Original Paper

Monetary Policy Convergence within the EAC: A Focus on Interest Rate and Exchange Rate

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Abstract

This study was conducted to establish whether the key variables in monetary policy transmission mechanisms are converging within the East African Community. This region is eyeing having an economic union and subsequently a monetary union hence the significance of investing developments in the monetary sector. The analysis used panel data from the year 2005 to 2020 for five EACs. To test for convergence of interest rates and exchange rates, the analysis employed; unit-root test, sigma convergence, co-integration tests, and finally used the panel fixed effect model to establish the impact of the two variables on the GDP. The analysis shows that in the short run, there is no convergence in interest rates but there is convergence in exchange rates. However, in the long run, the two monetary policy variables are co-integrated indicating that the region is doing well in terms of integration in the financial sector in their preparation to form a common trade area and monetary union. The analysis of the impact of the two variables on economic growth shows that only the exchange rate is significant, therefore, the region should strive to foster a stable exchange rate regime to realize increased economic growth.

Keywords

East African Community (EAC), Convergence, Sigma convergence, Beta convergence, unit-root test, Co-integration test

1. Introduction

The desire for integration has been in existence since the African countries realized independence and as a result, several regional groups have been formed. The nations were mostly driven by the need to realize economies of scale in their production activities and access to the regional market and better

bargaining power in the international market, the respective nations were generally small. To date only two monetary unions (MU) have been established in Africa; the Common Monetary Area (CMA) based in southern Africa, and the CFA franc zones for countries that were colonized by the French. Other regions are also gearing up to this ultimate goal, the following regional communities have the same goal; the East African Community (EAC), the South African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA), and finally the Economic Community the West African Countries (ECOWAS). The continent also has the long-term objective of establishing the African Union (Masson & Pattillo, 2004).

Counties in a monetary union are likely to reap benefits that may include price stability in the region due to stable interstate exchange rates, regional exchange rates risks are going to reduce, having common international reserves would boost the terms of trade, and the cost of doing business in the region will drastically decline. Despite the gains, there are losses that these nations have to contend with; one most important is the loss of sovereignty to control monetary policy instruments and the control over exchange rate policy. Some of the macroeconomic shocks that the member countries may face could be country-specific leaving them with no cause for action when they cannot adjust their country monetary and exchange rate policy. A Summit of Heads of states from the EACs in the 6th extra-ordinary meeting agreed that the region should quickly move towards establishing a MU by the year 2012. In their subsequent 11th ordinary summit passed that after the formation of the common market, the secretariat should expeditiously start the process of establishing a MU.

A permanent tripartite Commission for the East African Co-operation was signed in the year 1993, thereafter the region moved quickly to form the East African Community through a treaty that was signed in 1999. This treaty lasted until 2004 when the countries agreed to the establishment of a monetary union and thereafter in the years 2009, they agreed that they should establish a Common Market Protocol (CMP). According to the agreements, the region was to realize a MU by the year 2012, and member countries committed to hastening the process.

For a monetary union to be stable and sustainable, the macroeconomic factors must be stable (converged) for the member countries. For example, these countries need to exhibit similarities in interest rates and inflation (monetary policy convergence) and other macroeconomic variables convergence for a monetary union to be established. An empirical study conducted by Rose and Engel (2000) concluded that a monetary union would lead to an increase in the member states' trade twice or three times because the countries are likely to develop similar demand movement and the changes in prices will most likely be moving in the same direction. A MU therefore would make the member countries have a similar macroeconomic environment.

If a test on the suitability of countries to join a monetary union is conducted and it is established that there is endogeneity, these countries need not meet the optimum currency criterion for a MU to be established. Analysis of the subsequent benefits of joining a MU was conducted for European Monetary Union (EMU) by Chintrakarn (2008) and Frankel (2008) and a paltry 15% gain was

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established. If the same post analysis was conducted for the established African MUs, the benefits may even be much smaller. The endogeneity test was conducted for the existing MUs by Carmignani (2010) and Tapsoba (2009) and they established that the MUs make the business cycles for the member countries to move together and the gains on trade were dismal.

From the above, the EAC must not be over-excited with the idea of forming a monetary union, to start with they have not been able to successfully establish a stable economic union ten years from the time the agreement was signed (inter-regional trade is only 15%). This is a very low starting point, the members heavily depend on exporting raw material which will make catching up with the developed countries be an uphill task. They must focus on macro-economic convergence before attempting to pursue a monetary union to avert adverse effects from the loss of control on monetary policy and exchange rate policies. Since EACs have already committed to a monetary union which was to have been formulated in 2012, it is important to establish the convergence of monetary instruments and exchange rates which are critical to the formation of a monetary union and the policy implication that it will have to the respective nations.

It is important to establish the extent to which the EAC monetary policy transmission mechanisms have converged over time and whether they have a significant effect on the economic performance of these nations. The general objective of this paper is to assess the level of convergence of the monetary transmission mechanisms with a focus on the interest rate and exchange rate. They form part of the key transmission mechanisms that the EAC has put as the targeted macroeconomic variables, in the long run, they are also expected to be stable.

Establishing the status of the convergence of the monetary and exchange rates policy is important to formulate policy recommendations to the EA Secretariat concerning the formation of a MU. Analysis of EACs panel data provides empirical evidence using stochastic methods and a fixed-effect model, which explains the behavior of the monetary policy instruments.

Empirical evidence suggests that monetary integration is beneficial to regional blocks in that it will promote competition and efficiency in the financial markets. This will lead to direct benefits to the consumers in terms of reduced prices in the financial services and indirect benefits in terms of reduced borrowing rates. It is, therefore, worthwhile to establish the gains that the EAC has so far made in terms of convergence in monetary and exchange rate policies, which would translate, to gains by the member countries from the deregulation of policies in the financial sector aimed at efficiency.

This paper examines whether nominal exchange rates and interest rates converge among members of EAC. Given the interest in a monetary union (integration), the extent of convergence of these variables will not only inform monetary policy among the partner states of the EAC but will also inform other decisions regarding exchange rate policy within the EAC in general.

