are shown for two models. Model 1 includes Kenya, Uganda, and Tanzania, while Model 2 adds Rwanda and Burundi to the panel. The inclusion of these additional countries in Model 2 allows for a broader comparison. The countries in Model 1 are relatively larger economies, and the focus was to determine whether the results differ significantly from the full set of countries. Additionally, Kenya, Uganda, and Tanzania have a longer history of economic integration, particularly since the formation of the previous East African Community (EAC) that disintegrated in 1977. The estimated results indicate that the outcomes from both models are largely similar, which may be attributed to the countries' adherence to the macroeconomic convergence criteria established by the current EAC.

The estimated results in Table 4 show that the long-run coefficients conform to a priori as predicted in the monetary model. The results show that in the long-run relative GDP have a statistically significant negative effect on nominal exchange rate. A high GDP reflects larger production, increase in demand for the country's products and impliedly increased demand for the country's currency and this leads to appreciation of country's currency. Further, results show that in the long-run relative interest rate have statistically significant negative effects on nominal exchange rate.

Furthermore, relative broad money supply has a statistically significant positive effect on nominal exchange rate. This positive causal effect implies that an increases in money supply led to currency depreciations. Central banks maintain money supply growth targets to achieve policy goals such as inflationary targets. Money supply growth rate is the central bank's policy instrument. Thus, in a cyclically expanding economy, the demand for real money balances is increasing, and the central bank therefore will have to reduce the amount of money supply expansion to achieve its short - term policy goals. Moreover, results show a negative and significant coefficient of the error correction term; the mean convergence rate. This imply that when a shock occurs in nominal exchange rate, then nominal exchange rate will respond each time to restore to equilibrium. While the short-term effects of interest rate and money supply on nominal exchange rate are statistically significant, the short-run effect of real GDP on exchange rate remains statistically insignificant.

Table 4: PMG estimation results

Variables	Model 1	Model 2
Short run coefficients		
Relative real GDP	-0.104	0.036
Relative real interest rate	-0.015**	-0.021**
Relative broad money supply	0.510***	0.394***
Mean convergence rate	-0.226***	-0.123***
Long run coefficients		
Relative real GDP	-0.541***	-0.454***
Relative real interest rate	-0.005***	-0.004***
Relative broad money supply	0.217***	0.131***
Constant	1.510***	1.001***
Observations	87	145
Number of groups	3	5

*** p<0.01, ** p<0.05, * p<0.1

4.4. Pairwise Dumitrescu–Hurlin (2012) panel causality test results

Table 5 presents the results of the Dumitrescu-Hurlin (2012) panel causality test. All variables, except for the nominal exchange rate, are expressed relative to their US counterparts. The results reveal the presence of unidirectional causality between the exchange rate and its determinants—

namely, real GDP, real exchange rate, and money supply. Specifically, causality runs from real GDP to the exchange rate, from money supply to the exchange rate, and from the exchange rate to the interest rate. Additionally, the analysis indicates reverse causality between money supply and real interest rate. However, no Granger causality is found between real interest rate and real GDP, nor between real GDP and money supply.

Table 5: Results of Dumitrescu–Hurlin (2012) panel causality test

Null hypothesis	Test statistics	Decision
Real GDP does not Granger-cause nominal exchange rate	2.7232***	Reject
Nominal exchange rate does not Granger-cause real GDP	0.1187	Accept
Real interest rate does not Granger-cause nominal exchange rate	1.5330	Accept
Nominal exchange rate does not Granger-cause real interest rate	3.6599***	Reject
Broad money supply does not Granger-cause nominal exchange rate	2.2283**	Reject
Nominal exchange rate does not Granger-cause broad money supply	0.3558	Accept
Real interest rate does not Granger-cause broad money supply	2.8061***	Reject
Broad money supply does not Granger-cause real interest rate	2.7314***	Reject
Real interest rate does not Granger-cause real GDP	0.6464	Accept
Real GDP does not Granger-cause real interest rate	1.4232	Accept
Real GDP does not Granger-cause broad money supply	1.4195	Accept
Broad money supply does not Granger-cause real GDP	1.4342	Accept

