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IMPACT OF CFA FRANC EXCHANGE RATE ON CEMAC NATIONS ECONOMIC GROWTH.

By

MBUBIT BENS MBUBIT

**A Thesis Submitted to Business School in Partial Fulfilment
of the Requirements for the Degree of**

**Doctor of Philosophy
Economics**

at

Leeds Beckett University

July 2022

**IMPACT OF CFA FRANC EXCHANGE RATE ON CEMAC
NATIONS ECONOMIC GROWTH.**

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DECLARATION

This thesis is a product of my own work and is not the result of anything done in collaboration.

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I agree that this thesis may be available for reference and photocopying, at the discretion of the University.

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DEDICATION

This research work is dedicated to my lovely wife who has been by my side, encouraging me for more than a decade. Sweetheart, I will always love you.

ACKNOWLEDGMENTS

My special thanks go to the Almighty GOD for His special grace for seeing this day and for the strength to get through this program. I would like to thank my supervisor Dr. Milton Yago and my co-supervisor Dr. Paul Jones for their patience, guidance and constructive feedbacks. I extend my gratitude to the Research Student Programme Director Dr. Moade Shubita, for his advice and support. My gratitude to the entire team of the university research office, especially to Ms. Joanne Burgess, and Melissa Watts.

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ABSTRACT

The impact of changes in the real exchange rate (RER) on economic growth has been of growing attention in recent policy debates. One of the focal reasons for the growing attention is due to the growth experienced by some East-Asian nations between the period 1965 to 1990s, which is attributed to the exchange rate. On the other hand, the debate was renewed due to series of economic crises faced by some nations, whereby unsustainable exchange rate was identified as the cause.

The main goal of this thesis is to examine the relationship between the CFA franc and the economic growth of the CEMAC zone. This was done by first investigating the state of the currency in all CEMAC nations, as seen in the first empirical question. Because there is not 'one' equilibrium REER, rather there is a path of equilibrium REER through time, I used the Behavioural Equilibrium Exchange Rate (BEER) approach by Clark and MacDonald (1998) to ascertain the state of the CFA franc. The results showed that as of the year 2018, the CFA was at equilibrium in all the CEMAC nations, and governments should not be worried.

The second question analysed if currency devaluation improved the trade balance in CEMAC nations through the presence of the *J*-curve. I used the aggregate bilateral trade date approach by Rose and Yellen (1989), and the aggregate trade date approach by Magee (1973) to analyse the presence of *J*-curve between the individual CEMAC nations and their main trade partners. Due to lack of data for some of the CEMAC nations, only three CEMAC nations were used in this section (Cameroon, Central Africa Republic – CAR, and Gabon). The results showed the presence of *J*-curve only in Cameroon models for both approaches, implying that CFA franc devaluation improves the trade balance in Cameroon. The absence of *J*-curve in CAR and Gabon means that policymakers could use other tools than the CFA franc devaluation to improve their trade balance. Also, there is a need for an improvement of bilateral trade flow within the region.

The third question examined the relationship between the REER and economic growth in the CEMAC zone. The CFA franc devaluation was meant to improve the economic growth of the entire CEMAC Zone. As such, I used the Pooled Mean Group (PMG) panel autoregression distributed lag (ARDL) approach to investigate the nature of the relationship between REER and the CEMAC region's economic growth. The result showed that the CFA franc devaluation did not influence the region's economic growth. Thus, policymakers should use other tools to improve the region's economic growth.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

As a vital relative price affecting the economy via numerous channels, the impact of changes in the real exchange rate on economic growth has been of growing attention in recent policy debates. The debate was renewed due to the series of economic crises (1994 Mexican Peso crisis, 1997 Southeast Asia financial crisis, 1998 Russia financial crisis, 1999 Brazil currency crisis, 1998 -2002 Argentina great depression), whereby unsustainable exchange-rate regimes were identified as the cause (Gluzmann *et al.*, 2012, Farrant and Peersman, 2006).

Nations are constantly evaluating their competitiveness in the global market and seeking to empirically provide explanations on the fundamentals that drive their international competitiveness.¹ With competitiveness being the ability of a nation to attain sustained, inclusive growth under stable macroeconomic conditions, a nation's international competitiveness in the foreign trade pivots on its real exchange rate (RER) level. Over the years, policymakers and economists focused on fiscal policy and exchange rate policy. While the fiscal deficit's role is well understood, the opposite is the situation concerning the exchange rate policy.

Some of the reasons for the controversial nature of the exchange rate policy is that it comes in different manners: floating, fixed, managed, dirty floating, and dirty managed. Besides the floating exchange rate, the failure or success of a specific exchange rate policy is contingent not on the regime's nature but instead on the direction of the currency misalignment (Bhalla, 2008). Currency misalignment is the departure of the actual RER from its equilibrium value,² while when the currency revolves around the equilibrium value, it is said to be at equilibrium.

The results of an overvalued exchange rate are well known. A persistently overvalued RER leads to factor misalignment, loss in efficiency, and loss of competitiveness, which hinders growth and slows convergence. Also, an overvalued RER exposes a currency to speculative attacks which could eventually lead to capital flight as was the case of the Southeast Asia 1997 crisis (Ngian, 2000; Goldstein, 1998).³ The above conclusion is unanimously accepted for the

¹ This is predominantly important for African nations, most of whom are small open economies striving to offer their citizens the opportunities to ameliorate their quality and standard of living via employment and productivity gains (Ramirez and Tsangarides, 2007).

² When the misalignment is above the equilibrium value, the currency is overvalued, and when it is below the equilibrium value, it is said to be undervalued.

³ On 19th May 1997, the Thai Baht was hit by massive speculative attacks because it was not devalued and lacked the foreign reserves to support the USD-Baht currency peg. As such, the Thai government was forced to float the Baht on 2nd July 1997, allowing the value of the Baht to be set by the currency

RER overvaluation, but the theoretical and analytical equivalent for its alternative – the RER undervaluation being helpful to economic growth – is not.⁴ Besides, even if accepted in theory, in practice the discussion is involved with issues of its definition and measurement, which include:

How do we define the real exchange rate? How is it measured? Most importantly, how does one measure the equilibrium exchange rate? It is from the latter that the misalignment is measured. This has made the RER and misalignment among the most debated macroeconomic policies on national and international platforms (Hinkle and Montiel, 1999; Williamson, 1994). Some empirical results do not support the conclusion that an undervalued RER contributes to economic growth. Easterly (2005) review of the updated Dollar (1997) measure of currency devaluation concludes that RER devaluation was insignificant as a determinant of economic growth. Acemoglu *et al.* (2003) and the IMF (2005) also concluded that the outcome was even weaker when institutions were introduced in the growth model. Nevertheless, some evidence of a positive effect of RER devaluation has surfaced, with the East-Asian nations (China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Thailand, and Taiwan) being perfect examples. It is believed that their "miraculous" growth between the periods 1965 to 1990 was due to the support of "smart"⁵ in their export-led growth strategy, alongside their manipulation of the exchange rate (Razmi *et al.*, 2012; Rodrik, 2008; World Bank, 1993).

The 'Washington Consensus' by Williamson (1994) acknowledges the vital role of RER in the growth process. The Washington consensus refers to a set of broadly free market economic ideas supported by prominent economists and international organisations like the World Bank, the International Monetary Fund (IMF), and the European Union (EU), which advocates free trade, free market, and macroeconomic stability through ten principles stated by John

market. This eventually caused a chain reaction of events into a region-wide crisis affecting Indonesia, South Korea, Philippines, Hong Kong, Malaysia, Japan, and Singapore.

⁴ This is because when a currency is devalued, the domestic exporter will benefit from exports getting cheaper (competitive), thereby increasing their sales and returns. This boosts their product demand and could result in job creation in the export sector of the economy. Also, a high export could improve the nation's current account deficit, especially if the deficit is due to the absence of competitiveness. Thus, high export and aggregate demand (AD) could result in high economic growth. Contrarily, a currency devaluation could have some setbacks to a nation because it is likely to result in inflation: much money getting into the economy due to the much export sales will increase aggregate demand relative to aggregate supply (AS), resulting in demand-pull inflation. Simultaneously, a devaluation will cause imports to be much more expensive (imported raw materials and semi-finish goods will increase in price), thereby increasing the cost of production. This eventually results in a cost-push inflation, increasing the cost of living and impoverishing the population. In addition, because it is difficult for developing nations to borrow in their currency from the international market "original sin" – as stated by Eichengreen and Hausmann (1999), they are compelled to borrow in foreign currencies. With a devaluation, the cost of borrowing becomes much more expensive, increasing production costs and dependency on developed nations.

⁵ SMART is a well-established tool used to plan and achieve goals and is the acronym for Specific, Measurable, Achievable, Relevant, and Time-bound.

Williamson in 1989.⁶ According to it, an appropriate real exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economy growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance.⁷

Contrary to the 'Washington Consensus' is the view that Rodrik (2008) championed, RER undervaluation promotes economic growth, and overvaluation harms it. This stance is in part due to the point of view that exchange-rate – precisely an undervalued currency could be used in protecting home-based infant industries and the competitiveness of their exports (Nouira and Sekkat, 2015; Grekou, 2015; Levy-Yeyati *et al.*, 2013; Rodrik, 2008). This perspective was recently rekindled due to the success story of the export-led growth in conjunction with apparently undervalued currency in East-Asian nations (Grekou, 2015; Rodrik, 2008; Levy-Yeyati and Sturzenegger, 2007).⁸ Finally, Rodrik (2008) says that due to institutional weakness and market failure,⁹ the manufacturing sector in developing nations is unduly subject to distortions. As such, it is below its optimal size in equilibrium. Because removing those distortions appears difficult, an undervalued RER serves as a 'more practical' second-best option for optimally re-allocating resources towards the manufacturing sector (Rodrik, 2008).

Frankel (1999) said: *"No single currency regime is right for all countries or at all times."* This expresses the complexity of the exchange rate policy. Though the International Monetary System has advocated a generalization of flexibility since 1971 following the collapse of the Bretton Woods system (with the idea that the exchange rate as the basic price of the economy –alongside the interest rate and wages– must necessarily be flexible so that, market

⁶ Looking at implementing some of the IMF recommendations, - the ten pillars of the Washington consensus are i.) Low government borrowing, ii.) Reduction of public spending, iii.) Tax reform, iv.) Interest rates that are market determined v.) Competitive exchange rate, vi.) Trade liberalization, vii.) Liberalization of inward foreign direct investment, viii.) Privatization of state enterprises, ix.) Deregulation, x.) Legal security for property rights.

⁷ Nevertheless, an overly competitive RER is not appropriate because it would fuel inflation and curb resources (foreign reserve) available for investment (Schroder, 2013; Williamson, 1994). From this vantage point, there is the notion that there exists an equilibrium real exchange rate (ERER) that satisfies both internal and external balances (Nurkse, 1945), and any deviation from it could impede economic growth.

⁸ However, it should be noted that the export-led growth strategy also considers the type and quality of exports (primary, industrial, or tertiary).

⁹ A weak institution depicts a state of decline or powerless government agencies to effectively discharge some of the fundamental responsibilities of the state, such as the maintenance of law and order and the protection of its territorial integrity. Some of the manifestations of institutional weakness are Losing control of territory or the sole power of using physical force therein, Crisis of legitimacy in which some part of the state seeks disintegration, and Inability to provide essential services to the citizens (Usman *et al.*, 2015). Market failure occurs when there is a state of disequilibrium in the market because of market distortion. It takes place when the quantity of goods and services supplied is not equal to the quantity demanded, and some of the distortions that could affect the free market include price limits, monopoly power, minimum wage requirements, and government regulations. Thus, the causes of market failures are externality, public goods, market control (monopoly, oligopoly, monopsony, oligopsony), and imperfect information in the market.

adjustments lead to internal and external balances). Yet, the fixed exchange rate regime subsists in the currency areas (Zobo, 2014). After the collapse of the Bretton Woods exchange rate (or fixed exchange rate) system in 1973, and with globalisation and new technology, most nations moved from a fixed exchange rate system to a floating one. With the adoption of the floating exchange-rate system, both the market forces of demand and supply for their currency determine the exchange rate of the countries practicing the system.

On the other hand, for countries still practicing fixed exchange-rate regimes, their monetary policy and the management of all matters related to the banking system are assigned to their Central Bank (Zobo, 2014; Adom, 2012). Despite the shift from fixed to floating exchange rates, some nations still maintained the fixed exchange rate regime. Examples of such nations are Bahrain, Bosnia and Herzegovina, Cuba, Eritrea, Hong Kong, Jordan, Lebanon, Lesotho, Nepal, Oman, Panama, Qatar, Saudi Arabia, Swaziland, United Arab Emirates, Venezuela, some French-speaking Sub-Sahara Africa nations (CEMAC, and UEMOA zones), still maintained the fixed exchange rate regime (Shalifay, 2013).

In this thesis, we will focus on the CEMAC zone nations, investigating whether the currency is at equilibrium. The behavioural equilibrium exchange rate (BEER) approach by Clark and MacDonald (1998) is used to track the currency trend throughout the period and assert the state of the currency in each of the CEMAC nations as of the year 2018. This approach helps us see the state of the currency prior to the devaluation and if the currency was overvalued. We will check if CFA franc devaluation improves the trade balance of the CEMAC nations by investigating the presence of the *J*-curve in their trade balance. The aggregate bilateral trade data approach by Rose and Yellen (1989) is used to investigate the presence of the *J*-curve in the trade balance relationship between each of the three CEMAC nations and their individual main trade partners. To have an overview of the impact of CFA franc devaluation on the nation's trade balance, we will use the aggregate trade data approach by Magee (1973). The presence of the *J*-curve means that the CFA franc devaluation worsen the CEMAC nations' trade balance in the short run and improves it in the long run *ceteris paribus*. The presence of the *J*-curve is achieved when the coefficient of real effective exchange rate (REER)¹⁰ is negative and statistically significant (i.e., the *t*-statistics $\geq |2|$) in the short-run, while positive and statistically significant (i.e., the *t*-statistics $\geq |2|$) in the long run. Among other things, one of the main aims of the CFA franc devaluation was to improve the region's economic growth. As such, we investigate the relationship between the CFA franc and the CEMAC region's economic growth using the panel autoregressive distributed lag (ARDL) model. The annual data used in this

¹⁰ In this thesis, our exchange rate is define based on the REER and not the RER as explained in section 2.1.

research are secondary and are within the period 1980 to 2018, covering the period before and after the devaluation.

The rest of the chapter is as follows: section 1.2 deals with the Real Effective Exchange Rate and economic growth, section 1.3 deals with the background on CFA Franc, section 1.4 deals with exchange rate and its channel of economic growth in CEMAC zone, section 1.5 deals with objectives and research questions, while section 1.6 deals with the structure of the thesis.

1.2 REAL EFFECTIVE EXCHANGE RATE AND ECONOMIC GROWTH

Nations are constantly evaluating their competitiveness in the global market and seeking empirical explanations on the fundamentals that drives their international competitiveness. This is important for developing nations, most of whom are small open economies striving to offer their citizens with the opportunities of ameliorating their quality and standard of living via employment and productivity gains (Ramirez and Tsangarides, 2007). The general macroeconomic objectives of every government are to maintain economic growth, full employment, price stability, balance of payment equilibrium (internal and external balance), and good standard of living.¹¹

Economists see the real effective exchange rate (REER) as a policy instrument for promoting economic growth of a nation. This view was championed by Rodrik (2008) who stated that REER undervaluation promotes economic growth and overvaluation harms it. This stance is in part due to the view that exchange-rate – precisely an undervalued currency could be used in protecting home based infant industries and the competitiveness of their exports (Nouira and Sekkat, 2015; Grekou, 2015; Rodrik, 2008). Thus, in this section we shall review the REER, economic growth and the TB channel through which economy grows as seen below.

1.2.1 EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE.

Estimating the equilibrium REER and assessment issues have become topical recently due to variety of reasons. Firstly, a number of nations – like the Central European nations that agreed to the European Union (EU), Sweden and the UK were interested in knowing the right exchange rate for their entry into the euro. Secondly, the behavior of some currencies, like the initial sharp and continual fall in euro's external value immediately after its inauguration in 1999, the post 2005 Chinese renimmbi's behavior against the US dollar, and the continuous appreciation of the pound sterling during the late 1990's, generated the debate about the sources of the exchange rate movements (Macdonald and Dias, 2007). Does such behavior symbolize

¹¹ *The economic growth is measure via the gross domestic product (GDP) growth rate, with a healthy rate ranging between 2% to 3%. The unemployment rate should be at a natural rate of 4.5% to 5%. The inflation (price stability) should be near 2% target. The BOP trade balance should be zero (Amadeo, 2018).*

movements in the underlying equilibria, and the currencies are therefore accurately price, or are they signifying a misalignment? Thirdly, is the global imbalance issue and the impact of such imbalance for exchange rate behavior and above all the required exchange rate movements needed to address the imbalances. Answering such issues entails some measurements of the equilibrium exchange rate. Thus, we shall be looking at the concept of equilibrium exchange rates and the various way of estimating it.

The equilibrium REER is the relative price of tradable to non-tradable which for given (sustainable or equilibrium) values of other variables (like technology, international prices, trade taxes, capital and aid flow), results in the simultaneous achievement of both internal and external equilibrium (Edward, 1989; Clark and MacDonald, 1998). The internal equilibrium means that the market for non-tradable goods clears in the current period and is expected to be in equilibrium in future. This implies that there is no deviation from the natural rate of unemployment within the economy. While the external equilibrium is reach when the entirety of the present current account and the expected current account in the future satiates the intertemporal budget constraint; which states that the discounted value of the current account balances must be equivalent to zero (Edward, 1989; Clark and MacDonald, 1998). That is, the current account balance (current and future) is compatible with long-run sustainable capital flows (Edward, 1989).

From the above definition, it means that the REER equilibrium is mutable. Once any of the variables that affect a nation's internal and/or external equilibrium changes, the REER equilibrium will as well change. These immediate determinants of the REER equilibrium are known as *real exchange rate fundamentals*. Secondly, there is not 'one' equilibrium REER, rather there is a path of equilibrium REER through time (Edward, 1989). Thus, the choice of the REER fundamentals will be determined by the theoretical framework to be used, and the values of the fundamentals are determined by the type of equilibrium of interest (meaning that they could either take their actual values, or alternatively their medium-term or long-term values) (Driver and Westaway, 2005). Thirdly, the path is not only affected by the current values of the fundamental determinants, but by also their expected future evolution.

The fundamental determinants of the REER equilibrium are the real variables which in addition to the real exchange rate, perform a great part in determining a nation's internal and external equilibrium (Edward, 1989; Clark and MacDonald, 1998). The external REER fundamentals include: i) world real interest rates; ii) international transfers (including foreign aid flows); iii) international prices (that is, the international terms of trade). While the internal (domestic) REER fundamentals could be split into variables that are policy related and non-policy related decisions. The policy related REER fundamentals are a) exchange and capital controls; b)

import quotas, import tariffs; c) the composition of government consumption; and d) other taxes and subsidies. While the non-policy fundamentals include technological progress as the most important. It should be noted that, not only do the above-mentioned variables affect RER equilibrium, but many times the relationship goes in both directions with changes in REER affecting the fundamentals.