1.1 Interest Rate Channel as a Transmission Mechanism

Interest rates have been the main tool that monetary authorities have been using to control the flow of money in an economy since the inception of macroeconomic theory. In a model where aggregate

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demand for money depends on income and short-term interest rates, the effect of monetary policy on the short-run interest rate would first start with a constant demand for money. In such a scenario, the central bank may then make changes in interest rates through adjustments in the supply of money. When the central bank increases the money supply, the short-run interest rates would decline.

Using the standard Keynesian IS-LM framework, the interest rates channel can be summarized. Here, the interest rates would decline if the central bank applies an expansionary monetary policy, which will lead to increased investments triggered by a reduction in the cost of capital. The result is that aggregate demand would increase prompting an increase in output. The ultimate spending choices by individual economic units are only affected by changes in real interest rates, but a monetary authority can only control short-run nominal interest rates. Sticky prices have a close linkage to the monetary base and the real interest rate which significantly affect the effectiveness of the interest rate channel. Therefore, the monetary policies are only effective in the short run, but in the long run, the prices would adjust. In the same breath, the rational expectation hypothesis of the short-term structure postulates that; the expectations about the future short-term real interest rates determine the long-run real interest rates. The real economy can therefore be affected by policies that take into account how short-run policies affect the long-run real interest rates through sticky prices.

1.2 Exchange Rate Channel as a Transmission Mechanism

When studying monetary policy transmission mechanisms, the exchange rate is one of the key variables to consider. Changes in monetary policies in a nation affect the exchange rates leading to changes in the net exports. The relationship between short-term interest and exchange rates was demonstrated by Mundell (1962), he argued that this is shown through capital mobility in the international financial market. He went further and said that according to the interest rate parity relationship; the difference of the interest rates between two nations would be equated to the exchange rate that is expected between the two countries. Capital will always be supplied to the nation where the returns are high to the time that the returns in the different countries will be equated. Therefore, the interest rate parity must hold for capital to move freely between nations.

The exchange rate channel is the most important monetary channel in small and open economies. In this case, the theory of uncovered interest rate parity (UIP) would largely affect the degree to which changes in monetary policy would affect the movements in exchange rates. The theory states that; future changes in the nominal exchange rates are related to the variation between the interest rates in the local and foreign markets. This knowledge enables the central bank of the nation to cause a change in exchange rates leading to changes in the relative prices of the goods in the trading nations, which consequently affect the volume of trade.

To put this to perspective, if the monetary policy is expansionary, the interest rates would decline making domestic investments to be less attractive. This would decrease the demand for domestic currency making the local currency depreciate, hence making the domestic goods relatively competitive compared to foreign goods increasing total output and by extension the net export.

Therefore, the effect of the exchange rate channel is largely influenced by UIP condition. This theory has limitations that have been highlighted by subsequent scholars and suggested that it must be implemented with a risk premium term. The term is security for foreign investors that they would be protected from depreciation and the risk of investing in a foreign country.

According to Dornbusch (1976), the speed of convergence of real exchange rates in open economies is related to sticky prices. The real exchange rates appear empirically to converge much faster than the nominal prices, this is what is referred to as the "purchasing power parity puzzle". If there is no interest rate smoothing, the persistence of the sticky prices does not matter, this is according to the New Keynesian models. When there is interest rate smoothing, the stickiness of the prices does matter, the internal real-exchange rate ability to be stable for long depends on the interest rate smoothing parameter and the chances that firms will not change prices under Calvo pricing (Engel, Lee, Liu, Liu, & Wu, 2019). Exchange fluctuations can also be explained through the exchange rate overshooting hypothesis. Feuerriegel, Wolff, and Neumann (2016), explained the concept through the Dornbusch Model, where they stated that short-run changes in appreciation or depreciation are larger than the long-run changes when looking at the fundamentals in the market would result in overshooting in the exchange rates. This means that when market fundamentals change, it results in higher changes in the exchange rates (Carbaugh, 2015). Exchange rates overshooting are likely to occur in models where the adjustment in the market takes time. However, in models where there is a gradual adjustment in prices, the interest rate overshooting will be due to the slow changes of goods prices over time. When the exchange rate is haphazard, the likeliness of exchange rate overshooting would be high.

The theory of optimum currency areas has been the basis of most empirical studies that seek to access a countries preparedness to join a monetary union. The theory was first put forth by Mundell (1961), then McKinnon (1963), and finally by Kenen (1969). The theory is the bedrock for analyzing the costs and benefits of monetary integration. According to the theory, for member countries in a monetary union to earn better benefits, they need to have similar structures. As a result, convergence, which is a necessity for the formation of a MU, relies on the OCA theory to develop convergence criteria to be adopted by member states. These targets have to be fulfilled as an obligation for joining a monetary union. It is held that convergence eliminates transaction costs associated with exchanging currencies and exchange rate volatilities (Gumede, n.d.).

1.3 Interest Rate Convergence

Most studies on interest rate convergence, about monetary unions, have been done in the European Union. Arghyrou, Gregoriou and Kontonikas (2009) investigated the parity of the real interest rates in the EU25 area. The researchers wanted to examine the effect of; interest rate differentials, structural breaks, and regress interest rate on the European Monetary Union (EMU). The same definitions for inflation and nominal interest rates were used for ex-post real interest rates variables. The sample covered monthly data from 1996-2005. The researchers extended the standard Augmented Dickey-Fuller (ADF) unit root tests, where they corrected for heteroscedasticity and normality using

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the wild-bootstrap technique for simulation. Findings revealed the interest rates converged quickly within EMU before 1999 and later on divergence was observed in some countries. Further, the results showed that most of the new EU members attained were able to realize convergence equal to the average of EMU by the end of the year 2005. Overall, there is convergence in real interest parity (RIP) in the EU that is subject to structural breaks (Arghyrou, Gregoriou, & Kontonikas, 2009).

Studies have shown that the convergence in interest rates in the EU is a game of catching up. Rich countries in Northern Europe and poor countries in Southern Europe have different levels of cost-competitiveness, which has been linked to the widening of the imbalances in the current accounts of the countries in the Euro-area. A study that sought to establish the reason behind the widening imbalances and its relation to the 2009 Euro crisis found out that large interest rate differentials among EMU12 states which existed before the euro adoption are to blame. This implied that the crisis in the euro was a consequence of the initial convergence shock (Otsuka & Goto, 2016).