*** p<0.01, ** p<0.05, * p<0.1

However, the estimated results reported in this study should be interpreted with caveats. In particular, the monetary model estimated in this study primarily focuses on the role of money supply, interest rates, and output in determining exchange rates. In doing so, it overlooks other critical determinants such as political events, speculative activities, and market shocks, which can significantly influence currency values. The monetary model tends to be more applicable in the long run, where it assumes that exchange rates adjust to fundamental economic variables, Jesus *et al.*, (2005). In the short run, exchange rates can be influenced by factors such as investor sentiment, market expectations, and capital flows, which are not captured by the model. The model assumes that monetary variables are the same across countries or exhibit similar dynamics. In reality, countries often have different institutional settings, monetary policies, and fiscal conditions, which can lead to significant variations in exchange rate behavior. The model assumes a constant relationship between money supply, interest rates, and exchange rates, which may not hold during periods of economic crisis, structural reforms, or regime changes. The findings from Oyakhilome (2018) and Okot *et al*. (2022) indicate that, in developing economies, exchange rate management cannot be fully understood through the monetary model alone. Other factors such as export concentration, financial flows, and external market conditions are often more influential than monetary variables alone.

4.5 Discussion of Results

The estimated results presented in this study provide empirical support for the role of money supply in influencing the behavior of the nominal exchange rate. Additionally, the findings highlight the significant role of real income in shaping the exchange rate dynamics. As discussed in the literature review, the monetary approach to exchange rate determination posits that exchange rates are partly influenced by shifts in the demand for and supply of money, a proposition that this study effectively confirms, among other key findings. Similar results are reported in the works of Husted and MacDonald (1998), Groen (2000, 2005), Mark and Sul (2001), Jesus Crespo *et al*. (2005), Basher and Westerlund (2009), Cerra and Saxena (2010), Dąbrowski *et al*. (2014), Oyakhilome (2018), Okot, *et al* (2022). Furthermore, this study reinforces Pesaran *et al*. (1999) assertion that panel data estimation can overcome biases commonly encountered in country-specific estimates.

In terms of policy implications, East African countries may benefit from coordinating their monetary policies. This could reduce exchange rate volatility and enhance regional economic stability. The EAC countries may explore mechanisms like a regional currency union to stabilize their currencies against external shocks. The adoption of a common currency will require substantial adjustments to the monetary policies of the East African Community (EAC) countries. EAC member states stand to benefit from a shared currency, which is expected to promote deeper integration, reduce transaction costs in international trade and finance, curb inflation, and enhance resource allocation efficiency. However, the move to a common currency also entails relinquishing control over individual monetary policies, necessitating a monetary policy framework that caters to the region as a whole rather than national-specific conditions (Paulo *et al*., 2015). Ultimately, this study asserts that when the EAC partners transition to a currency union by 2033, they will forgo control over their national currencies and, by extension, lose the ability to use the nominal exchange rate as a tool for stabilizing their economies independently.

Moreover, the findings of this study highlight the importance of macroeconomic convergence for the East African Community (EAC). To achieve effective regional exchange rate cooperation, member states must prioritize fiscal discipline, as large budget deficits or high public debt in one country could destabilize the entire system. Additionally, the results underscore the need for coordinated inflation-targeting frameworks to enhance exchange rate stability. While the EAC has a strong rationale for pursuing a common currency, this endeavor necessitates addressing existing disparities in fiscal policies and economic structures among member states to ensure its long-term viability.

5.0 Conclusion and Policy Implication.

This study has explored the monetary model of exchange rate determination in a panel framework comprising five East African countries: Kenya, Uganda, Tanzania, Rwanda, and Burundi. A key motivation for this study is the scarcity of empirical research investigating the determinants of exchange rates within the EAC region. To address the primary objective of this paper, we use a dataset from the World Development Indicators (WDI) spanning the period from 1995 to 2023, and apply a series of econometric analyses, including cross-sectional dependence tests, second-generation panel unit root tests, the Westerlund cointegration test, Pooled Mean Group (PMG) estimation, and the Dumitrescu–Hurlin (D-H) panel causality test.