The notion that an equilibrium REER moves whenever the fundamental determining factor (determinants) change has significant ramifications for policy. But some policymakers still believe that the equilibrium REER is an unchallengeable amount or a constant. This suggests that any deviation of the REER from its value in the past period (equilibrium year) symbolises a disequilibrium and it is a cause for alarm (Edward, 1989; Clark and MacDonald, 1998). On the other hand, real changes in the REERs do not automatically represent a disequilibrium. Rather, they could reflect changes in the equilibrium generated by changes in the fundamentals. Though the equilibrium REER is a function of only the real variables, the actual REER responds to both the real and monetary variables. So, the actual REER depends on the values of the fundamentals (real interest, international prices, tariffs, and so on) and on aggregate macroeconomic pressures like fiscal deficits and an excess supply of money. The presence of an equilibrium value of the REER does not imply that the actual real rate ought to be perpetually equal to the equilibrium value. Factually, the actual REER will usually differ from its equilibrium especially in the short-run. Nonetheless, other types of deviations could persist and produce REER misalignment.

The present economic and econometric approaches for estimating the EREER generally follow one of these three basic analytical models developed in the economic literature. In a chronological perspective, the models are: Fundamental Equilibrium Exchange Rate (FEER) by Williamson (1983), Natural Real Exchange Rate (NATREX) by Stein (1999), and Behavioural Equilibrium Exchange Rate (BEER) by Clark and MacDonald (1998). These models are presented in chapter 2 (section 2.3). Both the FEER and the NATREX approaches define the EREER as one corresponding to some definition of the general macroeconomic equilibrium.¹² Contrarily to this is the Behavioural Equilibrium Exchange Rate (BEER) framework by Clark and MacDonald (1998), which view the equilibrium rate as one consistent with the prevailing level of economic fundamentals. The BEER approach is often argued to have a number of advantages over the internal – external balance approaches (specifically the FEER). For instant, the FEER

¹² *Given its complexity and the simultaneous equations structure, the estimation of the NATREX models runs into similar difficulties as FEER approaches. To avoid some of the problems, most of empirical research utilizing NATREX approach uses reduced form estimations. That of course raises both the question of a stability of estimated coefficients (given the long run dynamics of factors determining saving—investment nexus, the Lucas type critique is certainly possible) and value of fundamentals free of short term and cyclical variations.*

approach is a method of calculation rather than an estimated exchange rate model like the BEER approach. The BEER approach has the potential of capturing all the systematic and fundamental movements of the exchange rates and can be subject to rigorous statistical testing of various metrics, such as the speed of mean reversion. Also, the BEER is a highly tractable approach to gauging an equilibrium exchange rate, relying on a single equation approach using either time series or panel data. Contrarily, the FEER based estimate require the full-blown multi-nation macroeconomic model which could be cumbersome, though it has the advantages in terms of ensuring internal consistency of the estimates (MacDonald and Dias, 2007). Contrarily to the FEER approach, the BEER approach could produce measures of exchange rate misalignment that are free of any normative elements retaining to sustainability. In this research, we will use the BEER approach to determine the misalignment of the CFA franc in CEMAC zone and it is done in chapter 3.

1.2.2 REAL EFFECTIVE EXCHANGE RATE AND TRADE BALANCE.

It is highly contested among economists that currency devaluation improves a nation's trade balance (TB) deficit, leading to a reduction of the current account deficit and improving economic growth (Kurtović, 2017; Bahmani-Oskooee, 1985). An undervalued exchange rate is viewed as an improvement in price competitiveness and a means towards faster economic growth, as championed by Rodrik (2008) and supported by others (Kurtović, 2017; Grekou, 2015; Schroder, 2013; Cakrani *et al.*, 2013; Levy-Yeyati *et al.*, 2013). A REER devaluation could lead to the deterioration of TB in the short run while improving TB in the long run (Šimakova and Stavarek, 2015; Šimakova, 2013).

Quantifying the short-term and long-term responsiveness of the TB to changes in the exchange rate is vital to economic policy for numerous reasons. First, it establishes if there exists a stable long-term relationship between the exchange rate and TB. In case a stable long-term relationship does not exist, then devaluating a currency might not be a reasonable way of improving a nation's competitiveness in the long-run perspective. Second, if the long-term relationship exists, it is essential to establish if devaluation could lead to a net improvement of TB in the long term (causality) or not.¹³ Third, quantifying the extent of the TB improvement is desirable because it enables one to weigh the TB benefit against the cost of devaluation (like foreign reserve accumulation). Fourth, the estimate of the short-term dynamics provides information regarding the immediate and medium-term impacts of exchange rate changes on

¹³ A long-term relationship could either result in the presence of a J-curve or an S-curve. An S-curve occurs when a currency devaluation leads to an initial improvement in the TB in the short-term and a drop in the long-term (thereby producing an S-sharp like movement of the TB).

the TB (i.e., does a devaluation have a short-term adverse impact on the TB). If it does, it is reasonable to estimate the persistence and the extent of such adverse impact.

It is also important to know so that when TB gets negative in the short term, there will not be much concern because it will improve in the long term. If this understanding of the short-term negative impact is absent, there could be panic and a rush to reverse the devaluation policy (or implementation of other policies), thinking that it will lead to a further deficit of TB. This is often an empirical question, and the literature refers to it as the *J*-curve effect. The economic concept of the *J*-curve and the exchange rate devaluation are closely related, with Magee (1973) being the first researcher to introduce the *J*-curve phenomenon.

Several theories have been used in analyzing the impact of exchange rate movements on nations' TB. These theories are the standard theory of international trade, the structuralists' (elasticity theory), the Keynesian (absorption theory), the monetary theory and the *J*-curve theory. These theories are explained in chapter 2 (section 2.4). Among all these theories, the *J*-curve theory has had the most attention. The *J*-curve theory occupied the most recent empirical literature due to its ability to incorporate other older approaches indirectly and provide a novel approach to the issue by itself, as explained in chapter 4 (section 4.3).

The *J*-curve theory is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC)¹⁴ holds, it is likely that following a devaluation, an initial drop in TB occurs before an improvement follows (Ziramba and Chifamba, 2014; Baek *et al.*, 2006). The response of the TB over time looks like a tilted J shape. The *J*-curve effect is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). The two aspects of the TB responsiveness to changes in the exchange rate are the long-term and the short-term response. The long-term describes the steady state between the new level of the REER and the TB. Once the steady state is attained, the dynamic responses are worn out, and the system is in a new equilibrium (Sahlan *et al.*, 2018). While the initial short-term deterioration of TB as a response to the devaluation is referred to in the literature as the *J*-curve (Sahlan *et al.*, 2018; Kurtovic *et al.*, 2016; Bahmani-Oskooee and Kantipong, 2001; Rose and Yellen, 1989; Magee, 1973). The name stems from the pattern of the TB caused by contracts outstanding during the exchange rate change. The *J*-curve occurs because of the sticky domestic currency prices of exports, which are subject to medium-term contracts. Therefore, the export prices in foreign currency fall, while at the same time the import prices in terms of domestic output increase. After a certain

¹⁴ The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

time lagged, export and import volumes adjust to the new prices, and the TB starts improving. In other words, the *J*-curve represents a possible transition path from the old equilibrium level to the new equilibrium level. The cause of the *J*-curve is attributed to three adjustment periods: i) the currency contract period ii) the pass-through period and iii) the sluggish response (quantity-adjustment) period, as explained in section 4.3. The perverse short-term effect is thought to have a duration of about a year (Stucka, 2003; Krugman and Baldwin, 1987).

A nation's TB is often negative before a devaluation occurs to address it, else there is no need for the devaluation. Once the devaluation takes place, the TB worsens in the short-run till it gets to the minimum before it starts improving. That is why we have a tilted "*J*" shape and not a "*U*" shape, because the TB was already negative and not zero or positive.¹⁵ However, there are situations whereby a devaluation causes the TB to improve in the short-run and worsen in the long-run, producing an "*S*" shape curve, which is the opposite of the *J*-curve.

Though the *J*-curve effect improved the understanding on the impact of movements in the exchange rate on the TB, it has undergone several stages of improvement. There exist three different approaches of investigating the presence of *J*-curve in a nation's TB which include:

- i) Aggregate Trade Data Approach by Magee (1973),
- ii) Bilateral Aggregate Trade Data Approach by Rose and Yellen (1989), and
- iii) Bilateral Disaggregate Trade Data approach by Doroodian *et al.* (1999).

Lots of empirical analyses on the *J*-curve hypothesis are mixed. Studies on the impact of exchange rate movements on the trade balance are still in considerable disagreement on the relationships between these economic variables and the effectiveness of currency devaluation as a tool for improving the TB of a nation (Borena, 2013; Onafowora, 2003). Thus, necessitating an empirical analysis for the CEMAC zone on the relationship between the CFA franc and the nations TB. Thus, we will be interested at investigating if the CFA franc devaluation improved CEMAC nations' TB via the presence of the *J*-curve.

1.2.3 REAL EFFECTIVE EXCHANGE RATE AND ECONOMIC GROWTH.

There is a continuous divide between policymakers and economists regarding the impact of foreign exchange on economic growth. Whereas laypeople and politicians are often convinced

¹⁵ For example, in case there is a devaluation of a domestic currency, then the increase in the domestic price competitiveness could result in the exportation of more and the importation of less. By so doing, it improves the TB, known as the volume effect. At the same time, the devaluation increases the import unit value, resulting in the deterioration of the TB, known as the price (value) effect. The price effect dominates in the short term, while the volume effect prevails in the long term, thereby causing the time path of the TB depicted by the *J*-curve phenomenon (Ziramba and Chifamba, 2014; Abd-El-Kader, 2013; Bahmani-Oskooee and Mitra, 2009; Baek et al., 2006).

that a lower exchange rate will spur growth, economists are often sceptical that the relative price of two currencies could be a fundamental driver of growth over the long term. Most economists believe the exchange rate is an endogenous variable whose contribution to growth might be difficult to disentangle. Whether the exchange rate devaluation aids medium-term growth is still very unsettled in the literature.

Traditionally, the RER was not at the centre of analyses of economic growth. It did not feature in the first generation of neoclassical growth models (starting with Solow 1957) or in their practical policy incarnations (e.g. Rostow 1960) which focused on the determinants of savings and investment (Eichengreen, 2007). That these were closed-economy models dictated that there was no role for the RER. The early neoclassical model focused attention on the large fraction of output growth not explained by the growth of observable factor inputs (residual). The recent general neoclassical growth models (reviewed in Romer, 1994) gave the RER more prominence. The literature on export-led growth is essentially about the advantages of keeping the prices of exportable high enough to make it attractive to shift resources into their production. Historically, this has meant the growth of the production for export of manufactures. Using the RER to provide an incentive to shift resources into manufacturing provides a boost to national income insofar there are conditions making for higher productivity in manufacturing than in agriculture. If technological transfer or learning-by-doing is relatively rapid in sectors producing for export, then there will be additional stimulus to the overall rate of growth. Nations such as Japan, Hong Kong, South Korea, Singapore, Taiwan, and China had success with this growth model have directed attention to the RER as a development-relevant policy tool. It is difficult thinking of many developing nations that have sustained growth accelerations in the presence of an overvalued RER.

They argued that there is a positive relationship between exchange rate changes and economic growth. An exchange rate devaluation influences the relative prices of domestic and foreign goods, promoting exports while decreasing imports. Currency devaluation converts the demands of foreigners into the country and directs the import demands of the indigenous to the local products. As such, currency devaluation supports economic growth by encouraging net exports (i.e., devaluation could be proposed as an effective policy tool to stimulate economic growth) (Karahan, 2020).

On the contrary, the Structuralist economists argued that currency devaluation hurts the economies of developing nations. A crucial structural problem in developing nations' economies is the phenomenon of foreign dependency, as most of the inputs used by these nations in their production process are provided via imports. Most inputs used by these nations in their production processes are imported. An exchange rate devaluation will increase the cost of imported inputs like semi-finished goods and machinery used in the production process. Hence,

the increased cost of production because of the devaluation of domestic currency could harm the output level of the nation.

The 'Washington Consensus' by Williamson (1994) acknowledges the vital role of RER in the growth process.¹⁶ According to it, an appropriate real exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economic growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance. From this vantage point, there is the notion that there exists an equilibrium real exchange rate (ERER) that satisfies both internal and external balances (Nurkse, 1945), and any deviation from it could impede economic growth. A persistently overvalued RER leads to factor misalignment, loss in efficiency, and loss of competitiveness, which hinders growth and slows convergence. Also, an overvalued RER exposes a currency to speculative attacks, which could eventually lead to capital flight as was the case of the Southeast Asia 1997 crisis (Ngian, 2000; Goldstein, 1998). The above conclusion is unanimously accepted for the RER overvaluation, but the theoretical and analytical equivalent for its alternative – the RER undervaluation being helpful to economic growth – is not.

Contrary to the 'Washington Consensus' is the view championed by Rodrik (2008) that RER undervaluation promotes economic growth, and overvaluation harms it. This stance is in part due to the point of view that exchange rate – precisely an undervalued currency could be used in protecting home-based infant industries and the competitiveness of their exports (Nouira and Sekkat, 2015; Grekou, 2015; Levy-Yeyati *et al.*, 2013; Rodrik, 2008). This perspective was recently rekindled due to the success story of the export-led growth in conjunction with apparently undervalued currency in East-Asian nations (Grekou, 2015; Rodrik, 2008; Levy-Yeyati and Sturzenegger, 2007). Finally, Rodrik (2008) says that due to institutional weakness and market failure, the manufacturing sector in developing nations is unduly subject to distortions. As such, it is below its optimal size in equilibrium. Because removing those distortions appears difficult, an undervalued RER serves as a 'more practical' second-best option for optimally re-allocating resources towards the manufacturing sector (Rodrik, 2008).

Some empirical results do not support the conclusion that an undervalued RER contributes to economic growth. Easterly (2005) review of the updated Dollar (1997) measure of currency devaluation concludes that RER devaluation was insignificant as a determinant of economic growth. Acemoglu *et al.* (2003) and the IMF (2005) also reached this conclusion, and that the

¹⁶ *The Washington consensus refers to a set of broadly free market economic ideas supported by prominent economists and international organisations like the World Bank, the International Monetary Fund (IMF), and European Union (EU) advocates; free trade, free market, and macroeconomic stability through ten principles stated by John Williamson in 1989.*

outcome was even weaker when institutions were introduced in the growth model. Nevertheless, some evidence of the positive effect of RER devaluation has surfaced, with the East-Asian nations (China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Thailand, and Taiwan) being perfect examples. It is believed that their “miraculous” growth between the periods 1965 to 1990 was due to the support of “smart” in their export-led growth strategy, alongside their manipulation of the exchange rate (Razmi *et al.*, 2012; Rodrik, 2008; World Bank, 1993).

1.3 BACKGROUND ON CFA FRANC

Created on 26th December 1945 in the wake of the Bretton Woods conference, the Franc of African Financial Community (FCFA) – was initially known as the Franc of French Colonies of Africa (Franc des Colonies Francaises d'Afrique acronym - FCFA). The CFA franc (FCFA) is the currency used in 15 African states grouped into three zones: CEMAC (acronym for Communauté Économique et Monétaire de l'Afrique Centrale - Central African Economic and Monetary Community), UEMOA (acronym for Union Economique et Monetaire Ouest Afraine - West Africa Economic and Monetary Union –WAEMU), and Comoros. The CEMAC zone consists of the following countries: Cameroon, Central Africa Republic, Chad, Republic of the Congo, Equatorial Guinea, and Gabon. The currency is redistributed in this zone by the Banque des Etats de l'Afrique Centrale (BEAC) – Bank of Central African States. UEMOA zone consists of the following countries: Benin, Burkina Faso, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo. The currency is redistributed in this region by Banque Central des Etats de l'Afrique de l'Ouest (BCEAO) – Central Bank of the West African States. In the Comoros, the currency is redistributed by Banque Centrale des Comoros (BCC) – Central Bank of Comoros (Adom, 2015; Banque de France, 2010; Coleman, 2008).

The International Organization for Standardization (ISO) currency codes are XAF for the Central African CFA franc (CEMAC nations), XOF for the West African CFA franc (UEMOA nations), and KMF for Comoros. The monetary and exchange rate policies of CFA franc zone nations are set by BEAC, BCEAO, and BCC boards of governors, and the policies implementation is done by the national branches of the independent central banks, which are linked to France (Adom, 2012; Amin, 2000). Any change in policy, such as parity change, must be in absolute agreement between France and the central banks. Until 1992, there was limitless transferability within regional members and between the region and France, free mobility of capital within and between the zones and France. Some restrictions were imposed on currency convertibility in 1993, such that there was no repurchasing of FCFA outside the zone of issue. Thus, each zone is autonomous from the other, necessitating this study to focus on the CEMAC zone nations and not the entire CFA franc zone.

The FCFA was created with a fixed exchange rate versus the French franc (FF), and the exchange rate changed only twice: in 1948 and 1994. While the events in both 1960 and 1999 were simply changes in the currency in use in FF/ € as shown below.

Table 1.1: FCFA Parity.

Period	Parity	Comment
26 th Dec. 1945 to 16 th Oct. 1948	1 FCFA = 1.70 FF	The 0.70 FF was a premium for creating the FCFA
17 th Oct. 1948 to 31 st Dec. 1959	1 FCFA = 2 FF	The FF devalued against the US dollar, and the CFA franc was revalued against the FF.
1 st Jan. 1960 to 11 th Jan. 1994	1 FCFA = 0.02 FF	(i.e., 1FF = 50 FCFA), and the parity did not change.
12 th Jan. 1994 to 31 st Dec. 1998	1 FCFA = 0.01FF	(i.e., 1FF = 100 FCFA). The devaluation was to help African exports.
1 st Jan. 1999 onward	100 FCFA = 0.152449 euro (€)	(i.e., 1€ = 655.957 FCFA). France joined the euro, and the € replaced FF at the rate of 6.55957 FF = 1 €.

Source: Central Bank of West African States - BCEAO (2017).

The FCFA and FF monetary arrangements included the FCFA convertibility into the FF backed by the French treasury. The convention encompassed strict fiscal and monetary rules, which provided much financial and monetary stability. The advantages, such as greater stability and discipline and low inflation, made the FCFA zone suitable for foreign investment, economic development, and growth (Amin, 2000; Devarajan and De Melo, 1991). Such macroeconomic stability was to attract foreign investors/capital into the nations, which will be used to improve productivity/output, create employment, and growth in the economy, which will eventually result in the improvement in the standard of living of the citizens.¹⁷

However, it is believed that the same institutional arrangements that contributed to the good economic performance of the FCFA zone nations before the 1980s had also hindered them from adjusting timely to internal and external shocks. For instance, the fixed exchange rate system practiced by the FCFA nations made it difficult for their currency to change quickly to adjust to shock (Amin, 2000; Devarajan and De Melo, 1991). Therefore, if the institutional arrangements hindered the timely adjustment of the currency, it is necessary to ensure that it does not re-occur, mindful that it has been more than two decades since the currency was devalued. This leaves us with the question of whether the 1994 currency devaluation achieved its objectives and if the currency is still at its optimal level (equilibrium or not).