Jenkins and Madzharova (2008) also investigated the convergence of the interest rates that happen in the euro. The researchers employed co-integration tests in evaluating the behavior of real and nominal interest rates in the EU region. The results revealed that real interest rates were not co-integrated, but the nominal interest rates were co-integrated. These findings were unexpected owing to the assumption that real interest parity was expected as a result of open EU economies that had adopted the euro. The divergence in results from the assumptions was explained by the low power of bilateral co-integration tests as a result of the limited period covered by the euro data.

In the Eurozone, nominal convergence is the main criteria as spelt out in the Maastricht Treaty. At the time of the accession, the observance of the nominal criteria was mandatory, however, after accession, the observance of the nominal criteria was no longer strictly applied. A study by Aursulesei and Maha (2019) noted that states tend to abandon all criteria, to the detriment of national interests, especially political ones. The study found that the countries that have neglected most of the convergence criteria are currently the most vulnerable countries economically. Portugal, Italy, Ireland, and Spain have experienced the financial crisis, and Greece was one step away from Grexit, with the entire European Monetary Union being forced to sacrifice to save a possible bankruptcy of the country. The evolution of convergence indicators revealed that states tend to abandon in particular the inflation rate and public debt. While the nominal long-term interest rate and the budget deficit tend to go towards convergence. However, abandoning the two criteria only disadvantages the Member States. To begin with, the entire Monetary Union becomes more vulnerable to economic or financial shocks. States with a larger public debt will be more affected by possible shocks. And because of the single currency, the other Member States will also feel the negative effects of the shock, plus they will have to intervene to help the affected state. Failure to meet the convergence criteria can lead to a deep crisis within the euro area. States should focus on deepening convergence to also urge non-member states to join the single currency and to pursue the integration process. Only a United Europe can become an important global player and a leader in the global economy (Aursulesei & Maha, 2019).

The East African Community (EAC) views regional financial integration as necessary for the promotion of trade within the region and exploitation of operating on a large scale by merging the segmented markets to promote industrialization. Financial integration is associated with the ability to maximize the financial sector's capability to encourage savings which should then be utilized by various sectors of the economy. A highly developed financial sector mobilizes savings, facilitates access to credit, and enhances resource allocation (Obere, Muthoga, Mburu, & Muchai, 2013). Financial market integration encompasses variables such as investment, capital markets, equity markets, centralization of markets, and instruments to advance convergence. One of those instruments is interest rates. Interest rates convergence can be used as a measure of financial integration (Stoica, Oprea, Bostan, Sandu Toderașcu, & Lazăr, 2020).

For member countries to create a monetary union, they need to forgo their sovereignty, change their nominal exchange rate as one of their macroeconomic policy instruments at the country-level, and accept a common exchange rate policy that is set by a supra-national bank. The regional supra-national bank can establish a fixed common exchange rate, a floating exchange rate that will bring stability to all member countries in the monetary union as a result of international shocks, or it can adopt a mixed framework that uses exchange and interest rates to intervene to achieve fiscal and monetary objectives (Adam, Allsopp, & Vines, 2017). The EAC member states pursue a hybrid framework.

The framework draws greatly from the experiences of the European Union. The understanding of its effectiveness is based on the fact that it is key relative prices that keep an economy on a balanced and sustainable growth path. This means that the real exchange rate, therefore, becomes an indicator of competitiveness; measures relative price of output in the common currency, since the rate of interest such as the interest rates that are nominally adjusted for domestic inflation is an indicator of the inter-temporal balance between aggregate consumption and aggregate saving. The monetary policy, therefore, entails fixing the nominal exchange rate between partner states while the supra-national bank established by the union sets a single nominal interest rate that is applied in all the member states. Therefore, the real exchange rate is determined by the competitiveness relative to other members is determined by the difference between the supra-nationally established nominal interest rate and the domestic inflation rate. Additionally, it also means that the same factors that drive the convergence external competitiveness effect also simultaneously drive real interest rate, an effect that pulls in the opposite direction. Convergence then becomes the relative strength of the exchange rate effect relative to the interest rate effect (Adam, Allsopp, & Vines, 2017).

Within the context of a monetary union, macroeconomic policy instruments are concerned with stabilizing the economy using interest rates. For instance, when output volatility increases as a result of aggregate demand shocks, interest rate movements should be designed to keep inflation on target to stabilize output (Adam, Allsopp, & Vines, 2017). The monetary policy supplies lender-of-last-resort liquidity to ensure financial stability, implying that monetary policy shoulders the burden of short-run macroeconomic stabilization, while fiscal policy anchors long-term public debt that is sustainable and

determines the composition of public expenditure (Stoica, Oprea, Bostan, Sandu Toderaşcu, & Lazăr, 2020). Decisions made taking into account global interest rates would affect the interest rate prevailing locally. The Solow model, which was based on an open economy, provides a perfect theory where the movement of capital in the international market entry into the growth function of a local market. Investments would freely be directed where it will earn more returns, countries have decreasing marginal return to capital and therefore excess capital will be moved to less developed countries. A country with less capital investment has room to adjust to higher risk-return to investment. Sigma convergence is used to check for convergence of the macroeconomic policies and the higher the variation in their variance over time, the lower the level of integration. In the local economies, the finance of local investments is mostly through the commercial banks but the governments can negotiate for cheaper loans in the international market. Through a MU, member countries will be able to access cheaper international loans that would help spur growth in the region (Obere, Muthoga, Mburu, & Muchai, 2013).

According to Stoica, Oprea, Bostan, Sandu Toderaşcu and Lazăr (2020), the banking sector integration is best indicated by convergence in the interest rates in a MU. When the interest rate is converging at a faster rate, at the same time the banking market will be getting more integrated. Convergence is an indicator of growth that is sustainable because it denotes an even spread of wealth. When banks can offer cross-border loans, it means that the banking sector is highly integrated. Cross-border loans manifest strong cross-border economic activity. The net interest margin has been associated with a negative effect on the growth of the economy, given that an increase in the margin of the interest rate affects the growth negatively, while a decline in the margin of the interest rate stimulates the growth of the economy. The provision of credit facilities is central to regional trade.