Our empirical results confirm the presence of strong cross-sectional dependence, indicating that the observations across different cross-sectional units (e.g., countries in our study) are not independent. In other words, the behavior of one unit may influence or be influenced by others, which violates the assumption of independence often required in economic modeling. Additionally, our results reveal the presence of unit roots in exchange rates, real GDP, and broad money supply. The Westerlund cointegration test further confirms the existence of a long-run relationship. This test is particularly valuable as it allows for heterogeneous cointegrating relationships across different countries in the East African Community (EAC). Such flexibility is essential when analyzing real-world data, where countries, although sharing similar macroeconomic characteristics, may exhibit differing relationships.

The estimated results from the Pooled Mean Group (PMG) indicate that, in the short run, real GDP and interest rates have negative signs and are statistically significant at the 1% level. Conversely, the short-run coefficient for money supply is positive and statistically significant at the 1% level. Similar results are observed in the long run, with the exception of real GDP, whose estimated coefficient is statistically insignificant. Additionally, the error correction term shows a negative and significant coefficient, reflecting the mean convergence rate. The results of the Dumitrescu–Hurlin (2012) panel causality test reveal that causality runs from real GDP to exchange rates, from money supply to exchange rates, and from exchange rates to interest rates. Furthermore, reverse causality is found between money supply and real interest rates, while no causality is detected between real interest rates and real GDP, or between real GDP and money supply. In terms of policy implications, this study suggests that EAC member states are likely to benefit from the adoption of a common currency, which would promote closer integration, reduce transaction costs in international trade and finance, and enhance efficient resource allocation.

Our contribution to the literature is both comparative and empirical. Comparatively, this study demonstrates that the monetary model of exchange rate determination is applicable not only in developed countries but also in developing regions such as the EAC. Empirically, this research adds to the literature through the application of advanced econometric techniques, including the cross-sectional dependence test, second-generation panel unit root tests, Westerlund cointegration, Pooled Mean Group (PMG) estimation, and the Dumitrescu–Hurlin (D-H) panel causality test, specifically applied to the EAC dataset. A major limitation of this study is the oversimplification inherent in the monetary model when explaining exchange rate behavior. While the monetary model provides a useful theoretical framework for understanding long-term exchange rate dynamics, its simplifying assumptions and abstractions may limit its ability to fully capture the complexities of exchange rate movements, particularly in the short run or during periods of high economic volatility.

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Appendix 1

Table 6: Summary statistics of the variables (1995 – 2023)

Country/variable	N	Mean	Std. dev	Min	max
Tanzania					
Exchange rate (in log)	29	7.183	0.469	6.35	7.79
Relative real GDP (in log)	29	-6.267	0.369	-6.91	-5.78
Relative real interest rate	29	4.263	4.005	-4.3	12.48
Relative money supply (in log)	29	-0.521	0.821	-1.81	0.47
Kenya					
Exchange rate (in log)	29	4.413	0.231	3.94	4.94
Relative real GDP (in log)	29	-6.016	0.524	-6.74	-5.36
Relative real interest rate	29	5.478	7.674	-12.74	17.06
Relative money supply (in log)	29	-2.37	0.588	-3.16	-1.51
Uganda					
Exchange rate (in log)	29	7.688	0.420	6.88	8.22
Relative real GDP (in log)	29	-6.81	0.476	-7.5	-6.29
Relative real interest rate	29	9.211	10.221	-37.36	20.13
Relative money supply (in log)	29	-0.656	0.801	-1.98	0.37
Rwanda					
Exchange rate (in log)	29	6.361	0.398	5.57	7.06
Relative real GDP (in log)	29	-8.051	0.420	-8.68	-7.57
Relative real interest rate	29	8.027	7.926	-5.74	29
Relative money supply (in log)	29	-3.235	0.778	-4.3	-2.14
Burundi					
Exchange rate (in log)	29	6.994	0.593	5.52	7.85
Relative real GDP (in log)	29	-9.105	0.245	-9.59	-8.68
Relative real interest rate	29	1.35	8.214	-23.49	15.6
Relative money supply (in log)	29	-3.188	0.869	-4.54	-1.66

Source: Computed from World Bank dataset