The non-CFA franc African nations had crises in the late 1970s and continued into the early 1980s, while the crises in the CFA franc nations began in the mid-1980s. Due to the crises in the non-CFA franc African nations, within the period 1986-1993, they depreciated their currencies by almost 40% to improve their competitiveness (Zobo, 2014; Bahmani-Oskooee,

¹⁷ This is because currency devaluation makes the domestic currency more competitive, meaning more goods and services will be demanded in the international market. This increased demand will require more labour for production purposes, implying that more people within the nation will be employed, increasing disposable income and living standards.

1998; World Bank, 1994). This undermined the international competitiveness of the FCFA nations, thereby causing them to import more and export less, which resulted in a negative trade balance. As such, the FCFA nations resorted to cutting their expenditure to reduce their current account deficits (Amin, 2000; Devarajan and Melo, 1991). It led to a reduction in government expenditures and low economic growth. Because of that, within the period 1986-1993, most of the FCFA zone nations had a negative growth rate and protracted macro imbalances.¹⁸

Before the 1994 devaluation, the CEMAC zone was faced with two types of imbalances (internal and external deficit):

- The internal deficit was due to unemployment, on the one hand, caused by a low level of the legal, administrative, and institutional framework, human capital, and structural and financial policies.
- While the external deficit was due to foreign interests and terms of trade shocks (Bahmani-Oskooee, 1998; Nashahibi and Bazzoni, 1994).

The CFA franc devaluation was aimed at three objectives (Bank of France, 1997): Firstly, the external restoration of the competitiveness of the savings of the zone franc and the recovery of trade balances. Secondly, balancing the public finances (reducing the budget deficits) via improving export commodities. Thirdly, the resumption of growth thanks to the resumption of private investment (Fouopi, 2012). Hence, the devaluation was aimed at enhancing their trade balance, attracting foreign direct investors, and improving the BOP and economic growth (Zobo, 2014; Amin, 2000).

1.3.1 THE REFORMS

The general macroeconomic objectives of every government are to maintain economic growth, full employment, price stability, and balance of payment equilibrium (internal and external balance).¹⁹ The 1994 devaluation aimed at putting the CFA franc nations back on a path of sustainable growth by helping them regain their competitiveness in the world market (IMF, 2000). It encouraged exports to the detriment of imports since their exports were half price, requiring them to buy products from other nations for twice as much. In addition, it was to attract foreign investors because the assets were cheap, and the currency was stable. It was achieved

¹⁸ The average GDP growth rate for CEMAC zone nations was 4.6% during 1975-1985 compared to 1.4% for non-CFA African nations. However, from 1986 to 1993, the rate was as low as 0.1% for CFA-franc nations compared to 2.5% for non-CFA-franc African nations (Zobo, 2014; Amin, 2000). The investment rate for the CFA franc nations had fallen during the period compared to non-CFA African nations.

¹⁹ Economic growth is measured via the gross domestic product (GDP) growth rate, with a healthy rate ranging between 2% to 3%. The unemployment rate should be at a natural rate of 4.5% to 5%. The inflation (price stability) should be near the 2% target. The BOP trade balance should be zero (Amadeo, 2018).

via the OHADA treaty's enactment.²⁰ To avoid some of the immediate side effects of a one-time price surge that could lead to inflation, the IMF encouraged governments to couple devaluation with sound macroeconomic and structural adjustment policies (Washington Consensus). The former includes prudent fiscal and monetary policies and an appropriate exchange rate regime, and the latter includes trade liberalization, diversification of agriculture, reduction of government workforce and spending, elimination of price controls, and privatization of state-owned industries. Moreover, the policies were to be implemented simultaneously or in a carefully planned sequence, necessitating a very high level of cooperative decision-making (IMF, 2000).

Contrary to the above IMF views, the possibilities of import replacement and export elasticities seemed low (Fouopi, 2012). Moreover, CEMAC zone nations were not ready to increase their output, be it technological or infrastructure-wise. As such, a devaluation could be contractionary, as in several Latin American nations.²¹ An exchange rate is the price of a nation's currency for that of another nation(s). Since the CFA franc was devalued by 50% against French France, it has stayed the same, which poses a question of alignment. It implies that if the currency was at its equilibrium, it is still at equilibrium more than two decades later. The Washington Consensus perspective states that the exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economic growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive." So, if the CFA franc value has not changed, it implies that the macroeconomic objectives of CEMAC nations have not changed since then. Alternatively, if the macroeconomic objectives have changed, the exchange rate might no longer align with its equilibrium or the objectives (either overvalued or undervalued).

If neither the macroeconomic objectives nor the exchange rate of CEMAC zone nations changed since the devaluation, what about the exogenous factors? After the 1994 devaluation, the CFA franc was pegged to the French Franc at 100 CFA Franc = 1 FF. When France joined the European Union (Euro) in 1999, the CFA Franc was pegged to the Euro at the rate of 1CFA Franc = €0.00152, better still, €1 = 655.40CFA Franc (The World's Trusted Currency Authority, 2015). The CFA Francs pegged to the Euro resulted in its appreciation of 18.7% between 2000

²⁰ OHADA is the acronym for the French "Organisation pour l'harmonisation en Afrique du droit des affaires". When translated to English as: "Organisation for the Harmonisation of Corporate Law in Africa." It was created on 17th October 1993 in Port Louis - Mauritius, to foster economic development in Central and West Africa by creating a better investment climate in order to attract investment into the nations (Dickerson, 2005).

²¹ Looking at the implementation of some of the IMF recommendations – the Washington consensus, because of the current account deficit of the BOP in the CEMAC nations, and mindful of the fact that the zone was not yet prepared, be it infrastructure or technological wise, attracting foreign investment/investors was one of the prerogatives in correcting the balance of payment. Due to the devaluation, more foreign investment might have flown into the region because of the cheapness of domestic assets and liberalisation policies. However, if the environs were not conducive, it could lead to capital flight whereby more investments are leaving the nation, as was the case of the 1997 Southeast Asian crisis. Thus, the status quo might not be the same from 1994 until now.

and 2010 against 6.6% between 1994 and 1999 (Couharde *et al.* 2012; Zafar, 2005). The appreciation of the Euro at the same time might have placed the real exchange rate of the CFA franc high (Coulibaly, 2014). This had an impact on the value of the CFA franc in the international market.²²

Looking at the commodity market, the increase in the price of crude oil in the year 2008 and its fall in the year 2013 could not have also kept CEMAC nations indifferent, mainly as crude oil contributes to more than 60% of CEMAC zone nations' export revenues and 40% of their GDP (Selassie, 2017; Coulibaly, 2014). The fall in oil prices led to a substantial economic blow that cut the government's revenue by half between 2014 and 2016, with the regional current account deficit widening from 3.9% of GDP in 2014 to 9.3% in 2016 (Selassie, 2017). Despite some public spending reductions to compensate for the drop in the government's revenues, the public debt increased from 29% of GDP in the year 2014 to 47% in the year 2016.²³

The 1994 CFA franc devaluation and the implementation of the structural adjustment program (SAP) in the mid-1990s led to economic austerity, which the FCFA nations still struggle to escape (Dongfack & Ouyang, 2019). In the context whereby importation is a substitute for industrialization, economic growth heavily depends on exporting unprocessed raw materials whose prices are decided in the international markets. Thus, could the CFA Franc devaluation remedy the zone's persisting trade deficit?

For an effective devaluation, the nation's central bank needs to increase its foreign reserves to back the devaluation. These reserves yield little return relative to if it was invested in the economy, leading to a high opportunity cost for the government. Nevertheless, the opportunity cost is engulfed by the profit realized during the improved return of the trade balance and economic growth. Nations like China use this strategy to improve the exportation of its manufactured products and economic growth. The situation seems different for the CEMAC

²² Also, the series of shocks across the globe could not have occurred, leaving CEMAC zone nations indifferent. The 1997 South East Asian Financial crisis, the 2008 mortgage crisis which began in the United States of America (USA) and moved to Europe and eventually to the rest of the world, the late 2009 to 2012 European debt crisis that erupted at the wake of the great recession (Petrakis *et al.*, 2013). These could not have occurred without affecting the CEMAC zone, mindful of the financial integration and technological advancement that has made the world a small global village.

²³ The continuous low commodity prices and security threats faced by the region contributed to their stalled economic growth of 0.1% in 2016. This was significantly below the average 3.6% experienced in Africa (ADB, 2018). The insecurity threats in the region are from different fronts; the Maritime insecurity in the Gulf of Guinea affects the following CEMAC nations: Cameroon experienced 60% of the attacks, i.e., 44 attacks between the period 1997 to 2010. Gabon experienced 25% of the attacks; Congo had 12%, and Equatorial Guinea 3% (ICC, 2012; IMO, 2010). The "The Lord's Resistance Army" threat exists in Central Africa Republic and the Democratic Republic of Congo. There is "Boko Haram" threat in the Lake Chad Basin region – in Cameroon and Chad, and the series of crises in Cameroon – Anglophone crisis (UN, 2015). These have gone a long way to drop the region's productivity and increase its unemployment. As stated by "Okun's law," for every 1% increase in unemployment rate, a nation's GDP will be at an additional 2% lower than its potential GDP (Wamey, 2011).

zone because they are engaged in exporting primary products whose prices are sticky (i.e., a reduction in the prices of products does not increase the quantity sold). Implying that a devaluation might have a less significant impact than manufactured goods.²⁴ Thus, this research will help us address the above-mentioned issues.

1.3.2 MACROECONOMIC CHARACTERISTICS OF CEMAC NATIONS.

The economy of CEMAC nations has evolved since independence, starting from the period of economic growth engendered by the agricultural and agro-industrial growth, as well as petroleum discoveries (1960-1986) (Mbu, 2015; Tambi & Baye, 2012; Molua, 2010). It was followed by a period of economic crisis, caused partly by the fall in world prices and depreciation of the US dollar, resulting in the fall in GDP, which contributed to the devaluation of the CFA franc (1986-1994). Then by the period of economic recovery with significant reforms to increase investment, economic growth, and globalisation. Hence, in the period 1980 to the present date, the CEMAC nations might have witnessed all the possible phases of the business cycle: economic prosperity (up to 1985), economic and social crisis (1986-1994), and probably renewed economic fortunes (from 1995) (Mbu, 2015; Tambi and Baye, 2012). CEMAC nations are in the primary sector and import most of the manufactured goods. Looking at the individual nation's macroeconomic characteristics will give us a better view of the region, which show that the region is engaged in the primary sector, with significant percentage of the population living in poverty. These indicators are presented below on table 1.2.

Table 1.2: Economic Indicators

Indicators (2018)	Cameroon	CAR	Chad	Congo	Equi. Guinea	Gabon
Main economic activities	Petroleum and agriculture	Agriculture, forestry, livestock farming, mining.	Agriculture and livestock breeding	Petroleum, timber and forestry, mining, agriculture	Petroleum, agriculture, fishing, forestry, mining	Petroleum, and wood, textile.
Primary exports	Fuel (gas, oil), minerals, cocoa, cotton, rubber, and wood	Rough wood, gold, diamond, sawn wood, and refined copper.	Petroleum (60% of export), cotton, cottonseed oil.	Petroleum (80% of export), timber, raw copper.	Petroleum, timber	Petroleum, manganese ores, ferroalloys, timber.
Main imports	Manufactured products (electrical and electronic equipment, vehicles, machinery).	Foodstuffs, fuel and energy products, machinery and equipment, electricals,	Foodstuffs, transport machinery, equipment, textiles	Special-use vessels, machinery, meat, cereals, vehicles, electrical	Machinery, foodstuff, construction equipment, electronics, vehicles, pharmaceutical	Boats, machinery, meat, electrical machinery, cereals, iron,

²⁴ More to that, 85% of the FCFA nations' foreign reserve is deposited in an 'operation account' controlled by the French Treasury. The Treasury has invested the reserve of the African nations in its name on the Paris Bourse such that the yield from the investment is not shared with the FCFA nations (Warney, 2011). This increases the opportunity cost endured by the FCFA nations and brings to question whether the devaluation was to enrich France to the detriment of FCFA nations.

		vehicles, pharmaceuticals.		equipment, food, steel structures, and medical products	als, grain, meat, dairy products	pharmaceuti cal products
Trade record in 2018	Deficit of \$1.8 billion	-	Surplus of \$610,000	Surplus of \$7.67 billion	-	Surplus of \$2.4 billion
GDP growth (annual %) 2018	4%	3.8%	2.4%	5.8%	-6.2%	0.8
Inflation rate	1.9%	-1.2%	5%	31%	9.5%	7.2%
Unemploye ment	3.6%	6%	1.1%	4.7%	8.2%	20.5%
Poverty	40% of population	70% of population	42% of population	72% of population	76.8% of population	35% of population.
GDP per capita (current \$)	\$1,594	\$436	\$720	\$546,	\$8,719	\$7,695
GDP per capita growth (annual %)	1.1%	1.8%	-1%	2.4%	-9.4%	-1.5%
GDP (Billion \$)	39.97	2.22	11.24	47.57	13.1	16.87

Source: World Bank (WDI) (2020)

1.4 EXCHANGE RATE AND ITS CHANNEL OF ECONOMIC GROWTH IN CEMAC ZONE

The 12th of January 1994 CFA franc devaluation was aimed at three main objectives: Firstly, the external restoration of the competitiveness of the savings of the zone franc and the recovery of trade balances. Secondly, balancing the public finances (the reduction of the budget deficits), via the improvement of export commodities. Thirdly, the resumption of growth thanks to the resumption of private investment (Fouopi, 2012; Bank of France, 1997).

Hence, the devaluation aimed at improving the competitiveness and enhancing the trade balance, thereby reducing their current account's trade deficit. It was also to attract foreign direct investors since their assets were cheap, the currency was stable, which is a good condition for investment, and thereby improving the balance of payment (BOP) and economic growth (Zobo, 2014; Amin, 2000).²⁵ Thus, the main goal of a currency devaluation is often to improve a nation's economic growth via the improvement of its trade balance (TB). For this to be achieve, we need to know the state of the currency (i.e., is it at equilibrium - in the CEMAC nations).

A TB is the monetary difference between a nation's exports and imports over a given period. It is likely that, following a devaluation, an initial drop in the TB occurs before an improvement follows. It is often due to an increase in import value, while export value decreases, leading to the deterioration of the TB (Ziramba and Chifamba, 2014). After a while, the inverse situation

²⁵ Nations like the United States of America (USA) often attract foreign investments in order to improve the capital account of their Bop, thereby balancing the negative impact of the current account trade deficit. This helps to get the balance of payment to zero.

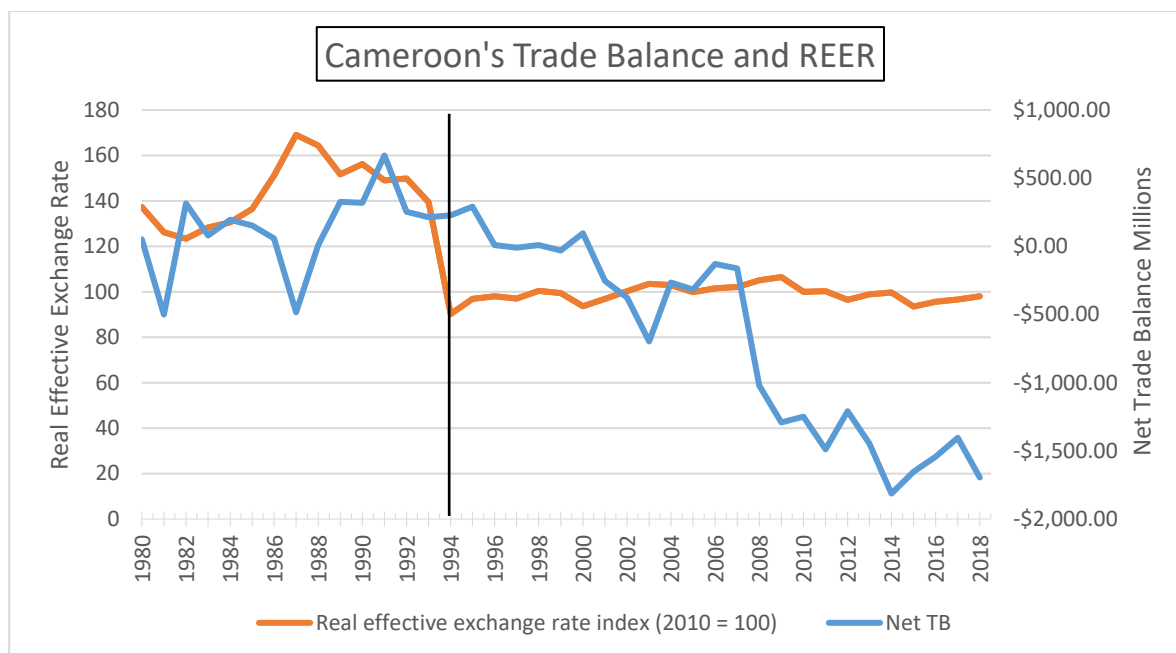
occurs, thereby improving the TB (Sihong, 2018; Kurtović, 2017). The response of the TB over time often looks like a tilted J shape. The presence of the *J*-curve implies that currency devaluation improves a nation's TB, thereby justifying the necessity for the devaluation.

In this thesis, we will use the bilateral aggregate trade data approach by Rose and Yellen (1989) to investigate the presence of the *J*-curve in each of the CEMAC nations and their trade partners. It will help us understand the state of the TB with each trade partner. However, to get an overview understanding of each of the CEMAC nation's TB, we will use the aggregate trade data approach by Magee (1973). This approach investigates the presence of the *J*-curve between each of the CEMAC nations and their main trade partners combined.

Though many researchers have investigated the impact of currency devaluation on the TB to influence economic growth, research on the CEMAC region is hardly common. One of the reasons for the difficulty is the lack of data for some nations in the region. To ascertain the impact of currency devaluation on TB is often empirical, it will be necessary to have a panoramic view of the liaison between the two variables in the CEMAC zone. This research dataset is sourced from the World Development Indicators (WDI) published by the World Bank (2020). The study covers the period between the years 1980 and 2018 to capture the period prior to and post-devaluation. Data prior to the devaluation is unavailable for some nations (Chad, Congo, and Equatorial Guinea). As such, the three nations with available data will be used to represent the zone (Cameroon, Central African Republic, and Gabon).