Interest rates convergence studies can be used to check whether the aims of realizing deeper integration in the financial sector, strengthening monetary unification, and making the use of common currency sustainable. In most cases, the structure of interest rate monetary policy is bank-based. Higher integration means that there is greater diversification in the banking sector and subsequently reduced dependency on business cycles in the domestic economy. Greater banking integration is associated with improved monetary policy as a central function, and uniform interest rate transmission policy (Gupta & Sehgal, 2018). On the contrary, while interbank market integration can alleviate credit constraints and decrease loan interest rates, greater banking integration is also associated with credit crunch during downturns as a result of cross-border contagion and systemic risk (Fecht, Grüner, & Hartmann, 2012).

There are various ways of measuring financial integration. These measures can be based on; news, quantity, or price. The quantity-based method is concerned with transactions across the border, including loans across borders and acceptance of deposits, as well as mergers across the borders and acquisitions. In general, it is often not easy to obtain data on quantity-based measures. They are either unavailable or unreliable. The measures based on price evaluate integration based on the law of one price (LOOP). Interest rates are a price-based measure. In testing for the integration in the financial sector, the conditions to achieve interest rate parity are the relevant parity condition. The tests involve analyzing

interest rates charged by the central bank and retail banking markets, to establish monetary policy convergence or banking market convergence. A study of the Southern African Development Community (SADC) used interest data to determine convergence, and the findings showed that there was both monetary interest rates convergence and banking market convergence, with the latter dominating, indicating a possibility of selective expansion of the Common Monetary Area (Bangura, 2011).

According to Iluţ and Chirleşan (2012), the convergence of interest rates is measured by sigma convergence and beta convergence. Sigma convergence measures bank integration based on the idea that the higher the convergence rate, the greater the integration of banking markets. Sigma convergence can be understood as cross-sectional dispersion. On the other hand, beta convergence refers to the speed of convergence.

1.4 Exchange Rate Convergence

Convergence, in the context of regional integration, is necessary for establishing commonality in an economic region. Economic integration is driven by common approaches to policy formulation to reduce the constraints of asymmetry or desperate performance concerning economic indicators (Masalila, 2009). Macroeconomic policy convergence provides efficiency and growth by eliminating exchange rate uncertainty and transaction costs, ensuring monetary stability in terms of price stability and lowered interest rates, while cultivating discipline among member countries to reduce excessive budget deficits (Ruley, Tumuhairwe, Amoding, Opolot, Oryem-Origa, & Basamba, 2019). In pursuit, of macroeconomic stability, the East Africa Community (EAC) set macroeconomic convergence benchmarks to be achieved by member countries as the region strives to transition to full economic and monetary union. The benchmarks are outlined in Table 1 below.

Table 1. EAC Macroeconomic Convergence Criteria

Criteria	Stage I 2007-2010	Stage II 2011-2014	Stage III 2015
Primary Criteria			Introduction and circulation of
Budget deficit/GDP (excluding grants)	<6%	<5%	a single East African currency
Budget deficit/GDP (including grants)	<3%	<2%	
External reserves (months of imports of goods and non-factor services)	>4	>6	
Annual inflation rate	<5%	<5%	
Secondary Criteria			
Exchange rates	Stable	X	
Interest Rates	Stable	X	
Real GDP growth rate	>7%	>7%	

Note. Source of Information is the EAC Monetary Affairs Committee (MAC) report, 2009; X implies that the criterion is considered for that stage.

These benchmarks are important because macroeconomic instability in one country can have spillover effects, which undermine the regional stance on monetary policy and poses adverse effects on the exchange rate and balance of payments in the region (Opolot, 2019).

One of the principal objectives of reviving the East Africa Community (EAC) was to establish a monetary union and introduce a common currency. The heads of 5 member states signed an agreement in 2013 to establish a monetary union, with the timeline set for 10 years. The agreement required member states to sacrifice their monetary and exchange rate policies to one central bank. The formation of a monetary union requires that the transmission mechanisms across member states are similar. Therefore, to successfully conduct monetary policy under a monetary union, the transmission channels in monetary transmission mechanisms play a central role in driving the process since differences in economic structures, and subsequently differences in transmission channels, affect the behavior of the real economy (Mlosa, Hakim, & Rahayu, 2019).

According to Muwanga (2016), effective monetary policy is a prerequisite to ensuring that countries can achieve homogeneity before they join monetary unions. This is because monetary policy has an effect on money supply and can also affect inflation rates, unemployment rates, interest rates, and economic growth. As a result, the convergence of these variables must happen before the goal of regional integration can be achieved. Countries can adopt monetary policy strategies such as exchange rate targeting, which can either be stable or fixed against a currency or a group of currencies. This implies that the convergence criteria are essentially advocacy for exchange rate targeting since EAC member countries are currently not operating similar monetary strategies. Besides, these countries are still in the process of stabilizing their exchange rates through the management of the floating exchange rate regime (Mafusire & Brixiova, 2013).

Different countries have different exchange rate regimes. Countries intending to get into a monetary union must therefore work together to synchronize their monetary policy management (Muwanga, 2016). According to Adam, Allsopp and Vines (2017) the three largest economies in the EAC, notably Kenya, Tanzania, and Uganda, operate managed floats. Kenya and Uganda operate managed floats with fully open capital accounts. Tanzania also operates managed floats but it still retains capital account restrictions. Ongoing liberalization will eliminate these remaining restrictions. The two other members, Rwanda and Burundi, are also in the process of full liberalization. Once the three main economies establish an exchange rate policy framework that is adopted by all the central banks, the financial market in the region becomes flexible determining the exchange rate, this will signal positive movements towards convergence. Therefore, while studies show that EAC member countries are putting in place strategies for convergence, issues around that involve exchange rates between banks, the controls on capital investments and the flexibility of exchange rates are yet to be addressed. In terms of operating procedures for exchange rate management, Kenya, Uganda, and Tanzania have comparable frameworks in which they have committed to upholding flexible exchange rates determined through exchange amongst the banks on foreign exchange. They also committed to having

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their foreign exchange structure operations through liquidity management goals and reserve coverage programs. However, the variation in the management of the exchange rates in the EACs contributes to the observed characteristics of the foreign exchange markets (Adam, Allsopp, & Vines, 2017).

Various studies have been carried out to understand the nature of exchange rate management in the region and the effect of exchange rate volatility on other macroeconomic variables. Buffie et al. (2018) investigated the coordination of monetary and exchange policy in small open economies. The researchers used a two-factor model that features imperfect substitution between domestic and foreign assets. The findings showed that tight exchange rate management has a positive effect on inflation targeting. Focusing on a flexible exchange rate regime, findings showed that inflation targeting had a high risk of indeterminacy. In addition, small inflation shocks were also found to increase in inflation ex-post. Fixing the nominal exchange rate or effecting changes that increase the leaning towards a managed float solved both problems (Buffie, Airaudo, & Zanna, 2018).

Jandoo and Gonpot (2018) noted that since exchange rates affect a country's relative external level of price competitiveness and trade, most major economies operate a floating exchange rate regime. In most cases, the exchange rates are denominated to the dollar. The researchers studied 14 dollar-denominated African currencies to evaluate the best models to be applied in identifying a common Value at Risk (VaR) model for the 14 currencies. Descriptive findings revealed salient features common to all currencies. The three models tested were GARCH, GJR-GARCH, and FIGARCH, the objective is to establish volatility using the following four distributions: Skew-t, GED, Student-t, and normal. Results indicate that Unconditional EVT over-predicts VAR and the use of dynamic EVT is not suitable for the estimation. The GJR-GARCH (38.5%) and GARCH (33.3%) models give a better estimation but the dominant model is GJR-GARCH (Adam, Allsopp, & Vines, 2017). On the other hand, another study that sought to determine conditional correlations between daily returns of 6 currencies of EAC countries pegged to the US dollar, found that there are significant correlations in the exchange rates in the member states (Shiferaw, 2019).

Real exchange rate and exchange rate volatility, and how they affect trade balances in Sub-Saharan Africa are also of profound interest. Drawing data from 14 African countries over the 2006 to 2016 period, the Generalized Method of Moment (GMM) was used to estimate how exchange rate volatility was produced by real exchange rate volatility. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) analysis indicates that real exchange rate and exchange rate volatility have a positive and significant effect on the trade balance in the Sub-Saharan region (Olomola & Dada, 2017). Muwanga (2016) conducted a study to investigate the convergence of exchange rates using the bivariate co-integration approach which is allowed to role. He used the Sup LM test and allowed structural breaks to apply. He found that the extent to which convergence has been realized is dismal. These findings show that the EAC needs to more in their quest for a monetary union.

A study that sampled from the Economic Community of West African States (ECOWAS) states using data from 1980 to 2015 sought to establish whether exchange rate regimes influence economic

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integration. The measurements for economic integration were exchange rates tariffs, similarity in languages, the cost of transport, the income per capita, the real GDP, and openness to trade. They used panel data and applied the fixed effect model. They concluded that when the exchange rate regime increases by a unit, the economic integration of ECOWAS deepens by 0.13%. therefore exchange rates regimes are crucial for integration in ECOWAS (36).

Mlosa, Hakim and Rahayu (2019) evaluated the role of credit, money supply, and exchange rates in EAC as the transmission mechanisms since monetary transfer mechanisms form part protocol desired for the monetary union. They used panel data for five EA states over 22 years, the finding was that the real economy is positively and significantly affected by the money supply channel. Therefore, it is a crucial channel in monetary policy transmission in the EACs. On the contrary, the rate of exchange and credit channels did not have a significant effect on the transmission of monetary policy.

Existing studies show that findings on exchange rate convergence in the EAC are inconclusive. There are difficulties in comparing the data due to differences in methodological designs that define the sample period (monthly, quarterly and annual data). Specifically, this paper would focus on the convergence of the two main variables in monetary policy transmission; that is, the interest rates and the exchange rates to establish clearly how they are behaving as the east African region is gearing to attain a common trade area and subsequently a monetary union.

2. Methodology

Various studies have adopted different techniques to study economic convergence. Barro and Salai-i-Martin (1995) for example introduced the concept of beta (β)-convergence and alpha (σ)-convergence. To further check for the presence of stability and long-run relationship, this study will conduct a unit root test and co-integration test using several methods to ensure that the results are robust.

2.1 Testing for Stability

To check whether a time series data is stationary (stable), the appropriate test is to check for the presence of unit root. The test for unit roots is conducted on the following equation

$$x_t = \mu + \beta t + \varphi x_{t-1} + \sum_{i=1}^{k} e_i \Delta x_{t-1} \qquad (1)$$

Where x is the macroeconomic variable (interest rate or exchange rate) series; t=time; and k=the lag order. As the model includes a constant and a trend term, each series is expected to have a non-zero mean and a non-zero drift. The null hypothesis for this model is that $|\varphi| = 1$. This compares to an alternative that $|\varphi| < 1$. A variable is considered non-stationary if the null hypothesis cannot be rejected.

2.2 Testing for Convergence

To check whether there is the convergence of interest rate and exchange rates amongst the EACs the study checks for sigma and Beta convergence and finally conduct a co-integration test to see whether there is a long-run relationship in these variables.

2.2.1 Sigma (σ) Convergence

Sigma convergence occurs when macro-economic variables differentiation decrease over time. The dispersion of macro-economic variables can be measured by getting their standard deviation (variation). This can also be referred to as the coefficient of variation (CV) of the macroeconomic variables. This analysis checks CV for interest rates and exchange rates for all the EACs. The formula for calculating the CV is given by;

$$CV = \frac{standard\ deviation}{mean} \tag{2}$$

To establish the trend for the sigma coefficient, the CV is plotted against time to establish the trend.

$$CV(y_t) = \alpha_0 + \alpha_1 t + \varepsilon_t \tag{3}$$

The dependent variable is the coefficient of variation for the macro-economic variable for the EACs and the independent variable is the time covered by the analysis (2008-2018). The criteria for checking convergence is that the coefficient for the time variable (α_1) be negative.