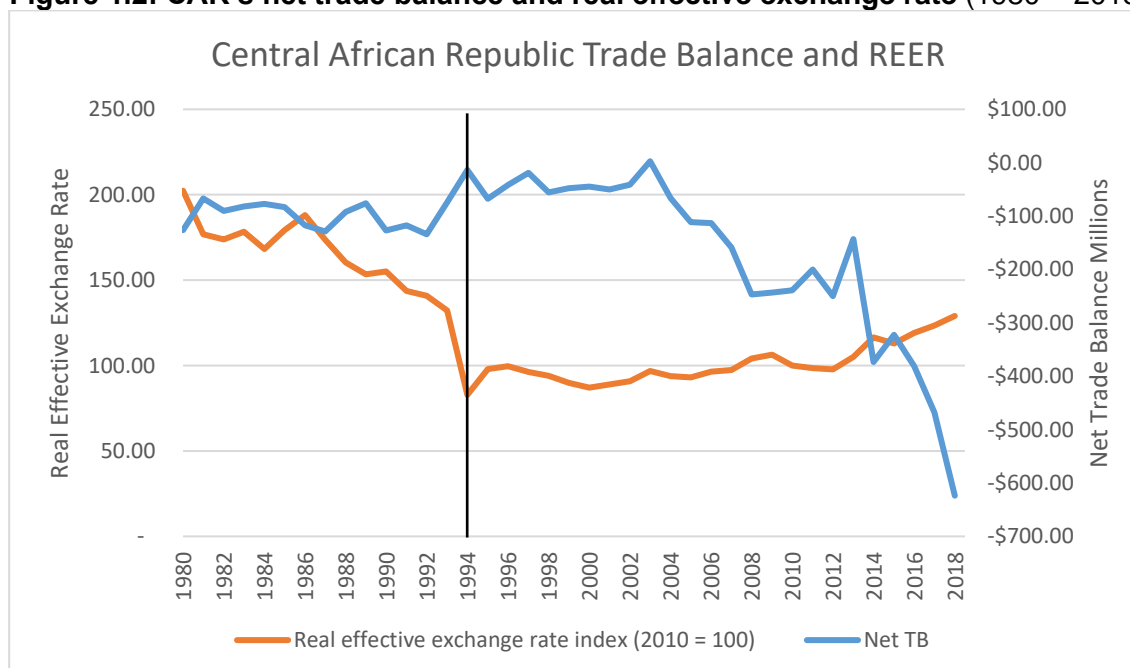
A graphical view of the relationship between the real effective exchange rate (REER) and the TB for these three nations is present below, with a vertical black line indicating the year of the devaluation. The REER graph of the three nations shows that their currency was above the "100" mark before the devaluation. During the devaluation, there was a drop in the REER, after which the currency has been revolving around the "100" mark. As for the TB, the graph for the three nations shows different movements. It could be due to their uniqueness (product exported and imported, factors of production).

Figure 1.1: Cameroon's net trade balance and real effective exchange rate (1980 ~ 2018)



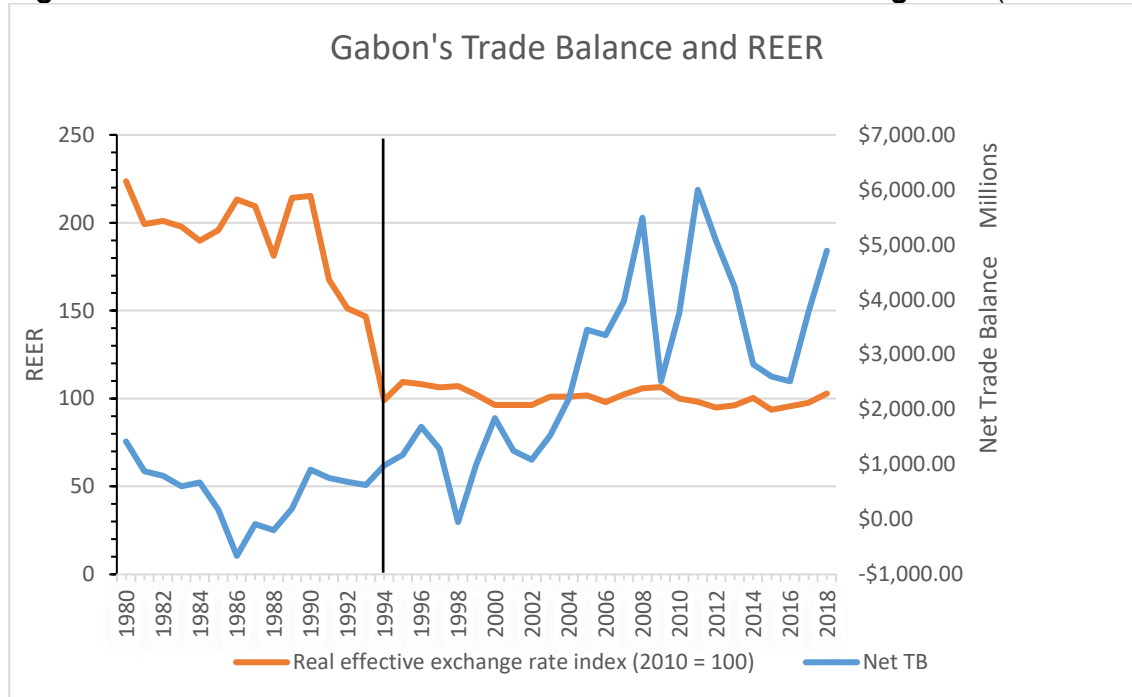
Notes: The net trade balance in current US Dollars; the real exchange rate index for the base year 2010 =100.
Source: World Bank (2020), World Development Indicators.

Figure 1.2: CAR's net trade balance and real effective exchange rate (1980 ~ 2018)



Notes: The net trade balance in current US Dollars; the real exchange rate index for the base year 2010 =100. Source: World Bank (2020), World Development Indicators.

Figure 1.3: Gabon's net trade balance and real effective exchange rate (1980 ~ 2018)



Notes: The net trade balance in current US Dollars; the real exchange rate index for base year 2010 = 100.
Source: World Bank (2020), World Development Indicators.

As observed in Figure 1.1, before the 1994 devaluation, the REER of Cameroon was high. This implies that the currency was overvalue, and since the devaluation, Cameroon's REER has been stable, revolving around 100. The TB which was deficit only twice (1981 and 1988) before the devaluation, with a peak of it surplus in 1991 (\$666.3 million). After the devaluation, the trade surplus continued though in a declining mode until 1996, after which the series of trade deficit began in 1997. The deficit coincides with the period of the Southeast Asian financial crisis of 1997. With the creation of the euro in 1999 and France joining it, Cameroon has continuously experience trade deficit until 2018, with the worse occurrence in 2014 (-\$1.8 billion). The year 2014 is also when the world price of crude oil dropped which could have impacted the nation's trade. Nevertheless, the two graphs presented in Figure 1.1 seem to have opposite trends, implying that the TB tends to improve through the depreciation of the REER and *vice versa*. This observation could justify the potential existence of a negative correlation between the REER and the TB for Cameroon. Also, since the REER began revolving around the equilibrium, the TB has continuously experienced a deficit. The results of the above figures are not enough to rush into such conclusions because we ought to prove the existence and the nature of the liaison between TB (dependent variable) and the REER (independent variable). After that, we determine the direction of the causality via further empirical testing.

From the observation in Figure 1.2, before the 1994 devaluation, the REER of Central Africa Republic (CAR) was high, meaning that the currency could be overvalued. After the devaluation

in 1994, the currency was devalued and around the equilibrium until 2007. From 2008 and 2009, the currency was overvalued which coincides with the 2008 global financial crisis which began in the USA, moved to Europe and eventually to the rest of the world. Between the periods 2010 to 2012, the currency was stable and began appreciating from 2013 until 2018. The TB has been on deficit throughout from 1980 to 2018 with the only surplus in 2003. The two graphs on Figure 1.2 also show an opposite trend that the TB tends to improve as the REER depreciates and *vice versa*.

From the observation in Figure 1.3, before the 1994 devaluation, the REER of Gabon was overvalued. After the 1994 devaluation, the currency has been revolving around the equilibrium until 2018. Gabon is the only nation among the three nations with a consistent TB surplus. With the devaluation, the TB improved very much, and the graphs show an opposite trend that the TB tends to improve as the REER depreciates. However, it will be too early for us to draw any conclusion that the TB improvement is due to the devaluation, thereby requesting for empirical analyses.

1.5 OBJECTIVES AND RESEARCH QUESTIONS

As explained in section 1.3 above, it is believed that the same institutional arrangements that contributed to the good economic performance of the FCFA zone nations before the 1980s had also hindered them from adjusting timely to internal and external shocks. Therefore, it is necessary to ensure that it does not re-occur, mindful that it has been more than two decades since the currency was devalued. As seen in section 1.3.1, the IMF encouraged governments to couple the 1994 CFA franc devaluation with sound macroeconomic and structural adjustment policies (Washington Consensus). If the CFA franc value has not changed, it implies that the macroeconomic objectives of CEMAC nations have not changed since then, as well as the commodity markets. Alternatively, if the objectives and commodity markets have changed, then the exchange rate might no longer align with its equilibrium or the objectives (either overvalued or undervalued).

In a light manner, assessing the competitiveness of the CFA zone requires quantitative analysis of the actual and equilibrium REER, as well as adjustments of macroeconomic fundamentals to corresponding exchange imbalances. Previous empirical work on the CFA franc currency valuation focused on the first few years after the 1994 devaluation, with specific interest in some studies on how REER misalignments were corrected by the 1994 change in parity (Ahlers & Hinkle, 1999). To the best of my knowledge, studies on the effects of the recent appreciation of the euro on the CFA franc are scanty. Time series studies on the state of the CFA franc in the CEMAC zone did not consider all the nations in the region. Asongu and Nnanna (2020) used four CEMAC nations (Cameroon, Central Africa Republic, Gabon, and Equatorial Guinea) to

investigate the state of the CFA franc. Without looking at the other 2 CEMAC nations (Chad and Congo), we will not be able to ascertain the state of the CFA franc in the entire region. While panel-based results as presented by Abdi & Tsangarides (2010), are essential, they fail to account for country-specific dynamics that could have pertinent policy implications. This is because macroeconomic fundamentals could differ across CFA franc nations, as in the euro crisis. There is a necessity for country-specific analyses to complement existing literature. Thus, in this research, we will be analysing the state of the CFA franc in all the six CEMAC nations, instead of some of the nations. This will give us a vivid inside of the CFA franc in the CEMAC region.

It is highly contested among economists that currency devaluation improves a nation's TB deficit. A REER depreciation could lead to the deterioration of the TB in the short-run, while improving the TB in the long-run (*J*-curve effect). The CFA devaluation was meant to improve CEMAC nations' TB. Lots of empirical analysis on the *J*-curve hypothesis have mixed results. Studies on the impact of exchange rate movements on the TB are still in considerable disagreement on the relationships between these economic variables and the effectiveness of currency devaluation as a tool for improving the TB of a nation. Most empirical analyses used either the Aggregate Trade Data Approach by Magee (1973) or the Bilateral Aggregate Trade Data Approach by Rose and Yellen (1989) to investigate for the presence of the *J*-curve in a nation's TB. However, in this research, we shall be using both approaches. The Aggregate Trade Data Approach will give us an understanding if CFA devaluation is a good policy tool to improve the nations' TB. While the Bilateral Aggregate Trade Data Approach will help us understand which trade partners have the *J*-curve in their TB, so to make informed policy decision on which partner to engage more with.

In his work, Rodrik (2008) stated that RER undervaluation promotes developing nations economic growth, and overvaluation harms it. However, other empirical results do not support the conclusion that an undervalued RER contributes to economic growth. Easterly (2005) review of the updated Dollar (1997) measure of currency devaluation concludes that RER devaluation was insignificant as a determinant of economic growth. Acemoglu *et al.* (2003) and the IMF (2005) also reached this conclusion, and that the outcome was even weaker when institutions were introduced in the growth model. It is believed that the 1994 CFA franc devaluation and the implementation of the structural adjustment program (SAP) in the mid-1990s led to economic austerity, which the FCFA nations still struggle to escape (Dongfack & Ouyang, 2019). However, the devaluation was meant to improve the region's economic growth. As such, we will investigate if there is a relationship between CFA franc and the region's economic growth. For all these to be addressed, the following research questions will have to be answered:

- 1) Is there a real exchange rate misalignment problem in the CEMAC nations?
- 2) Is there a relationship between the REER and the TB in the CEMAC nations?
- 3) Is there a relationship between the REER and economic growth in the CEMAC Zone?

1.6 STRUCTURE OF THE THESIS

This study is organized as follows. Chapter 2 deals with the theoretical arguments and empirical studies on the three empirical chapters of this thesis, which are; the equilibrium real effective exchange rate (EREER) and misalignment, the impact of REER on trade balance, and REER movement and economic growth. The chapter also look at the monetary cooperation between France and the CFA franc zones, and a brief history of CFA franc exchange rate.

In chapter 3, we examine the extent to which the CFA franc is misaligned from its equilibrium level in the six CEMAC nations. This is achieve using the Behavioural Equilibrium Exchange Rate (BEER) framework of Clark and MacDonald (1998) to estimate the equilibrium value of the CFA franc consistent with economic fundamentals.²⁶ The deviation of the observed exchange rate from this equilibrium level is interpreted as REER misalignment (i.e., if the REER is greater than EREER, it is said to be overvalued and vice versa). Because the REER is seldom at equilibrium, we will assume it is at equilibrium when the differences between REER and EREER revolve around an absolute 5%. We used the Vector Autoregression (VAR) approach, which consists of the full-information maximum likelihood (FIML) method due to Johansen (1995).²⁷ The outcome of the Johansen cointegration test reveals that there is cointegration, we proceed to the restricted VAR (VECM). The result of the VECM consists of the estimates of both short-term and long-term dynamics of the time series, taking into consideration the coefficient of the error correction term (ECT). To test for stability, we apply the cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The variables used in this thesis are secondary annual data collected from the World Bank - World Development Indicators (WDI) database lastly updated on 18/03/2020.

²⁶ The BEER approach is often argued to have advantages over other approaches (specifically the FEER). For instant, the FEER approach is a method of calculation rather than an estimated exchange rate model like the BEER approach. The BEER approach has the potential of capturing all the systematic and fundamental movements of the exchange rates and can be subject to rigorous statistical testing of various metrics, such as the speed of mean reversion. Also, the BEER is a highly tractable approach to gauging an equilibrium exchange rate, relying on a single equation approach using either time series or panel data.

²⁷ The VAR approach is used when all the variables in the models are integrated of order one (i.e., the variables become stationary at the first difference - $I(1)$). On the other hand, the ARDL approach can be applied irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$) or integrated of order one (i.e., the variables become stationary at first difference - $I(1)$). However, the variables must not be integrated of order two (i.e., the variables are stationary at second difference - $I(2)$).

Chapter 4 investigates if currency devaluation (CFA franc devaluation) has an impact (improvement) on the trade balance (TB) of CEMAC nations. This is done by investigating for the presence of *J*-curve in the TB of three CEMAC nations used.²⁸ The presence of the *J*-curve is achieved when: The coefficient of REER is positive and statistically significant (i.e., the *t*-statistics $\geq |2|$) in the long run, while the short run coefficient of REER is negative and statistically significant (i.e., the *t*-statistics $\geq |2|$). This is achieved when the coefficient of the error correction term (ECT) of the model is negative (with TB being the target variable) and statistically significant (with the *t*-stat $\geq |2|$, and the *p*-value < 0.05).²⁹ This means that a shock in the REER will cause TB to deviate in the short term, getting worse before recovering and/or moving in the opposite direction in the long term. Thus, necessitating a check of both the long-run and short-run relationship. The aggregate bilateral trade data approach by Rose and Yellen (1989) will be used to examine for the presence of the *J*-curve in the TB relationship between each of the three CEMAC nations and their individual main trade partners.³⁰ To have an overview of the impact of CFA franc devaluation on the individual CEMAC nations' TB, we used the aggregate trade data approach by Magee (1973). The presence of the *J*-curve will mean that the CFA franc devaluation could lead to an improvement of the CEMAC nations' TB in the long-run.³¹ The Autoregressive Distributed Lag (ARDL) approach by Pesaran *et al.* (2001) will be used to investigate the presence of cointegration in the models.³² We will use the "Impulse Response Function (IRF)" to justify the results obtained. The variables used are in their log format. The dependent variable TB is measured in ratio of export to import because the net exports of the CEMAC nations have numerous occurrence of negative values and will not allow the TB to be expressed in logarithm form (Ln).³³ To test for stability, we apply the cumulative sum (CUSUM)

²⁸ The nations used were Cameroon, Central Africa Republic – CAR, and Gabon. The other three CEMAC nations (Chad, Congo, and Equatorial Guinea) were not used due to lack of data.

²⁹ The ECT is the speed at which a dependent variable returns to equilibrium after a change in other variables. If ECT has a negative sign and is statistically significant, it implies that any shock happening in the short-term will be corrected in the long-term.

³⁰ A real effective exchange rate (REER) devaluation often causes a nation's trade balance to worsen in the short-term before improving in the long-run, thereby having a *J*-curve-like effect on a nation's trade balance.

³¹ The absence of the *J*-curve implies that the devaluation does not improve the trade balance and that the government could use other policies to improve their trade balance (deficit) (Dhakir *et al.*, 2015; Ziramba and Chifamba, 2014; Magee, 1973).

³² ARDL approach allows us to determine the number of long-run equilibrium relationships between integrated variables irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$) or integrated of order one (i.e., the variables become stationary at first difference - $I(1)$).

³³ The natural log function of TB has the advantage of making the estimated coefficients directly interpretable as a percentage change and a measure of elasticity, thereby letting us check if the Marshall-Lerner condition (MLC) is fulfilled or not (Dongfack and Ouyang, 2019). Also, it eliminates the need of explaining the dependent variable (TB) in real terms with the appropriate price index.

and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models.

In chapter 5, we empirically analyse the effect of REER on the economic growth of CEMAC region. We will use the conventional growth model, which is a version of Barro (1991) in our study. Since the FCFA was devalued with the aim of improving the economic growth of the region, in this chapter we used the Pooled Mean Group (PMG) panel autoregression distributed lag (ARDL) approach to investigate the nature of the relationship between REER and the CEMAC region's economic growth. This will inform us if the FCFA devaluation improves the CEMAC region's economic growth or not. The approach assumes that all long-run coefficients are the same across groups, while the short-run coefficients could differ across groups (Pesaran *et al.*, 1997). This estimator is useful when one expects similar long-run relationships between nations, being of a similar nature with regards to economic growth. Finally, chapter 6 concludes the study, summarizing the findings.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

In this chapter, we will be reviewing the literatures on the three empirical chapters of this thesis which are; the equilibrium real effective exchange rate (REER), the exchange rate and trade balance, and exchange rate and economic growth. We will begin by having an overview of the CFA francs exchange rate. Then shall we review the theories on the empirical chapters. However, more analysis of the theory to be used in this research will be elaborated in the respective empirical chapters.