2.2.2 Co-integration Test

Various co-integration tests will be conducted for robustness to check for the presence of a long-run relationship between the interest rate and the exchange rates for the EACs. The empirical expression of the model is as follows:

$$\Delta V_t = \emptyset + \Omega V_{t-1} + \sum_{j=1}^{k-1} \bar{O}_j V_{t-j} + m_t \tag{4}$$

Where V_t denotes a vector of interest rate and exchange rate variables and $\Omega = \varphi\beta$. The symbol φ, represents the speed of adjustment matrix with β standing for cointegration matrix, r<n. For hypothesis testing on r, the maximum eigenvalue statistics and trace statistics can be computed.

Convergence occurs when the difference between two series x_i and x_j, become arbitrarily small over time, that is:

$$\lim_{n \to \infty} (x_{it} - x_{jt}) = \varphi \tag{5}$$

We defined for random series; convergence requires the expected value of the difference between the two series to become arbitrarily small as time elapses, that is:

$$E\left\{\lim_{n \to \infty} (x_{it} - x_{jt})\right\} = \varphi \tag{6}$$

Convergence occurs when the difference between the two X series has become integrated to a lower order compared with the initial series. This implies that if each X series is non-stationary, then the difference between the two series should be stationary.

2.3 Testing for Impact Interest Rates and Exchange Rates on GDP

Testing for the effect of the interest rates and exchange rates on the GDP will be estimated panel data estimation techniques which can generally be specified as:

$$y_{it} = \alpha_i + x_{it}'\beta + u_{it} \tag{7}$$

Where the dependent variable (y_{it}) if it is a time-variant, the independent variables are defined by the

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matrix (x'_{it}), and the specification α_i and u_{it} categorize the model as to whether it is a pooled OLS, fixed or random effect models, and within effect model.

The choice of the appropriate model to be adopted after analysis shall be determined by conducting the Hausman test and Breusch-Pagan Lagrange Multiplier test.

2.4 Definition of Variables and Data Sources

Here, a brief description of the panel data used in the analysis is given.

Table 2. Definition of Variables

VARIABLE	Data Description	Source
The Real Interest rate	The interest rate applied in lending adjusted for inflation using the GDP deflator	World Bank data indicator
Real effective Exchange rate	Given by the nominal effective exchange rate divided by a price deflator/ index of costs.	World Bank data indicator
GDP growth rate	"Is the average annual growth rate of real GDP measured by the change in GDP at constant prices as a share of GDP" WDI	World Bank data indicator
Inflation	"The percentage change in Consumer Price Index (CPI) on a year-on-year basis."	World Bank data indicator

3. Results and Discussion

Summary for the panel data variables was estimated to get a visual characteristics of the variables. These enabled the analyst to bring out the variation in variables in terms of whether it is varying across time and individuals, looking at table two all variables are varying across individuals and within individuals, the item to look at is the standard deviation between and within variables. These distributions help in knowing the appropriate panel data model to use. Not that given the knowledge of theory that the GDP is a function of investment, consumption, government expenditure, and net exports. The analysis uses savings as a proxy for interest rates and net export as a proxy for exchange rates. The first two, id and year are not varying between the countries that is why the variation is zero.

Table 3. Descriptive Statistics for Panel Data

Variable		Mean	Std. Dev.	Min	Max	Obs
id	Overall	3.0000	1.423136	1	5	N = 80
	Between		1.581139	1	5	n = 5
	Within		0	3	3	T =16
year	Overall	2,012.5000	4.638856	2005	2020	N = 80
	Between		0	2012.5	2012.5	n = 5
	Within		4.638856	2005	2020	T = 16
gdp_pc	Overall	724.6616	383.1022	151.6816	1,838.2100	N = 80
	Between		343.9596	241.1123	1,193.7090	n = 5
	Within		225.6606	42.5695	1,369.1630	T = 16
int_rate	Overall	8.4820	7.9024	(34.4620)	21.7656	N = 80
	Between		3.1153	5.3936	12.6529	n = 5
	Within		7.3882	(38.6329)	21.2461	T = 16
exch_rate	Overall	0.2988	0.4461	0.0268	1.4855	N = 80
	Between		0.4875	0.0405	1.1676	n = 5
	Within		0.0807	0.0706	0.6167	T = 16
cons_pc	Overall	629.2100	346.8711	158.5072	1,840.7420	N = 80
	Between		310.4173	255.4544	1,120.0140	n = 5
	Within		205.5643	(16.1287)	1,349.9370	T = 16
savings	Overall	91.6528	93.1284	(35.4114)	356.0832	N = 80
	Between		91.1923	(14.3421)	229.9988	n = 5
	Within		43.9985	(23.3523)	217.7372	T = 16
Govt exp.	Overall	804.4823	427.6742	186.1133	2,166.4560	N = 80
	Between		379.6533	288.7517	1,352.6950	n = 5
	Within		257.1698	16.7618	1,618.2430	T = 16
Net exports	Overall	(146.9750)	207.7410	(1,041.4790)	(8.6555)	N = 80
	Between		136.6136	(380.3040)	(36.4009)	n = 5
	Within		167.4417	(808.1500)	198.2263	T = 16

Source: Authors computation

3.1 Stability of the Exchange Rates and Interest Rates (Unit Root Test)

To analyze the stability of exchange rates and interest rates, a unit root test was conducted. When a time series is confirmed to have a unit root it implies that it is a random variable otherwise it is stationary (stable). This can be analyzed by way of plotting to see the pattern of the curve but in this study, several

tests for the presence of a unit root are checked so that we achieve robustness in our results. The following tests were conducted;

Table 4. Unit Root Test

unit-root test	Statistic	Exchange rate	P-value	Interest rates	P-value
Levin-Lin-Chu	Unadjusted t	-3.0963		-5.8736	
	Adjusted t*	-2.2798	0.0113	-3.7271	0.0001
Harris-Tzavalis	rho	0.8334	0.7688	0.0040	0.0000
Breitung unit	lambda	2.2547	0.9879	-0.7226	0.2350
Im-Pesaran-Shin	t-bar	-1.4807		-3.1026	
	t-tilde-bar	-1.3209		-2.1553	
	Z-t-tilde-bar	-0.0980	0.4610	-2.6615	0.0039
Fisher-type	Inverse chi-squared(10) p	8.5910	0.5713	40.1031	0.0000
	Inverse normal Z	0.1739	0.5690	40.1031	0.0000
	Inverse logit t(29) L*	0.1468	0.5578	-4.8916	0.0000
	Modified inv. chi-squared Pm	-0.3151	0.6236	6.7313	0.0000
Hadri LM	z	11.5034	0.0000	3.2979	0.0005

Author's Computation, 2021

From the analysis, we can see that the tests for the exchange rates largely confirm that the data is not stationary. When the p-value is not significant we accept the null hypothesis that we have a unit root, this implies that we have a random variable. Therefore, the exchange rates within the East African countries are largely volatile making the balance of payments between these countries to be so indeterminate. This would also mean that respective countries' investors are not able to adequately plan for exports and imports.