Theoretical discussion on the importance of exchange rate in a nation's macroeconomic adjustment surfaced in the 1950s and 1960s via the work of Friedman (1953), Mundell (1962), Mckinnon (1963), and Fleming (1963). They illustrated the role played by the different exchange-rate systems in facing the various shocks an economy encounters (macroeconomic trilemma – fixed exchange rate, open capital market, and independent monetary policy). The advent of the flexible exchange-rate system has been subject to excessive deviation from equilibrium value and volatility over the past decades. The high exchange-rate fluctuations and misalignment in the sphere of growing trade and financial liberalization attracted much attention from policymakers and economists. The exchange-rate misalignment is believed to daunt firms from international trade engagement, affecting their profitability, trade balance, and economic growth of nations. Despite adopting the floating exchange-rate system, some nations like the CFA Franc

nations remained in the fixed-exchange-rate system with some degree of variation from their equilibrium real exchange rate (misalignment).

The definition of the real exchange rate could be group into two main categories. The first definition is in line with the purchasing power parity (PPP), and the second definition is based on the difference between the tradable goods and the non-tradable goods (Dhakir *et al.*, 2014; Edwards, 1989). Though these two definitions might coincide in some cases, they usually give different results when applied in empirical studies. Base on the PPP also known as the external RER, the RER (r_{ppp}) is define in the long-term as the nominal exchange rate (e) adjusted by the ratio of the foreign price level (P_f) to the domestic price level (P). The nominal exchange-rate is the monetary notion which measures two moneys' relative price. The real exchange rate is mathematically express as:

$$r_{ppp} = \frac{\text{Nominal exchange rate} \times \text{Foreign price}}{\text{Domestic price}} = e \frac{P_f}{P} \quad (2.1)$$

From the above definition, a decline in the real exchange rate (r_{ppp}) means that there is appreciation of the domestic currency, as this indicates that few units of domestic currency are required to purchase the same one unit of foreign currency.

The second definition is the tradable/non-tradable, also referred to as the internal real exchange rate (r_{int}). It deals with the relative price of the tradables with respect to non-tradables (Edward, 1989; Hinkle and Nsengiyumva, 1999). The rationale of this definition is that the cost differential between nations is interrelated with the relative price structures in the economies. With the assumption that the prices of tradables are equal around the world via trade. The real exchange rate defines based on the tradable and non-tradable goods distinction is mathematically express as:

$$r_{Int} = \frac{\text{Price of tradable goods}}{\text{Price of non-tradable goods}} = \frac{P_t}{P_n} = e \frac{p_t^*}{p_n^*} \quad (2.2)$$

From the above formula, P_t (p_t^*) is the domestic (international) price of tradables, while P_n denotes non-tradables. The resources of each nation are divided in two sectors; tradable and non-tradable, and there is a trade-off in the allocation of resources between them. This means that producing one with resources, the other will reserve less resources. Hence, this definition of the RER is a valuable tool for the allocation of resources within a nation. If there is a rise in the internal RER (depreciation), it means that the tradable sector is more competitive than the non-tradable sector.

The above two definitions of RER rely on the assumption that the home nation has only a trading partner. In real life situation, a nation deals or does trade with more than one nation. As such,

the above definitions are seldom used in most empirical studies. Thus, we distinguish a third definition known as the real effective exchange rate (REER). The REER refers to the real exchange rate corresponding to a group of nations rather than one partner. It represents the value of a nation's currency against weighted average value of a basket of trading partners' currencies. All the currencies in the basket are adjusted for inflation. This is a measurement of the PPP of a currency, which calculates the units of domestic goods use to pay for 100 units equivalent of foreign goods. Following some weighting criteria, the share of the bilateral trade to total trade volume or the share of the currencies used in the international trade transactions can be example of the weighted criteria (Dhaker *et al.*, 2014).

$$REER_{t_i} = e_{t_i} = \sum_{j=1}^n RER_{t_{ij}}^{w_j} \quad (2.3)$$

Whereby n represents the number of trading partners of country i , and weight w_j the trade with trading partners j as the share of country i 's overall trade. The most important property of the REER is that it is a good proxy of a nation's international competitiveness.³⁴ Thus, in this thesis, our exchange rate is define based on the REER and not the RER.

The channels through which the exchange rate influences a nation's economic growth, among others, include trade balance (TB) and foreign direct investment. It is highly contested among economists that currency devaluation improves a nation's TB deficit, improves the current account, and improves economic growth (Kurtović, 2017; Bahmani-Oskooee, 1985). An undervalued exchange rate is viewed as an improvement in price competitiveness and a means towards faster economic growth, as championed by Rodrik (2008) and supported by others (Kurtović, 2017; Grekou, 2015; Levy-Yeyati *et al.*, 2013). The exchange rate devaluation is believed to improve TB in the long term after a short-term deterioration, referred to as the *J*-curve effect (Ziramba and Chifamba, 2014).

The *J*-curve theory is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC)³⁵ holds, it is likely that following a devaluation, an initial drop in TB occurs before an improvement follows (Ziramba

³⁴ An increase in a nation's REER is an indication that its exports are becoming more expensive, and its imports are becoming cheaper. It could lose its trade competitiveness as less of its export might be bought, while its residents import more of cheaper goods. The increase in imports means that the residents of the nation will be demanding more of the foreign nation's currency to purchase their products. At the same time, less of the domestic currency will be demanded by foreign residents since less of its products are demanded. An increase in the demand for foreign currency relative to its supply will cause an increase in the price of the currency. This increase in the foreign currency means that the currency is appreciating, and the domestic currency is depreciating (devaluing). As the process continues, the exchange rate changes, and it could eventually get to its equilibrium whereby the demand and supply of the currency is equal.

³⁵ The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

and Chifamba, 2014; Baek *et al.*, 2006). The response of the TB over time looks like a tilted J shape. The *J*-curve effect is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). The *J*-curve theory has occupied the most recent empirical literature due to its ability to incorporate other older approaches indirectly and at the same time, provide a novel approach to the issue by itself as will be seen in this thesis.

The rest of the chapter is organized as follows: we will begin by reviewing the CFA francs exchange rate and this is done in section 2.2. Section 2.3 deals with the equilibrium real effective exchange rate. Section 2.4 deals with the exchange rate and trade balance. Section 2.5 deals with the exchange rate and economic growth, while section 2.6 is the chapter conclusion.

2.2 THE CFA FRANC EXCHANGE RATE

Recent debates on structural adjustments to macroeconomic stabilization have highlighted the vital role of the exchange rate in promoting exports and driving toward optimal pathways of production and employment. Keeping a nation's currency at an appropriate level is fundamental since an overvaluation could result in a loss of competitiveness of the economy vis-à-vis the rest of the world. The franc zone, by its history, has inherited a fixed exchange rate regime since its colonial past. Hence, these nations saw their currency match the French Franc (FF), the currency of their metropolis. In the year 1948, 1 FF was equivalent to 50 CFA francs. The attainment of independence by France's former trust territories between 1954 and 1962 did not lead to the break-up of the area, though some nations left the franc zone (Wonyra, 2018).³⁶

The franc zone is an economic, monetary, and cultural area equivalent to none other in the world. It is made up of very diverse states and territories, and results from developments and changes in the former French colonial empire. After independence, most newly created African states remained within a homogenous group characterized by a new institutional framework and a common exchange rate mechanism. The franc zone is a rare example of close institutionalized cooperation between countries from two continents with a common language and history. The "Banque de Franc" has developed close ties with the franc zone central banks, with which it works towards ensuring the smooth functioning of the area's shared institutions (Banque de France, 2010).

The CFA franc zone is made up of Franc and 15 African states, with the African states grouped into three zones: CEMAC (acronym for Communauté Économique et Monétaire de l'Afrique Centrale - Central African Economic and Monetary Community), UEMOA (acronym for Union

³⁶ *The following nations left the franc zone: Lebanon (1948), Morocco, Algeria, and Tunisia (between 1958 and 1962), and Guinea Conakry (1958).*

Economique et Monetaire Ouest Afraine - West Africa Economic and Monetary Union – WAEMU), and Comoros. The CEMAC zone consists of the following countries: Cameroon, Central Africa Republic - CAR, Chad, Republic of the Congo, Equatorial Guinea, and Gabon. The currency is redistributed in this zone by the Banque des Etats de l'Afrique Centrale (BEAC) – Bank of Central African States. UEMOA zone consists of the following countries: Benin, Burkina Faso, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo. The currency is redistributed in this region by Banque Central des Etats de l'Afrique de l'Ouest (BCEAO) – Central Bank of the West African States. In the Comoros, the currency is redistributed by Banque Centrale des Comoros (BCC) – Central Bank of Comoros (Adom, 2015; Banque de France, 2010; Coleman, 2008).

The monetary cooperation between Franc and the CFA franc zone nations was based on the following four main principles:³⁷

- Unlimited convertibility guarantee from the French Treasury: the convertibility of currency issued by the various franc zone issuing banks is guaranteed with no limits by the French Treasury.
- Fixed parity with the anchor currency: the parity of the currencies of the area with the euro is established and defined for each sub-area. The currencies of the area are convertible among themselves, at fixed parities, with no limit on amounts.
- In principle, transfers are free within the area.
- Pooling foreign exchange reserves: foreign exchange reserves are pooled at two levels: (i) the states pool their reserves in each of the two central banks; (ii) in return for the unlimited convertibility guaranteed by France, central African banks are obliged to deposit a proportion of their foreign exchange reserves with the French Treasury, on the operational account held for each bank.³⁸ Since 1975, these assets have enjoyed an exchange guarantee vis-à-vis Special Drawing Right (SDR).³⁹

Adding to these four principles is the control of the currency flow, the freedom of transfer of the monetary signs, and the adoption of a common exchange regulation. The strict control of foreign exchange flows (incoming and outgoing) makes it possible to monitor their impact on inflation

³⁷ Obtained from Banque de France (2010).

³⁸ This proportion was reduced from 65% to 50% for the net external assets of the BCEAO, following the amendment of 20 September 2005 to the operations account agreement of 4 December 1973. In accordance with the new operation account agreement of the BEAC signed on 5 January 2007, this proportion has been gradually lowered and has stood at 50% since 1 July 2009 (Banque de France, 2010).

³⁹ The SDR is the unit of account for the International Monetary Fund. Its value is determined daily based on a basket of four currencies (the US dollar, the euro, the British pound, and the yen).

and the overall movement of capital. The freedom of transfer of the monetary signs was at the origin of the creation of the zone Franc. However, this principle has been repealed because central banks only accept the currency of the Banque de France and not those issued by other sister central banks. This suppression of convertibility was introduced in the aftermath of capital leaks observed within the currency areas, and this measure prevents speculation (Wonyra, 2018). As for the principle of free convertibility of the CFA franc and the free movement of capital, it applies to the individual zones and to France and vice versa. So, it does not concern exchange between the three CFA zones. This principle facilitates French investments in Africa, the repatriation of capital, the flight of capital from Africa to France, and France's importation of raw materials. As such, the view that the CFA franc hinders the intensification of intra-zone trade cannot be denied. Adding to this is that France participates in the management bodies of the central banks (Wonyra, 2018; Koulibaly, 2008).

2.2.1 A BRIEF HISTORY OF THE CFA FRANC EXCHANGE RATE

The table below shows a brief view of the CFA franc.

Table 2.1: A Brief History of CFA Franc

Year	Event
1939	Birth of the franc zone in the French overseas territories.
1945	Creation of the CFA franc.
1954-1962	Institutional transformation of the CFA franc zone following the independence of its member countries.
1972	Monetary cooperation agreements.
1976	Creation of the Comorian franc.
1977-1978	Transfer of the central bank headquarters in Africa.
1984	Integration of Equatorial Guinea.
1994	50% devaluation of the CFA francs and 33% devaluation of the Comorian franc. Launch of the convergence and economic integration programme.
1997	Guinea Bissau enters the CFA franc zone.
1999	The Council of the European Union recognises the monetary cooperation agreements within the CFA franc zone, ensuring that the transition to the euro would not lead to parity changes.

Source: Banque De France (2015).

After the creation of the CFA franc in 1945, in 1948, 1 FF was equivalent to 50 CFA francs. The parity did not change till 12th January 1994 devaluation by 50%, whereby the parity changed to

1FF worth 100 CFA franc in the nominal rate.⁴⁰ The devaluation was meant to reverse the domestic and external disequilibria that had built up since the mid-1980s. The internal deficit was due to unemployment caused by low levels of the legal, administrative, and institutional framework, human capital, structural policies, and financial policies. On the other hand, the external deficit was due to foreign interests and terms of trade shocks (Bahmani-Oskooee, 1998; Nashahibi and Bazzoni, 1994).

After the independence of CFA zone nations in the 1960s, they experienced an increase in the oil price. During the oil boom, the governments had the financial means to embark on ambitious economic policies. The petroleum exporting nations were flush with cash after the increase in oil prices of 1973 -1980 (Felix, 1990). Some oil-producing nations took substantial debts for economic development against future oil revenues (Zobo, 2014).⁴¹ This was an import substitution technique to industrialize their nations. With the debt valued in US dollars and the hope that the high price will persist, they can repay their debts. It transformed their states into omnipresent players in the economy, with state corporations being involved in all sectors, and state revenue was on the rise till 1984 (Pineau, 2005; Ghura, 1997). Also, the governments overprotected their corporations from foreign competition for the domestic markets of their finished commodities. At the same time, they greatly depended on the importation of cheaper raw materials, equipment, and spare parts.

However, the second half of the 1980s experienced a sharp fall in the international markets in oil, coffee, cocoa, and cotton prices. At the same time, the appreciation of the French Franc against other major currencies made the exports of the Zone less competitive (Africa Business Magazine, 2012; Coleman, 2008). This double shock, combined with rising wages, arrears payment, inefficiencies, and unproductivity of public enterprises, led to a fall in investment and capital flight. It created budget crises in the CFA franc zone, which peaked in 1987 with an average deficit of approximately 13% of their GDP (Pineau, 2005; Ghura, 1997). The downward deflationary spiral of income, expenditures, and production cut average real per capita income by 40% (Devarajan and Hinkle, 1994). This protracted recession impoverished much of the Zone's population and weakened the already inadequate essential social services.⁴² CFA franc zone nations faced a profound economic, financial, and social crisis.

⁴⁰ The parity of the CFA franc was changed from 50 CFA francs to 100 CFA francs per French Franc in the CEMAC and UEMOA region. While in the Comoros, the currency was devalued from 50 Comorian francs per French Franc to 75 Comorian francs per French Franc (Devarajan and Hinkle, 1994).

⁴¹ But for the Central Africa Republic, the other five CEMAC zone nations are crude oil exporters.

⁴² The crisis was due to the massive overvaluation of the real exchange rate caused by an unfortunate combination of inappropriate domestic economic policies and major external shocks. The internal adjustment programs pursued by the CFA franc zone nations were inadequate to depreciate the RER. Instead, it contributed to the continuous downward economic spiral, necessitating significant policy changes.

To address the challenges faced by the CFA franc nations, they had to adopt comprehensive economic reforms to restore export-led growth, reduce poverty, and repair the Zone's financial system. This resulted to the 12th January 1994 CFA franc devaluation by 50% to halt the recession, recovery in export growth, revival of investment, and an improvement in GDP growth rate. To achieve these, cooperation mechanisms were reinforced after the 1994 devaluation to foster convergence and economic integration within each region (UEMOA and CEMAC), and avoid further crises that could destabilize the CFA franc zone. Convergence criteria have been applied to each region since then.

- The UEMOA redefined them in 2015. There are three first-level criteria:
 - Inflation must remain below 3% per year.
 - public debt must not exceed 70% of GDP.
 - an overall budget deficit less than or equal to 3% of GDP.
- The "first-level" criteria for the CEMAC are identical for inflation and public debt, and also include:
 - an underlying budget balance greater than or equal to 0% of GDP.
 - non-accumulation of internal or external arrears.

A CFA Franc Zone Convergence Committee was set up in September 1999 to pursue economic integration and cooperation. This coordinating body includes France, the UEMOA, the CEMAC, and Comoros; it prepares the meetings of the ministers and governors of the CFA franc zone (Banque de France, 2015; 2010).

2.3 EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE (EREER).

Estimating the EREER and assessment issues have become topical recently due to variety of reasons. Firstly, a number of nations – like the Central European nations that agreed to the European Union (EU), Sweden and the UK were interested in knowing the right exchange rate for their entry into the euro. Secondly, the behavior of some currencies, like the initial sharp and continual fall in euro's external value immediately after its inauguration in 1999, the post 2005 Chinese renimmbi's behavior against the US dollar, and the continuous appreciation of the pound sterling during the late 1990's, generated the debate about the sources of the exchange rate movements (Macdonald and Dias, 2007). Does such behavior symbolize movements in the underlying equilibria, and the currencies are therefore accurately price, or are they signifying a misalignment? Thirdly, is the global imbalance issue and the impact of such imbalance for exchange rate behavior, and above all the required exchange rate movements needed to

address the imbalances. Answering such issues entails some measurements of the equilibrium exchange rate. Thus, we shall be looking at the concept of equilibrium exchange rates and the various way of estimating it.

The EREER is the relative price of tradable to non-tradable which for given (sustainable or equilibrium) values of other variables (like technology, international prices, trade taxes, capital and aid flow), results in the simultaneous achievement of both internal and external equilibrium (Edward, 1989; Clark and MacDonald, 1998). The internal equilibrium means that the market for non-tradable goods clears in the current period and is expected to be in equilibrium in future. This implies that there is no deviation from the natural rate of unemployment within the economy. While the external equilibrium is reached when the entirety of the present current account and the expected current account in the future satiates the intertemporal budget constraint; which states that the discounted value of the current account balances must be equivalent to zero (Edward, 1989; MacDonald and Clark, 1997). That is, the current account balance (current and future) is compatible with long-run sustainable capital flows (Edward, 1989).

From the above definition, it means that the REER equilibrium is mutable. Once any of the variables that affect a nation's internal and/or external equilibrium changes, the REER equilibrium will as well change. For instance, the REER 'required' to reach equilibrium will also vary as per if the world price of the nation's principal export is high or low. The EREER will also be affected by other factors like real interest rates, export taxes, capital controls, import tariffs, and so on. These immediate determinants of the EREER are known as *real exchange rate fundamentals*. Secondly, there is not 'one' equilibrium REER, rather there is a path of EREER through time (Edward, 1989). Thus, the choice of the REER fundamentals will be determined by the theoretical framework to be used, and the values of the fundamentals are determined by the type of equilibrium of interest (meaning that they could either take their actual values, or alternatively their medium-term or long-term values) (Driver and Westaway, 2005). Thirdly, the path is not only affected by the current values of the fundamental determinants, but by also their expected future evolution. For example, if there are potentials for intertemporal substitution of consumption via foreign lending and borrowing, and in production via investment, expected future events – an expected change in the terms of trade, will affect the current value of the EREER (Edward, 1989).

The fundamental determinants of the REER equilibrium are the real variables which in addition to the real exchange rate, perform a great part in determining a nation's internal and external equilibrium (Edward, 1989; Clark and MacDonald, 1998). The external REER fundamentals include: i) world real interest rates; ii) international transfers (including foreign aid flows); iii) international prices (that is, the international terms of trade). While the internal (domestic) REER

fundamentals could be split into variables that are policy related and non-policy related decisions. The policy related REER fundamentals are a) exchange and capital controls; b) import quotas, import tariffs; c) the composition of government consumption; and d) other taxes and subsidies. While the non-policy fundamentals include technological progress as the most important. It should be noted that, not only do the above-mentioned variables affect REER equilibrium, but many times the relationship goes in both directions with changes in REER affecting the fundamentals. An example of the two-way relationship with respect to REER movements and tariffs, whereby a REER overvaluation is met by an increase in exchange rate controls and tariffs.

The notion that an EREER moves whenever the fundamental determining factor (determinants) change has significant ramifications for policy. But some policymakers still believe that the EREER is an unchallengeable amount or a constant. This suggests that any deviation of the REER from its value in the past period (equilibrium year) symbolises a disequilibrium and it is a cause for alarm (Edward, 1989; Clark and MacDonald, 1998). On the other hand, real changes in the REERs do not automatically represent a disequilibrium. Rather, they could reflect changes in the equilibrium generated by changes in the fundamentals. Though the EREER is a function of only the real variables, the actual REER responds to both the real and monetary variables. So, the actual REER depends on the values of the fundamentals (real interest, international prices, tariffs, and so on) and on aggregate macroeconomic pressures like fiscal deficits and an excess supply of money. The presence of an equilibrium value of the REER does not imply that the actual real rate ought to be perpetually equal to the equilibrium value. Factually, the actual REER will usually differ from its equilibrium especially in the short-run.

There exist different approaches of estimating the EREER with the following being the most popular: the purchasing power parity (PPP), the fundamental equilibrium exchange rate (FEER) by Williamson (1994), the natural real exchange rate (NATREX) by Stein (1994), and the behavioural equilibrium exchange rate (BEER) Clark and MacDonald (1998).

2.3.1 THE PURCHASING POWER PARITY (PPP) APPROACH.

The Purchasing Power Parity (PPP) approach pivots on the law of one price. As per the law, in the absence of trade impediments like capital control and trade barriers (protectionism), identical goods should be sold in different nations operating full employment at the same price (Tipoy, 2016; Siregar, 2011). The PPP of a nation is the exchange rate that equalizes the price of a given basket of goods and services in two nations. There exist three concepts of the PPP used in must literatures, which are; the law of one price, absolute PPP, and relative PPP. The law of one price associates the exchange rate to prices of individual homogenous goods in different nations (Cahyono, 2008). This concept does not take into cognition transaction cost, trade

barriers (like quotas or tariffs), such that the prices of similar goods sold in different nations ought to be equal if expressed in a common currency (Tipoy, 2016; Siregar, 2011). The law of one price could hold for homogenous primary products traded on major exchanges, especially when adjustments for delivery lags and contract differences are made. However, when it concerns prices of differentiated products like manufactured goods, their prices tend to tilt greatly away from the law of one price due to other cost like, packaging, quality, marketing, storage, etc. The second PPP concept – the absolute PPP concept, stipulates that the same basket of goods must cost same amount in all nations when expressed in a common currency. This concept gives a specific equilibrium concept for the nominal exchange rate (NER) called the PPP exchange rate. Thus, the PPP exchange rate is defined as the rate that equalizes the prices of a mutual basket of goods in two different nations. The third concept is the relative PPP, which stipulates that the percentage change in the exchange rate should equal the difference between inflation at both domestic and foreign nations. However, the implications of PPP puzzle – how can one reconcile the enormous short-term volatility of real exchange rates with the extremely slow rate at which shocks appear to damp out (Rogoff, 1996).

In spite the rejection of the PPP approach, panel data stationary techniques showed that the PPP holds in the long-term like in the work of MacDonald (1996), and Frankel and Rose (1996). So, some of the reasons the PPP might not hold are; nations involve may not produce same goods, difference in consumer preferences, some goods may not be tradable (Tipoy, 2016; Siregar, 2011, Driver and Westaway, 2005). There are limitations to the use of the PPP approach which are; firstly, it provides the long-term measurement of the equilibrium, with its computation requiring very large span of data. These data are often difficult and available to collect for both emerging and developing nations. Secondly, the equilibrium exchange rate under the PPP approach is constant, abstracting from disturbance from external shocks. Thirdly, it ignores the different fundamentals, thereby providing no insight of exchange rates adjustment consistent with world imbalance being unravelled (Tipoy, 2016; Béreau *et al.*, 2012). These shortcomings have justified the use of other approaches.

2.3.2 THE FUNDAMENTAL EQUILIBRIUM EXCHANGE RATE (FEER) APPROACH.

Departing from the PPP approach is the Williamson (1994; 1985) proposed “Fundamental Equilibrium Exchange Rate” (FEER), suitable for medium-term analysis. Unlike the PPP, the FEER allows for changes to the equilibrium exchange rate. The FEER approach (also known as the structural general equilibrium approach) indicates that an exchange rate is at equilibrium when it satisfies the condition of simultaneous internal and external balance in the medium-run. The medium-run is the period needed by output to adjust to its potential level. The FEER is a very difficult approach to apply in developing nations because it requires huge data that are

often not available in developing nations. However, the positive side of this approach is that it permits a dynamic relation element from various economic variables, thereby making the estimation of the real exchange rate equilibrium to be close to the real world. However, the applicability of this approach is limited since it strongly depends on the quality and the availability of data.

The internal balance is reached when the nation is operating at the non-accelerating inflation rate of unemployment, or it is at the full employment level. While the external balance deals with a sustainable current account reflecting underlying and desired net capital flows (Tipoy, 2016; Clark and MacDonald, 1998). Thus, the FEER describes foreign trade relations and relates movements of exchange rates on internal and external imbalances (Jeong *et al.*, 2010). So, the FEER is the exchange rate that is consistent with ideal economic circumstances of macroeconomic balances, which take into cognition economic fundamentals or variables that persist in the medium term and overlooks short-term cyclical and temporal factors (Clark and MacDonald, 1998).

2.3.3 THE NATURAL REAL EXCHANGE RATE (NATREX) APPROACH.

The Natural Real Exchange Rate (NATREX) by Stein (1994), deals with both medium and long-terms. The NATREX is *“the rate that would prevail if speculative and cyclical factors could be removed while unemployment is at its natural rate”* (Stein, 1994, p.135). It is the exchange rate that is consistent with portfolio balance such that domestic and world interest are equal (Driver and Westaway, 2005). The NATREX converges to the long-term exchange rate when there is no further change in the fundamentals. It was noted that the NATREX was conceived modelling the USA equilibrium, as such suitable capturing futures of developed nations (You and Sarantis, 2012). Nonetheless, it has been proved that there is a possibility of also accommodating features of developing nations. The NATREX estimation starts with the identification of the different fundamentals, with the common ones being: the productivity proxy, like the productivity of labour; and a measure of thrift that is proxy by the ratio of government expenditure over GDP (Siregar, 2011).

2.3.4 THE BEHAVIOURAL EQUILIBRIUM EXCHANGE RATE (BEER) APPROACH.

The latest approach is the Behavioural Equilibrium Exchange Rate (BEER) proposed by Clark and MacDonald (1998). The BEER is a short-term concept that involves the direct econometric analysis of the exchange rate behaviour and does not rely on any theoretical model, with the equilibrium rate designated by the long-term behaviour of the macroeconomic variables. Another approach proposed by Clark and MacDonald (1998) is the Permanent Equilibrium Exchange

Rate (PEER). The PEER differs from the BEER in the manner that the exchange rate is a function only of those variables that have persistent impact on it.⁴³

The original BEER approach of Clark and MacDonald (1998) is not based on any specific exchange rate or theoretical model, thereby making it a very general approach for modelling the equilibrium exchange rates. But building idea of the BEER approach is based on the uncovered interest rate parity (UIP) condition. The core element of most BEER applications is that the current account must equal zero at equilibrium (and Dias, 2007). The BEER approach takes as a starting point the view that real factors are a key reason for the slow mean reversion of the PPP, and it is similar to variants of the internal-external balance approach like the FEER. The BEER approach exploits the theoretical (real) exchange rate model, to obtain a measure of the equilibrium exchange rate and the exchange rate misalignment. The approach is view as having numerous advantages over other approaches and specifically the FEER. Contrast to the FEER approach which Wren-Lewis (1998) argued was a method of calculation rather than an estimated exchange rate model. Whereas the BEER approach has the potential of capturing all the systematic and fundamental movements of the exchange rate and can be subject to rigorous statistical testing (MacDonald and Dias, 2007).

In addition, the BEER is a highly tractable approach to gauging an equilibrium exchange rate, often relying on a single equation approach, using either panel or time series data. Contrarily, the FEER-based estimate requires a full-blown multi-country macroeconomic model that could be cumbersome, especially for developing nations where data are hard to come-by. Whereas the BEER approach deals with variables that have a direct impact on the exchange rate. In other word, the EREER is driven by sustainable values of the fundamentals that affect the actual exchange rate in the long-term and not by the entire macroeconomic balance. The FEER has the advantage of ensuring internal consistency of the estimates (MacDonald and Dias, 2007). Contrarily to the FEER estimates, the BEER can produce measures of exchange rate misalignment. Thus, in this thesis, the BEER approach by Clark and MacDonald (1998) will be

⁴³ In the study of Clark and MacDonald (2004), they called the model that calculates the exchange rate current misalignment the "BEER model", and called the model that calculates the exchange rate long-run misalignment the "permanent equilibrium exchange rate (PEER) model". The use of the two names are not consistent among economists, like Funke and Rahn (2005) used same name as Clark and MacDonald (2004). While Wang et al. (2007) used the PEER (and the Hodrick-Prescott filtered values of economic fundamentals), and they still called their model the BEER model. Looking at the definition used by Clark and MacDonald (2004), the model used by Wang et al.(2007) is to be called the PEER model, as the difference between BEER and PEER models named by Clark and MacDonald (2004) is the use of current and long-term values of economic fundamentals. In this research, we classify them together under BEER model. That is, we shall be using both BEER and PEER models as the BEER model as done by Wang et al. (2007).

use in estimating the equilibrium exchange rate for each of the CEMAC nations as seen in chapter 3 (section 3.3). There is a large body of empirical work on EREER as discussed below.

Applying the Johansen cointegration and error correction methods, Amoah and Aziakpono (2017) estimate the equilibrium RER and determine the extent of misalignment of the Ghanaian cedi for the period 1980Q1-2013Q4. The empirical results suggest a significant misalignment of the exchange rate based on the BEER approach. In particular, the study observed undervaluation for the period preceding the redenomination exercise in 2007, while overvaluation was detected after that. Given the extent of overvaluation, the study suggested that a one-off devaluation of a minimum of 20% could bring the exchange rate to equilibrium.

In employing Geweke and Porter-Hudak fractional cointegration test, Erer *et al.* (2016) examined the long-term relationship between the Turkish Lira (TL) and the US dollar. Using monthly data from 2002-2015, the study's results detected causality from exchange rates to asset prices instead of from the asset prices to the exchange rate. Hence, the portfolio approach is not valid for Turkey. Umer *et al.* (2015) analysed the relationship between emerging markets and analysed the relation between asset prices and exchange rates. Their findings showed stronger movement of variables in the same direction during a crisis. Causality was from the exchange rates to asset prices during the crisis period while being in the opposite direction in the other periods. As per the results, the portfolio approach was invalid for Turkey among the nations analysed in the study.

In examining the long-term movement between the Canadian dollar and the USA dollar exchange rate from 1990:1 to 2008:8; Hussein (2015) study employed the Engle-Granger cointegration test and found no cointegration between the actual exchange rate and the PPP rate. This suggests that there is no long-term relationship between the Canadian dollar and the USA dollar exchange rates. Enders (1988) used the Auto-Regressive Integrated Moving Average (ARIMA) test to validate Canada, Japan, and Germany's PPP hypothesis pre and post-Bretton Woods era. The result of his study shows that there is mixed evidence of the PPP holding. Empirical studies by Shiller (2013) where the applicability of PPP theory in the long term yielded inconsistencies.

Using daily data from 1999-2004, Fatum (2015) empirically examined the transmission channels of central bank interventions for the USA and Japan. He assumed a zero-interest rate and limited use of traditional monetary policy tools. He concluded that intervention works through the portfolio balance channel. Khan and Abbas (2015) used quarterly data between 2001 and 2010 to test the validity of the portfolio balance approach for Pakistan. They used the ADF and Phillips-Perron unit root tests and the ARDL test. Their finding showed the validity of the portfolio approach.

Evaluating if the CFA franc is overvalued from its equilibrium rate, Abdih and Tsangarides (2010) concludes that it was not overvalued. Their panel-based result failed to account for county-specific dynamics that might have policy implications. This is so because macroeconomic fundamentals could differ across the CFA franc nations as was with the euro crisis. Thus, necessitating country-specific analysis to complement existing literature.

2.4 THE IMPACT OF REAL EFFECTIVE EXCHANGE RATE ON TRADE BALANCE

It is view among economists that currency devaluation improves a nation's trade balance (TB) deficit, leading to a reduction of the current account deficit and improving economic growth (Kurtović, 2017; Bahmani-Oskooee, 1985). An undervalued exchange rate is viewed as an improvement in price competitiveness and a means towards faster economic growth, as championed by Rodrik (2008) and supported by others (Kurtović, 2017; Grekou, 2015; Schroder, 2013; Cakrani *et al.*, 2013; Levy-Yeyati *et al.*, 2013). A RER devaluation could lead to the deterioration of TB in the short run while improving TB in the long run (Šimakova and Stavarek, 2015; Šimakova, 2013).

Quantifying the short-term and long-term responsiveness of the TB to changes in the exchange rate is vital to economic policy for numerous reasons. First, it establishes if there exists a stable long-term relationship between the exchange rate and TB. In case a stable long-term relationship does not exist, then devaluating a currency might not be a reasonable way of improving a nation's competitiveness in the long-run perspective. Second, if the long-term relationship exists, it is essential to establish if devaluation could lead to a net improvement of TB in the long term (causality) or not.⁴⁴ Third, quantifying the extent of the TB improvement is desirable because it enables one to weigh the TB benefit against the cost of devaluation (like foreign reserve accumulation) (Stučka, 2004). Fourth, the estimate of the short-term dynamics provides information regarding the immediate and medium-term impacts of exchange rate changes on the TB (i.e., does a devaluation have a short-term adverse impact on the TB). If it does, it is reasonable to estimate the persistence and the extent of such adverse impact.

It is also important to know so that when TB gets negative in the short term, there will not be much concern because it will improve in the long term. If this understanding of the short-term negative impact is absent, there could be panic and a rush to reverse the devaluation policy (or implementation of other policies), thinking that it will lead to a further deficit of TB. This is often an empirical question, and the literature refers to it as the *J*-curve effect. The economic concept

⁴⁴ A long-term relationship could either result in the presence of a *J*-curve or an *S*-curve. An *S*-curve occurs when a currency devaluation leads to an initial improvement in the TB in the short-term and a drop in the long-term (thereby producing an *S*-sharp like movement of the TB).

of the *J*-curve and the exchange rate devaluation are closely related, with Magee (1973) being the first researcher to introduce the *J*-curve phenomenon.

Several theories have been used in analyzing the impact of exchange rate movements on nations' TB, these theories include the standard theory of international trade, the structuralists' (elasticity theory), the Keynesian (absorption theory), and the monetary theory. The elasticity theory argues that the price effect outweighs the volume effect in the short-term, while the volume effect outweighs the price effect in the long-term (Eshetu, 2017; Krueger, 1983). The absorption approach or Keynesian theory assumes that; devaluation improves a nation's TB if the substitution from foreign to domestic products boost output more than spending (Pilbeam, 1998). The monetary theory states that currency devaluation increases the domestic price, which leads to a fall in the real money supply. Because of the fall in the real money supply, imports decrease, and TB improves. Also, the monetary policy argues that higher money supply leads to trade deficit, whereas low money supply causes TB surplus. Moreover, empirics on the impact of currency devaluation on TB of devaluation countries have presented contradictory results. Hence, we shall be presenting the various theories on the impact of currency devaluation on a nation's TB.

2.4.1 STANDARD THEORY OF INTERNATIONAL TRADE

Mercantilism was the prevailing economic system of most industrial nations in the 16th to 18th centuries. The assumption of the mercantilist approach to international trade is that; a nation's wealth principally depends on its capability of possessing precious metals like silver and gold (Dhakir *et al.*, 2014). The possession of the metals was via supporting exports and encouraging the discovery of metals in the Americas, and at the same time suppressing the imports via the imposing of excessive tariffs (Dhakir *et al.*, 2014; Peukert, 2012). Due to almost three centuries of instability and economic failure, the Mercantilist approach was criticized by the standard theory of international trade (Dhakir *et al.*, 2014; Wilson, 1959).

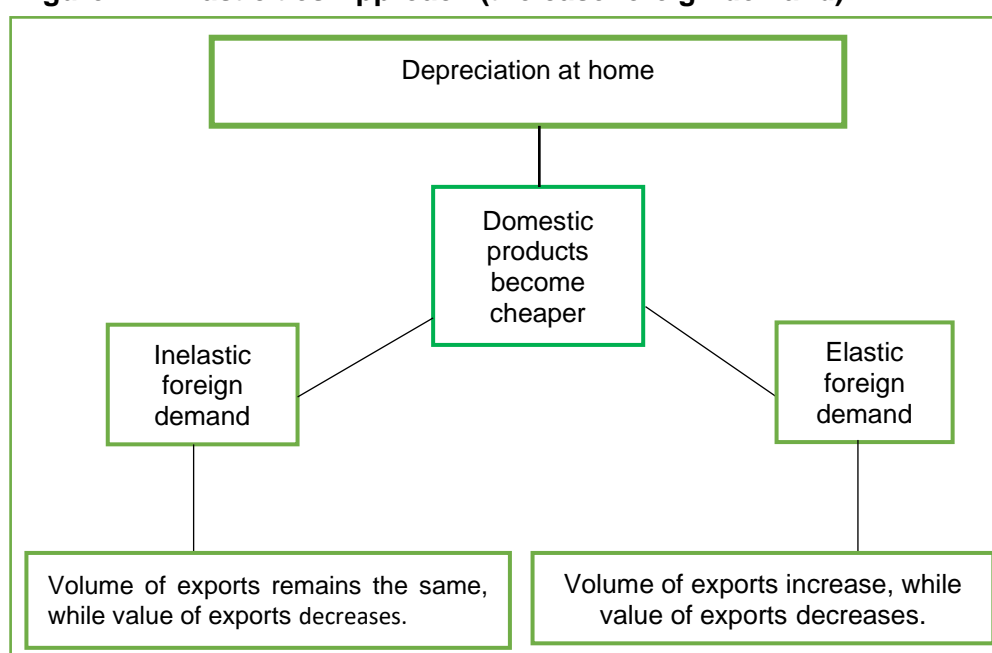
The standard trade theory uses a simple common-sense approach to liaise merchandise with RER movements. Keeping all other variables fixed, an exchange rate fluctuation affects both the trade value and volume. If the RER increases (depreciation of local currency), the households will get less imported goods in exchange for a unit of domestic product. Therefore, making a unit of imported product having higher number of units of domestic product. Eventually, domestic households buy fewer imports while foreign households buy relatively more domestic products. The higher the RER of the home nation, the more trade surplus they will have (Zhang, 2008). Lerner extended the theory by accounting for the demand price elasticities of imports and exports as vital elements in the measurement of the impact of variation of the RER on TB. Hence, a rise in exports and a decline in imports because of depreciation of the RER do not

automatically mean a correction of TB deficit. According to Lerner (1944), the TB is rather concern with the actual values and not on the volume of physical goods. This theory is often criticized because it mainly champion free trade via the principles of absolute advantage, and barely discussed the impact of RER on the TB.