On the other hand, the interest rates are largely stable for the East African states. To a large extent, this implies that the financial markets in these countries are largely stable and that financial investment among the EAC member states can be done with some degree of certainty. Only one test, that of (Breitung unit) failed in the test for stationarity but given that the majority of the test confirms the presence of stability, we conclude that the interest rates are stable.

3.2 Testing for Convergence

This section analyses whether exchange rates and interest of the EACs are converging over time, which will be an indicator that differences between the countries are decreasing over time, the analysis is conducted in two faces:

3.2.1 Sigma Convergence

Sigma convergence is analyzed by calculating the coefficient of variation from the respective variables

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and thereafter regressing this coefficient against time. The presence of convergence is demonstrated by the existence of a negative coefficient between the coefficient of variation and the period through which the data is analyzed. The negative relationship implies that the variation in the subject variable is declining over time. To start with, the analysis first generates a curve to establish the trend of the two variables of interest over time which is captured below under Figure 1. It is evident that the interest rate is downward slopping which is an indication that the variation in the interest rates is declining over time.
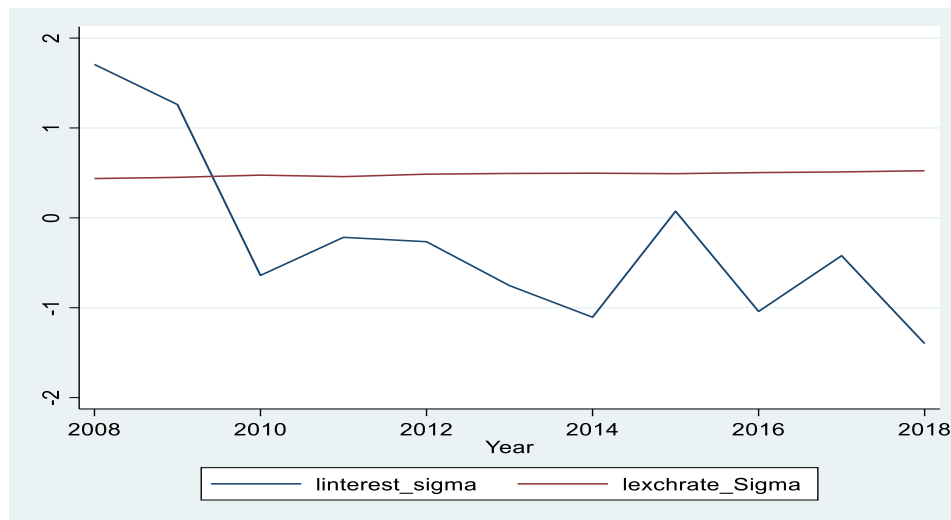

Figure 1. Convergence Curve

Source: Authors workings

However, looking at the exchange rates, they are largely stationary. The exchange rates are neither converging nor diverging according to the trend analysis evident in the figure.

Alternatively, regression is conducted for the coefficient of variation against time to check whether we have a negative or positive relationship, which should be significant. From the regression, it is evident the coefficient of variation for the interest rate is declining over time (convergence) and that of the exchange rate has a positive coefficient (divergence). The two are all significant. We, therefore, conclude that interest rates are converging over time and the exchange rates are diverging over time.

Table 5. Sigma Convergence Regressions Results

	Interest rates	p-value	Exchange rates	p-value
Constant	433.72	0.01	-14.86	0.00
Year	-0.22	0.01	0.01	0.00

Source: Author's Computation, 2021

Since the unit root test demonstrated that the exchange rates are random (they are not stationary) the next test will be to check whether there is a common trend between the exchange rate and the interest rate in the long run.

3.2.2 Co-integration Test

Co-integration postulates that time series variables could be individually not stationary but be stationary in the long run if combined with another time series variable. Here, we test whether the exchange rates have a long run common trend; the analysis is presented in Table 6 below. The test in this analysis is to check whether there is no long-run relationship (no co-integration) or there is a long-run relationship (presence of co-integration between the two variables). Several tests were conducted for robustness and the majority of the test confirm that there is a long-run relationship between the exchange rates and interest rates. We can therefore conclude that exchange rate and interest rate are converging in the long run.

Table 6. Co-integration Test

Cointegration test	Statistics	coefficient	P-value	Significance
Kao test	Modified Dickey-Fuller t	2.38	0.01	*
	Dickey-Fuller t	3.64	0.00	***
	Augmented Dickey-Fuller t	3.43	0.00	***
	Unadjusted modified Dickey-Fuller t	-4.69	0.55	
	Unadjusted Dickey-Fuller t	-0.17	0.43	
Pedroni test	Modified Phillips-Perron t	1.18	0.12	
	Phillips-Perron t	-0.44	0.33	
	Augmented Dickey-Fuller t	-1.38	0.08	*
Westerlund test	Variance ratio	2.65	0.00	**

Note. * signifies Significant at 1% level; ** signifies Significant at 5% level; *** signifies Significant at 10%

Source: Author's Computation, 2021

3.3 The Impact of Interest Rates and Exchange Rates on GDP

From theory, we know that GDP is a function of consumption, investment, government expenditure, and net exports. In this analysis, savings are used, as a proxy for investments due to data availability, the main variables of interest are the exchange rate and interest rates. The other variables are included as control variables, that is; consumption, savings, government expenditure, and net exports.

The analysis estimates the coefficients using all panel data estimation techniques then conduct the Hausman test and Breusch-Pagan Lagrange Multiplier test to establish the most appropriate model that should be adopted. Panel models' estimation is presented in Table 7 below:

Table 7. Panel Estimation Models Output

GDP	Pooled OLS regression	Between	Within or fixed effects	First difference	Random effects
Interest rate	-0.02	Omitted	-0.01	-0.03	-0.01
Exchange rates	6.18**	Omitted	-41.58**	3.29	6.18**
Consumption pc	0.75***	0.24***	0.79***	0.85***	0.75***
Savings pc	0.97***	0.60***	1.03***	1.02***	0.97***
Govt. Exp pc	0.19***	0.62***	0.14***	0.09	0.19***
Net exports pc	0.02***	0.07***	-0.03***	-0.03***	-0.02***
Constant	7.93***	5.65***	31.55***		7.93***
R2	0.99			0.99	
R2- within		0.99	0.99		0.99
R2- between		1.00	0.99		0.99
R2- Overall		0.99	0.99		0.99
Sigma u			28.02		-
Sigma e			7.76		7.76
Rho			0.93		-

Note. * signifies Significant at 1% level; ** signifies Significant at 5% level; *** signifies Significant at 10%

Source: Author's Computation, 2021

The next step is testing which is the most appropriate model to be adopted for our analysis, to achieve these, the Hausman and Breusch-Pagan Lagrange Multiplier tests are conducted and the results are presented below:

Table 8. Model Selection Tests

	Test	Statistic	p-value
Hausman test	chi2(1)	26.77***	0.00
Bresusch-pagan LM Test	chibar2(01)	0.00	1.00

Note. * signifies Significant at 1% level; ** signifies Significant at 5% level; *** signifies Significant at 10%

Source: Author's Computation, 2021

The Hausman test is significant which means we should use a fixed-effect model rather than a random effect model. The fixed-effect model from the output seems okay because it has high R-square values and the Rho is high than that of the random effect model; The Rho value for the within or fixed-effect

model shows that 93% of the variations in the model is explained by individual-specific terms rather than the idiosyncratic errors. The Rho value for the random effect model is zero showing that variations are explained by the idiosyncratic errors (model errors rather than individual errors).

On the other hand, the Breusch-Pagan Lagrange Multiplier test is not significant and the statistic is zero, which means that the pooled OLS model is not suitable for the analysis but rather one of the random effects models should be considered. Therefore, the most suitable model to explain the outcome of the analysis in this paper is the within or fixed-effect model which shall be the basis of explanation.

The within or fixed-effect model shows that interest rate has a negative but insignificant impact on the GDP. The exchange rate has a "negative and significant coefficient" and it shows that if the exchange rate increase by a unit the GDP would decrease by 41.58. That is, if a countries currency becomes stronger than the dollar, the country is likely to have fewer exports than when the currency depreciates.

The other control variables are all significant, consumption, savings, and government have a positive effect on the GDP and the net exports have a negative impact given that the EACs have largely been experiencing unfavorable balance of payment. These countries are largely net importers going by the data.

4. Conclusions

The sigma (σ) convergence test shows that the interest rates are converging among the EACs in the long run. This is confirmation that the variations in the interest rates among the EACs are declining over time, meaning that they are converging to a common value. This is a good precursor to the desire to have a common monetary union. This also shows that the measures that have been put in place by the EACs to realize monetary union is bearing fruits. The interest rates in the region are leveling up which is a good sign.

However, the sigma convergence test for exchange rates indicates that they are diverging over time. This is a matter of concern because the unit root test showed that they are not stable and here we see that it diverging for the member states. Therefore, there is more to be done in this particular area if the region is to realize a monetary union. The EAC needs to come with policies that would promote stability of exchange rates among the member states in their quest to realize monetary union.

To check the long run relationship of the two variables of interest in the monetary transmission mechanism, the analysis checked for the presence of co-integration amongst the two variables. The results largely confirmed the presence of a long-run relationship in the monetary transmission variables. This confirms that even though the variables could be individually unstable, they have a common trend in the end, which is a confirmed for the presence of convergence in the long run. This is good for the EACs because it indicates that their desire to realize a monetary union is on track.

The analysis of the impact of interest rates and exchange rates' effect on the GDP shows that the effect of interest rates on GDP is not significant but that of the exchange rate is significant for the within or fixed-effect model. Therefore, the stability of the exchange rates is important if the EACs are to realize increased growth in their GDP. The monetary authorities must emphasize that for the economies to get

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stronger, the imports should become cheaper as these economies are largely net importers. If the currencies in these economies are going to be stronger, they will realize reduced prices of imports, which will improve the balance of payment for the member countries.

The exchange rates in the EACs are not stable which calls for the member countries in the East African community to work together and put measures that will lead to a steady-state. These measures could be that the monetary policymakers in these countries work together through a common central bank and come up with monetary policies that are likely to result in similar and steady exchange rates in the region. Steady exchange rates would promote trade amongst the member countries and reduce uncertainty amongst the traders in the region.

The evidence that there is convergence for interest rate and divergence for exchange rate calls for more focus on stabilization of exchange rates if the region wants to realize economic union. The EACs exchange rates have to be converging and stable in the long run to realize smooth trading, these nations must put up mechanisms like caps (ceilings) or bands to which member nations must adhere so that they will be able to realize their long-run goal of a monetary union.

When the exchange rates and interest rates are put together, the two monetary transmission variables seem to be co-integrating. Hence, the monetary policies in these nations are working together well and they should investigate and compare their macroeconomic policies that are favorable leading to these convergences and further strengthen the ones that are not stationary like exchange rate as shown by the unit root test.

Finally, changes in the exchange rates are more significant in explaining the changes in GDP for the EACs and therefore more resources must be directed in ensuring stability in the export market. The government should promote export-led production, which would lead to a favorable balance of trade. Monetary policies should aim at stabilizing the local currencies so that they can compete favorably with foreign currencies. The policymakers should pursue policies that will make the local currencies stronger if the union of the EACs is to be strengthened.

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