2.4.2 THE ELASTICITY APPROACH

The elasticity approach views TB adjustment path on the bases of elasticities of demand for import and exports. The elasticity of demand is the quantity responsiveness of demanded products to changes in price. The elasticity approach is often known as the Bickerdike-Robinson-Metzler Condition, which deals with the view that changes in foreign currency value of trade balance depends on the import and export supply and demand elasticities and the initial volume of trade (Dhakir *et al.*, 2014). The elasticity approach revolves around the volume and value responses to changes in the RER. The figure below summarizes the case of domestic elasticity of supply in a devaluating nation.

Figure 2.1: Elasticities Approach (the case foreign demand)



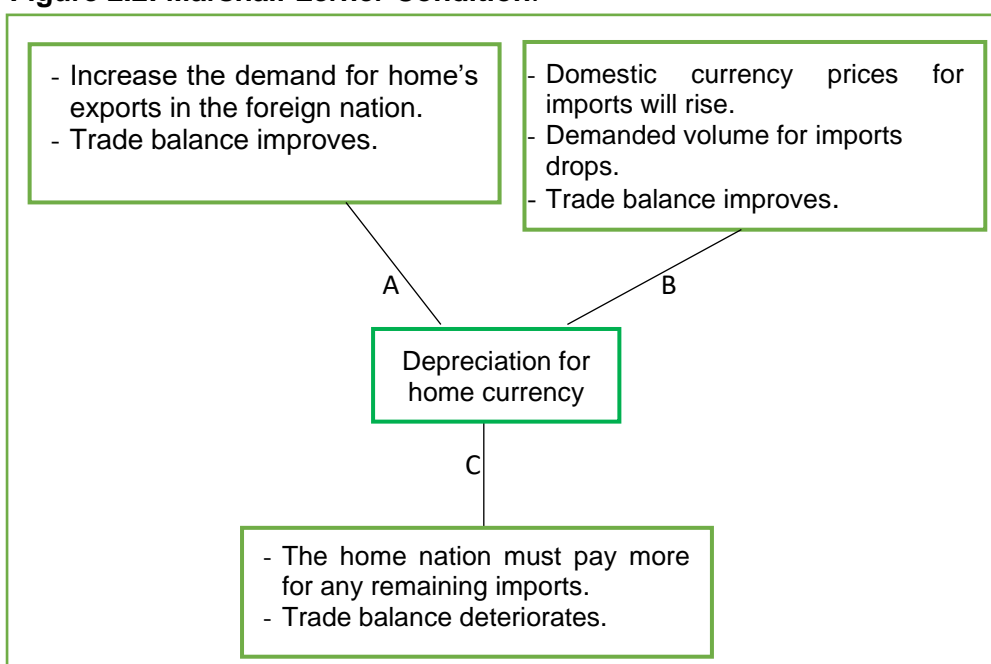
Source: Dhakir *et al.* (2014).

As seen on the figure above, same logic applies to the domestic demand, whereby lower prices in the domestic nation due to currency devaluation increases foreign demand for domestic products. But this can only occur if the foreign demand is elastic. On the contrary, if the foreign demand elasticity for domestic products is weak, then the quantity of domestic product will not rise to the level that it exceeds the declined in the value of export caused by the cheaper prices (Dhakir *et al.*, 2014). From the same perspective, the case of domestic elasticity of demand is understood in similar context. If the domestic demand for foreign products is elastic, changes (increase) in prices in the local market will result to changes in the local consumers' behavior.

They will switch from consuming foreign to local products, by so doing forcing down the value of imports. Thus, if the decline in the value of import is greater than the decline in the value of exports, there will be an improvement in the TB.

When a nation is face with trade balance deficit, policymakers often apply the elasticity approach to redress the situation. For this to be done, they take to consideration the responsiveness of import and export for a change in the exchange rate, to measure the extent at which a devaluation will impact the TB. In case the foreign and domestic demands for both imports and exports are elastic, a little change in the exchange rate could have a significant impact on the TB (Dhakir *et al.*, 2014; Daniels and VanHoose, 2005). The condition for a devaluation to improve the TB that contributes directly to an improvement in the BoP is known as the Marshall-Lerner condition (MLC)⁴⁵. The MLC is based on two main assumptions: The first being that trade was initially balance when the depreciation was done such that the foreign currency value of exports was equal the foreign currency value of imports. The second being that prices are fixed in seller's currencies; the supply elasticities are infinite. The effect is explained as shown on the figure below:

Figure 2.2: Marshall-Lerner Condition.



Source: Dhakir *et al.* (2014).

From the above figure, in the event of a currency depreciation, the TB improves when the volume effect (as seen in A and B) outweighs price effect (denoted C). Hence, $ML = (A + B) > (C)$. With

⁴⁵ The condition states that devaluation improves the BoP on trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e. if: $|\eta_x + \eta_m| > 1$.

a small 1% depreciation, leads to a 1% fall in the foreign price of domestic exports. In case the demand for exports increases by less than 1%, the foreign exchange rate earning will fall. If the demand rises beyond 1%, foreign exchange earnings will rise. If demand increases by exactly 1%, foreign exchange earnings will be the same. In this last scenario of unitary elasticity of demand, it will require a little reduction in import demand (an elasticity of demand for imports slightly above zero; $\eta_m > 0$) for the foreign exchange earnings to improve in total. Any combination of price elasticity of demand for import and export will improve the foreign exchange earnings if the sum is greater than unity.

In line with the Pugel and Lindert (2000), the focus of the elasticity approach is that there are two direct impacts of devaluation on the TB, one which work to improve and the other to worsen. The two effects are the volume effect and the price effect. The *volume effect* contributes to the improvement of TB because exports become cheaper, which encourages an increase in the volume to be exported. At the same token, imports become more expensive, thereby reducing the volume of import. The *price effect* contributes to worsen the TB since exports become cheaper when measured in foreign currency and import becomes expensive when measured in home currency. Thus, the net effect depends on which of the two effects dominates i.e. volume or price.⁴⁶

The elasticity approach is criticized mainly for being a partial equilibrium approach that does not account for the macroeconomic impacts arising from production price fluctuations and price changes in response to a devaluation (Kim, 2009). It accounts only for the volume and value response to changes in prices. On the other hand, both the absorption and monetary approaches descriptions are related to the macroeconomic variables undermining the favorable effect of the currency devaluation on the TB. The absorption approach is a merge of the elasticities approach and was initially model in the 1950s by Meade (1951), Alexander (1952), and others.

2.4.3 THE ABSORPTION APPROACH

The absorption approach to the BoP is general equilibrium in nature and based in the Keynesian national income liaison. It is also known as the Keynesian national income relationship. The main purpose of this approach is to integrate the BoP with the functioning of the entire economy in a general equilibrium framework in which the BoP disequilibrium of current account is regard as the outcome of the difference between decisions to produce and spend, or to save and invest

⁴⁶ It is generally believed by most economist that elasticity is lower in the short-term than in the long-term, in which case the Marshall-Lerner condition could only hold in the medium to long-term. The probability of the Marshall-Lerner condition not holding in the short-term, though it holds in the long-term has led to the phenomenon known as the J-curve effect. The concept underlying the J-curve is that in the short-term, export and import volumes do not change much such that the price effect outweighs the volume effect resulting to deterioration in the TB.

(Borena, 2013). The theory states that if a nation has a deficit in its balance of payment, it implies that it people are 'absorbing' more than they produce. The domestic expenditure on consumption and investment surpasses its national income. Alternatively, if it has a surplus in the BoP, then expenditure on consumption and investment is less than national income. Here, the BoP is regard as the difference between national income and domestic expenditure.

$$Y = C + I + G + (X - M) \quad (2.1)$$

Whereby Y is the national income, C is consumption expenditure, G is government expenditure, X is exports, and M is imports

Rearranging equation (2.1) above, we will have

$$Y + M = C + I + G + X \quad (2.2)$$

Whereby the left sides of the equation represent the total supply in the economy, which is a sum of the total domestic supply (Y) and the total imports (M). While the right-hand side shows how the total supply in the economy is spent or total demand through consumption, investment, government purchase, and exports. The domestic absorption as $A = C + I + G$, the trade balance as $TB = X - M$.

So, equation (2.2) could be rearranged as:

$$TB = Y - A \quad (2.3)$$

Trade balance is the difference between income (gross domestic product) and absorption. But, since $Y - C - G$ is the savings (S), equation (2.3) could be rewritten as:

$$TB = S - I \quad (2.4)$$

Also, the absorption approach could be spelled out using the leakage – injection terminology (Hallwood and Macdonald, 2000). Whereby the injections are flows additional to consumption that increase planned spending on domestic output, which includes investment (I), government expenditure (G) and exports (X). While leakages are withdrawal from the economic which causes the amount of income circulating in the economy to drop which constitute savings (S), taxes (T), and import (I). Hence, $S+T+M=I+X+G$ and on rearrangement $(S-I) + (T-G) = X-M$. Within this framework, devaluation could be evaluated in terms of whether it raises income (Y) relative to absorption (A), or saving (S) relative to investment (I). Therefore, an understanding of how a currency devaluation affects both income and absorption is central to the absorption approach. Government policies to reduce A is known as expenditure reducing policies which comprises; high interest rates, low government expenditure, high taxes. While policies to raise Y is termed expenditure switching policies which includes export subsidies, import quotas, tariffs, and currency devaluation (Hallwood and Macdonald, 2000; Thirlwall, 2004).

Currency devaluation increases exports and reduces imports, by so doing increases the national income. The additional income generated could further increase income through the multiplier effect. This results in an increase in domestic consumption. Hence, the net effect of the increase

in national income on the BoP will be the difference between the total increase in income and the induced increase in absorption i.e.;

$$\Delta TB = \Delta Y - \Delta A \quad (2.5)$$

Currency devaluation will have direct effect on income (ΔY), and on absorption (ΔA), while indirect effects on absorption working through changes in income (D) whose magnitude depends on the marginal propensity to absorb, α (determined by the propensity to consume and invest) ($\alpha\Delta Y$). Hence, changes in total absorption ΔA is:

$$\Delta A = \alpha\Delta Y + \Delta D \quad (2.6)$$

Substituting (6) in to (5) gives:

$$\Delta TB = \Delta Y - (\alpha\Delta Y + \Delta D) = \Delta Y (1 - \alpha) - \Delta D \quad (2.7)$$

Equation (2.7) shows three factors to be considered when analyzing the impact of devaluation in the absorption approach: (i) how does currency devaluation affect income? (ii) how does currency devaluation affect absorption directly? and (iii) what is the value of the propensity to absorb α ?⁴⁷

⁴⁷ *The Effect of devaluation on nominal income: There are two direct effects of currency devaluation on income, which are; first being a situation of idle resource (less than full employment) effect, and the second is the terms of trade effect. The Employment effect: if the resources are idle and provided the Marshall-Lerner condition is fulfilled, income will increase depending on the degree at which the rest of the world absorbs more exports and the value of the income multiplier. However, even if income increases, the TB will only improve if the marginal propensity to absorb is less than unity i.e. $\alpha < 1$. The term of trade effect: Term of trade (TOT) deteriorate after a devaluation because the imports become more expensive in terms of domestic currency, which is not matched by a corresponding rise in export prices. This TOT deterioration lowers the national income, as more units of exports are given for a unit of import. However, as stated by Laursen and Metzler (1950) that TOT deterioration following currency devaluation has two effects on absorption: the income effect and the substitution effect. While TOT deterioration lowers the national income and thereby income related absorption, making domestically produced goods relative cheap compared to foreign produce goods, implying a substitution effect in favor of increased consumption of domestically produced goods. In case the positive substitution effect outweighs the negative income effect, then the devaluation that results in a negative TOT could lead to an increase in absorption.*

The effects of devaluation on direct absorption: There are different ways via which a devaluation could impact upon the direct absorption like; the income redistribution effect, real income effect, money illusion effect, real cash balance effect, etc. The real income effect: Given an unchanging money stock i.e. the authority does not change the level of money supply, devaluation raises the overall price index. The price increase reduces the real value of money held by people. If economic agents try to restore their real money holdings, economic agents will be forced to cut down their direct absorption. In case the authorities try to respond to the increasing money demand by increasing money supply, the impact of devaluation on direct absorption will be sterilized.

The income redistribution effect: If currency devaluation redistributes income in favor of people with high marginal propensity to save, direct absorption will fall. While if income is redistributed in favor of people with high marginal propensity to consume, direct absorption will increase. Also, when the money income of people with low income increases with devaluation, they enter the income tax bracket. When the people start to pay income tax, their consumption reduces as compared to higher income group of people who are already paying tax. The results to a reduction in absorption in the case of the former.

The money illusion: When prices increase due to devaluation, consumers believe that their real income has fallen, in spite of the fact that their money income has risen. With the influence of the money illusion, their consumption expenditure reduces, or direct absorption reduces.

In summary, under the absorption approach, the trade balance is a function of domestic consumption (absorption) and real income $TB = f(Y, A)$. The trade balance could improve if there is a decrease in domestic consumption A or an increase in output Y or both. In case absorption is constant and the

The absorption approach is often criticized that it relies so much on policies designed at influencing domestic absorption without considering the impact of devaluation on the absorption of other nations. The approach fails as a corrective measure of BoP deficit under a fixed exchange rate regime. This is so because when there is a devaluation, people reduce their consumption expenses, and with the money supply remaining constant interest rate rises which leads to a fall in output along with absorption. Hence, currency devaluation has little impact on the BoP (Taboola, 2019). Also, the approach places much emphasis on the domestic consumption than on relative prices. For, a mere reduction in the domestic consumption level for reducing absorption does not imply that resources release will be redirected to improve the BoP deficit.

2.4.4 THE MONETARY APPROACH

Mundell and Johnson (1960) developed the monetary approach to the TB, and it states that the TB is fundamentally a monetary phenomenon. As per this theory, TB surplus and deficit is caused by tight and easy monetary policy respectively. A devalued currency influences the TB through its impact on the real money supply. This implies that when there is currency devaluation, domestic prices rise and real money supply decreases which results to lower imports. Nevertheless, if currency devaluation is followed by further rises in the nominal money supply, the initial disequilibrium will re-establish, and the positive impact of devaluation will be nullified. Hence, as per the monetary theory of TB, devaluation leads to an improvement of a nation's TB through its demand channel by reducing imports so long the money supply remains the same (Eshetu, 2017; Blanchard, 1993).

The core of the monetary theory is that the trade surplus and deficit in the BoP are denoted as disequilibrium in the money market. So, the disequilibrium (surplus or deficit) in the money market is a transitory phenomenon which lasts till the government responds by changing money supply. As per the theory, a nation's supply of money is given by:

$$H = D + F \quad (2.8)$$

Whereby H is a nation's total money supply, D is the domestic components of the nation's monetary base, and F is the foreign components of the nation's monetary base. The money supply equation could be written as:

$$\Delta NFA = \Delta H - \Delta D \quad (2.9)$$

Whereby ΔNFA denotes change in the net foreign assets, ΔH denotes total money supply of a nation, and ΔD stands for the central bank's extension of domestic credit. The equation above states that the change in the central bank's holding of foreign assets equal the change in the

economy is not at full employment especially in developing nations, when a currency is devalued, the crucial effect is expected to be an increase in output, leading to improvement in the trade balance.

stock of high powered money less the change in the domestic credit. Hence, ΔNFA is the balance of payment (BoP). The domestic component of the nation's monetary base (D) is the domestic credit created by the nation's central bank (monetary authority). The external balance is given by:

$$M - X = FS - \Delta R \quad (2.10)$$

ΔR is the change in international reserve and is the same as ΔNFA . Thus, the above equation shows that imports less exports equal foreign savings (Fs) minus changes in the international reserve (ΔR). So, the relationship between TB (external balance) and the monetary account could be written as follows from equations (2.9) and (2.10):

$$M - X = (\Delta H - \Delta D) - Fs \quad (2.11)$$

The above equation shows how the external account, and the monetary accounts are related to the monetary theory of TB of a nation. This shows that an excess stock of money supply is negatively to the TB of a nation (Eshetu, 2017). This implies that an excess stock of money supply will lead to an out flow of reserves (import increases) or a BoP deficit. It is obvious from equation (2.11) that devaluation improves the TB of a nation in line with the monetary theory. In case there is disequilibrium in the money market, this results to greater import or export which in turn brings equilibrium in the money markets through its impact on the nation's monetary base. This means that when the money market is in equilibrium, so does the BoP. Hence, a nation's BoP deficit/surplus is a temporal and self-correcting phenomenon (Eshetu, 2017; Dornbusch and Fischer, 1996).

2.4.5 THE J-CURVE EFFECT

The *J*-curve theory is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC)⁴⁸ holds, it is likely that following a devaluation, an initial drop in TB occurs before an improvement follows (Ziramba and Chifamba, 2014; Baek *et al.*, 2006). The response of the TB over time looks like a tilted J shape. The *J*-curve phenomenon is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). For instant, in case there is a devaluation of a domestic currency, then the increase in the domestic price competitiveness could result in the exportation of more and the importation of less. By so doing, it improves the TB, known as the volume effect. At the same time, the devaluation increases the import unit value, resulting in the deterioration of the TB, known as the price (value) effect. The price effect dominates in the short term, while the volume effect prevails in the long term, thereby causing

⁴⁸ The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

the time path of the TB depicted by the *J*-curve phenomenon (Ziramba and Chifamba, 2014; Abd-El-Kader, 2013; Bahmani-Oskooee and Mitra, 2009).

Among all the theories of TB mentioned above, the *J*-curve theory has had the most attention. The *J*-curve theory has occupied the most recent empirical literature due to its ability to incorporate other older approaches indirectly and, at the same time, provide a novel approach to the issue by itself (Dhahir *et al.*, 2015). For instance, as stated by the Marshall-Lerner Condition (MLC), for currency depreciation to have a positive effect on the TB, the elasticities of demand for imports and exports must, in absolute terms, exceed unity (Marshall and Groenewegen, 1923). A long-term improvement of TB under the *J*-curve analysis can show that the condition is met (Bahmani-Oskooee and Wang, 2008). Another approach is the Elasticity approach by Bickerdike-Robinson-Metzler, which states that for an exchange rate depreciation to improve the TB, the ultimate impact is determined by the interaction of the value and volume effects on the trade flow (Dhahir *et al.*, 2015). In the short-term, the value effect is fast by changing the traded goods' prices. Due to currency depreciation, the value of imports increases when paid in domestic currency, while at the same time, the volume of exports remains the same. Thus, the net exports decrease, causing the trade balance to worsen. However, in the long term, the value effect itself leads to improving TB by changing the volume of trade. The simultaneous combination of two effects causes this: firstly, the domestic market begins compensating for the relatively high price of imported products via the consumption of domestic production. Secondly, exports start improving due to the price competitive advantage of domestic products in the international markets.

Based on the criticisms of the other theories and the advantages the *J*-curve relative to them as mentioned above, we will be using the *J*-curve effect to analyse the impact of REER on the TB of CEMAC nations. This will be done in chapter 4 (section 4.3), where we will be looking at the *J*-curve assumptions. We will look at the three adjustment periods of the *J*-curve: i) the currency contract period, ii) the pass-through period, and iii) the sluggish response. Finally, we will go through the three different approaches of determining the *J*-curve (Aggregate Trade Data Approach by Magee (1973), Bilateral Aggregate Trade Data Approach by Rose and Yellen (1989), Bilateral Disaggregate Trade Data approach by Doroodian *et al.* (1999)). Thus, we will now proceed with empirical reviews.

Lots of empirical analyses on the *J*-curve hypothesis are mixed. Studies on the impact of exchange rate movements on the trade balance are still in considerable disagreement on the relationships between these economic variables and the effectiveness of currency devaluation as a tool for improving the TB of a nation (Borena, 2013; Onafowora, 2003). Mndaka *et al.* (2022) tested for the validity of the *J*-curve using evidence from South African Development Community

Countries (SADC). The study adopts the Autoregressive Distributed Lagged (ARDL) cointegration technique from 1980 to 2018 for SADC countries using data from the World Development Indicators and the Trade Map. The study found that the theory holds for Angola, Comoros and Seychelles, Madagascar, Eswatini, and South Africa. The theory does not hold for Botswana, the Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, Tanzania, and Zambia. For economies whose results are inconsistent with the *J*-curve phenomenon, the study suggested that authorities must rely on other policies than the exchange rate policy. Deliberate policies toward export diversification and fiscal policies ought to be employed to resolve the financial challenges faced by the export sector.

In revisiting the *J*-curve hypothesis Kamal *et al.* (2020) used data on bilateral trade involving China and the USA, using quarterly time series data from 1999 to 2018. Results from error correction estimation show that an increase in domestic and foreign income significantly improves China's trade balance with the USA., while the monetary variables (both domestic and foreign) do not affect that trade balance. The key finding is that a depreciation of China's currency initially worsens its trade balance, but over time, its trade balance improves. This pattern supports the *J*-curve hypothesis tested in prior studies with mixed results.

In researching the effect of exchange rate volatility on export performance in Southeast Asia Kamal *et al.* (2020) examined this relationship for the ASEAN-5 group, including Thailand, Malaysia, Singapore, Indonesia, and the Philippines for the period 1975-2016 for Indonesia, 1994-2016 for Thailand, and 1979-2016 for other ASEAN-5 countries. The variables modelled in the research include real exports, real GDP, real-world output, terms of trade, and exchange rate volatility. From a statistical perspective, export volatility was derived from the real effective exchange rate using a GARCH model. The estimation techniques used in the study include panel unit root test, Johansen-Fisher panel cointegration tests, and error correction model (ECM). The results suggested that exchange rate volatility harmed the export performance of the ASEAN-5.

In examining the impact of exchange rate movements on the agricultural exports in Nigeria for the period 1981-2015, Anthony *et al.* (2019) applied the unit root test and ordinary least square (OLS) regression analysis. The variables used were exchange rate, agricultural exports, government capital expenditure, foreign direct investment, credit to private sector, and Lending interest rate. The estimation results also indicated that exchange rate movements had a positive and significant influence on agricultural exports in Nigeria. Specifically, the findings showed that exchange rate, government capital expenditure, foreign direct investment, and lending interest rate were positively related to agricultural exports, while credit to the private sector was negatively related to the exports.

In analysing the impact of real exchange rate depreciation on the trade balance in Cameroon for the period 1980 to 2016, Dongfack and Ouyang (2019) applied the unit root test, cointegration test, vector error correction model (VECM), and Granger causality test. The variables modelled in the research were real exports, real imports, real exchange rate index, domestic income - proxied by gross domestic product, and foreign income - proxied by trading partners' GDP. The results of the unit root test revealed that all the variables were non-stationary at levels, but at first differencing, all the variables became stationary. Similarly, the Johansen cointegration test indicated evidence of a long-run equilibrium relationship among the variables. The estimation of short-run and long-run relationships between the variables using Johansen cointegration and the vector error correction model (VECM) as a mean to examine whether the Marshall-Lerner condition (MLC) and the J-curve phenomenon hold in the case of Cameroon yielded mitigated results. Although the Marshall Lerner Condition was not met for Cameroon, as the sum of the elasticities of demand for exports and imports was not greater than unity, the empirical analysis results provide evidence of correction over the long run of a prior deterioration of the trade balance; thus, supporting the existence of the J-curve pattern.

Estimating the long-run and short-run effects of the real exchange rate on Ethiopian export earnings for 1997-2016, Samuel (2019) applied the panel unit root test, panel cointegration test, and panel causality test. The variables utilized in the study include export earnings, real exchange rate, and real foreign income. The study's results showed that the real exchange rate had a significant impact on export earnings in the long run, while it had no effect in the short run. It implies that the depreciation of the real exchange rate improves the export earnings of the country. The study, as reviewed, showed that stationarity of the variables was achieved at both levels and first differencing, which implies the ARDL model was the appropriate estimation technique needed to estimate the coefficients of the variables. However, the study failed to use the proper procedures in the investigation.

In studying the impact of the exchange rate on exports in South Africa between the period 1994-2016 Ngondo and Khobai (2018) applied the Augmented Dickey-Fuller (ADF) and Philips Perron (PP) unit root tests and autoregressive distributed lag (ARDL) model. The variables used were exports, real exchange rate, real interest rate, inflation, and investment. The study incorporated real interest rates, investments, and inflation as control variables. By applying the ARDL approach, the study empirically investigated the impact of RER on exports in South Africa. The results revealed evidence of a long-run equilibrium relationship among the variables. The estimation results also indicated that the exchange rate has a significant and negative influence on exports, while real interest rate and investment had a positive and insignificant impact on exports in South Africa.

In investigating the impact of exchange rate depreciation on the BOP in Nigeria, lyoboyi and Muftau (2014) used secondary data obtained from the Statistical Bulletin of the Central Bank of Nigeria within the period 1961-2012. The data used were for the following variables: Balance of Payment, Exchange Rate, Government Expenditure, Real Gross Domestic Product, Money Supply, and Interest Rate (proxy by the prime lending rate). A multivariate Vector Error Correction Model (VECM) was adopted for all the variables. Three-unit root tests were used (Augmented Dickey-Fuller –ADF, Phillips-Perron – PP, and Kwiatkowski-Phillips-Schmidt-Shin –KPSS). The result showed that all the variables were non-stationary in levels (i.e., they had unit roots at level) and were stationary at their first difference. The Johansen cointegration test results showed that both the maximal eigenvalues and trace test statistics indicated that the hypothesis of no cointegration among the variables was rejected at the 5% significant level. The VECM result of the relationship between the exchange rate and BOP indicates that it is negative and statistically significant at the 1% level in the long term. The Granger causality test result shows a long-term causality between the BOP and all the variables in the system, and it is statistically significant at the 1% level. Thus, showing that there exists bi-directional causality between BOP and exchange rate.

In estimating the impact of the exchange rate on the balance of payment in Pakistan, Ahmad *et al.* (2014) used monthly data for exchange rate and balance of payment collected from the official website of the State Bank of Pakistan. The data comprised seven years from January 2007 to October 2013. The unit root test, ARDL, and Granger causality test were employed, and the study concludes that there is a significant and positive relationship between exchange rate and BOP. Therefore, the stability of the exchange rate creates a positive environment by encouraging investment, which can improve the balance of payment. The Granger pair-wise causality test result indicated a unidirectional causality running from exchange rate to BOP. This means that the BOP does not impact the exchange rate.

An analysis of the impact of the exchange rate on the balance of payments in Nigeria was done by Odili (2014), using annual data collected from the Central Bank of Nigeria statistic bulletin from 1971 to 2012. The variables used in the model are balance of payment, real exchange rate, exports, and imports. The empirical methodology employed an autoregressive distributed lag (ARDL) cointegration estimation technique to detect possible long-term and short-term dynamic relationships between the variables used in the model. The results revealed a positive and statistically significant relationship in the long term and a positive but statistically insignificant relationship in the short term between balance of payments and exchange rate. The BOP does not causal the exchange rate.

In the work of Šimakova (2013), he investigated the impact of depreciation on the Hungary TB with its major trading partners. He applied the Johansen cointegration test, using quarterly data from 1997 to 2012. The outcome of the research showed the presence of the *J*-curve in the bilateral trade with the United Kingdom. Šimakova (2013) investigated the impact of depreciation on Slovakia's bilateral trade with the Czech Republic, Hungary, and Poland. Applying the cointegration approach on quarterly data from 1997 to 2013, using the aggregate and disaggregate trade data. The results showed the presence of the *J*-curve. Bahmani-Oskooee and Zhang (2013) investigated the presence of the *J*-curve between China and the United Kingdom. They used data for 47 sectors from 1978 to 2010, and their results showed that currency devaluation had a short-term impact on 38 industries. The short-term impact lasted into the long term in only 7 cases.

In the work of Dhasmana (2012), a panel data analysis of the bilateral trade data of India and its 15 major trading partners was done. Using quarterly data for the period 1975 to 2011. He concludes that though the direction of the relationship between RER and TB might differ in the short term from one nation to another or a commodity to another, the relationship is homogenous in the long term (i.e., depreciation should improve trade balance in the long term). By using the REER rather than the bilateral RER, the results show a strong positive relationship between the depreciation of the RER and the TB.

The bilateral *J*-curve between the USA and its trade partners was researched by Ross and Yellen (1989). Specifying the equations for the demand and supply of imports, they followed the Marshallian demand analysis whereby the demand for imports by a home (foreign) nation is determined by the domestic (foreign) income and the relative price of imported goods. As such, an increase in home (foreign) real income results in an increase in the volume of import demand. Applying quarterly bilateral trade data from 1960 to 1985 for the USA and its six G-6 trading partners.⁴⁹ The results established the presence of the *J*-curve in the bilateral trade with Germany and Italy. Marwah and Klein (1996) used quarterly data from Canada and the USA with five of their largest trade partners to establish the presence of the *J*-curve. The results show the presence of the *J*-curve for both Canada and the USA.

In a study on bilateral trade data, Bahmani-Oskooee and Brooks (1999), investigated the shortcomings of Rose and Yellen (1989) and Marwah and Klein (1996) analyses. Three deficiencies of Rose and Yellen (1989) work were identified; firstly, the unit of measurement of TB was the difference between merchandise export and import. Secondly, the cointegration technique (Engle-Granger) has low power as it requires the Dickey-Fuller (DF) or augmented Dickey-Fuller (ADF) test. The short-term results were from a simple autoregressive analysis

⁴⁹ The USA's G-6 trade partners are (Canada, France, Germany, Italy, Japan, and the United Kingdom).

instead of an error-correction modeling. Thirdly, they did not use any objective criterion in selecting the lag length to estimate their VAR model. The main shortcoming of Marwah and Klein (1996) analysis is using non-stationary data. Thus, Bahmani-Oskooee and Brooks (1999) avoided the abovementioned shortcomings in their analysis of the *J*-curve between the USA and its six main trade partners. They adopted a model similar to that used by Rose and Yellen (1989) and employed a new cointegration technique of autoregressive-distributed lag (ARDL). The Error Correction Model was used to capture both short and long-term effects. By using quarterly bilateral trade data within the period 1973Q1 to 1996Q2, they found no short-term patterns favouring the *J*-curve (i.e., their result did not find the coefficient of the RER having a negative sign in the short-term and a positive sign in the long-term).

2.5 THE IMPACT OF REAL EFFECTIVE EXCHANGE RATE ON ECONOMIC GROWTH

The exchange rate and the choice of exchange rate regime have been at the centre stage in the post-crisis period. There is a continuous divide between policymakers and economists regarding the impact of foreign exchange on economic growth. Whereas laypeople and politicians are often convinced that a lower exchange rate will spur growth, economists are often sceptical that the relative price of two currencies could be a fundamental driver of growth over the long term. Most economists believe the exchange rate is an endogenous variable whose contribution to growth might be difficult to disentangle. Whether the exchange rate devaluation aids medium-term growth is still very unsettled in the literature.

The economic effect of the real exchange rate changes is among the controversial issues in the literature, especially the impact of changes in the real exchange rate on the economic growth of a nation over the past decades. The traditional view argues that there is a positive relationship between exchange rate changes and economic growth. An exchange rate devaluation influences the relative prices of domestic and foreign goods, promoting exports while decreasing imports. Currency devaluation converts the demands of foreigners into the country and directs the import demands of the indigenous to the local products. As such, currency devaluation supports economic growth by encouraging net exports (i.e., devaluation could be proposed as an effective policy tool to stimulate economic growth) (Karahan, 2020).

Structuralist economists, on the contrary, argued that currency devaluation hurts the economies of developing nations. A crucial structural problem in developing nations' economies is the phenomenon of foreign dependency, as most of the inputs used by these nations in their production process are provided via imports. Most inputs used by these nations in their production processes are imported. An exchange rate devaluation will increase the cost of imported inputs like semi-finished goods and machinery used in the production process. Hence,

the increased cost of production because of the devaluation of domestic currency could harm the output level of the nation.

Our goal is to find out if there is a link between REER devaluation and economic growth. Based on the work of Rodrik (2008), who evaluated this nexus on a database of 188 nations and 11 five-year periods from 1950 to 2004. His finding showed that for developing nations, an undervalued exchange rate predicted strong economic growth. The motivation for this finding was that tradable economic activities are special in developing nations as tradable suffer disproportionately from the institutional and market failure that keeps nations poor. In Rodrik's view, a sustained real depreciation increases the relative profitability of investing in tradable and acts in a second-best fashion to alleviate the economic cost of these distortions. However, a significant concern around this analysis regarding country-specific shocks like productivity shock could impact the REER, leading to reverse causality (i.e., the economic growth impacting the RER). Woodford (2008), in his discussion of Rodrik (2008), argued in defence of OLS regression of economic growth on the RER, with the possibility of reverse causality (i.e., a positive link between growth and REER appreciation). There is a large body of empirical work suggesting a nexus between RER and economic growth, as discussed below.

The impacts of devaluation on six Asian nations (India, Malaysia, Pakistan, Philippines, Sri Lanka, and Thailand) output were examined by Upadhyaya and Upadhyay (1999). A reduced model for output comprising the following explanatory variables: terms of trade, money supply, and government consumption. From their results, devaluation never had any positive impact on the output growth in the short-term, medium-term, and long-term in five of the six nations. Only in the Philippines did the real devaluation have an expansionary impact in both the short and medium term. The impact of currency devaluations was compared in two Latin American nations, Chile and Mexico, along with seven East Asian nations, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, and Taiwan, by Kim and Ying (2007). Both bivariate Granger Causality analysis and the multivariate Vector Autoregressive Regression (VAR) model were conducted. To account for the structural break in the series because of the 1997 financial crises, the pre-1997 period was distinguished in their analysis. As such, their results had different results as per the periods used. The devaluation was not contractionary for the East Asian nations in the pre-1997 era, whereas it was strongly contractionary for both Chile and Mexico. Nonetheless, for the entire period, the devaluation was contractionary for the Latin American nations (Chile and Mexico) and some East Asian nations such as Indonesia, Malaysia, and the Philippines. The RER devaluation is perceived to be correlated with the contraction of the economy, while the appreciated RER has been expansionary over the past decades in Mexico.

The effects of RER depreciation on output growth for fourteen MENA nations were evaluated by Bahmani-Oskooee and Kandil (2009). They applied both cointegration and error correction modelling to differentiate the growth effects of depreciation in the short term and the long term. Coupled with that, they differentiated the unanticipated and the anticipated components of RER. Their work showed that unanticipated depreciation was only evident in the short term, while in the long term, it had no expansionary impact. Contrarily, it had a long-term contractionary impact in Qatar, Kuwait, and Jordan. Meanwhile, the anticipated depreciation was contractionary in the long term for Libya and Lebanon but expansionary for Tunisia, Saudi Arabia, Syria, Oman, and Bahrain.

Edwards (1986) used 30 devaluation episodes in 22 less-developed nations to analyze the behaviour of investment, real output, and growth. The analysis showed a mixed outcome, depicting a contraction after the devaluation scenario in just a third to a half of the episodes. However, it was ambiguous if the reduction in the output was because of devaluation or changes in other exogenous variables. As such, by extending the study, Edwards (1986) set up a reduced-form equation for output controlling for the impact of foreign shocks, monetary policy, and fiscal policy. By using the pooled data of 12 less developed nations, it was confirmed that in the short-term, devaluation was contractionary, while in the long-term, it was neutral because the contemporaneous and lagged effects of RER cancelled each out.

Agenor (1991) analysed the impact of changes in RER on output for a set of 23 nations from 1978 to 1987. The empirical analysis was centred on an output equation obtained from a coherent expectations macro-model with intermediate products that are imported. By differentiating the impact of unanticipated and anticipated effects of a real depreciation, he applied the fixed effects estimation technique to the panel data set. The result showed that an unanticipated RER depreciation had a positive impact on output, while an anticipated RER depreciation harmed output. This result was contrary to that of Edwards (1986), whereby the contractionary impact of unanticipated depreciation was significant even after one year. Agenor (1991) postulates that depreciation was not neutral after a year, as stated by Edwards (1986); rather, it was continually contractionary in the medium-term to the long term. Concerning the differences in the estimation results to that of Edwards (1986), Agenor (1991) reiterated that it was important to define the RER adequately and to specify the output equation appropriately. Rather than using the bilateral RER, as done by Edwards (1986), Agenor (1991) preferred using the multilateral (effective) RER.

Magendzo (2002) postulates that the reason previous studies had a contractionary devaluation was due to “*selection bias*” because some variables affecting the possibility of a devaluation also determined the output growth. By using a Matching Estimator technique on a large set of

data consisting of 155 nations from 1970 to 1999, the selection bias was controlled. The reason for the matching estimators is to compare similar nations that were devalued and not devalued. When the selective bias was not taken into cognition, it was found that devaluations were contractionary. However, when the selective bias was controlled, the contractionary impact of the devaluation disappeared, having no significant impact on output.

In examining if depreciation under a flexible exchange-rate system and devaluations under a pegged exchange-rate system were similarly destructive for a country, Ahmed *et al.* (2003) said that governments of less developed nations often abandon the fixed-exchange-rate system in the event of a devaluation due to shortage of reserves. The relinquishment of the fixed-exchange-rate policy led to a drop in credibility in the economy from the investors' perspective, a sudden outflow of capital, and a contraction of the economy. It is unclear if the devaluation led to adverse results or the abandonment of the fixed exchange-rate system after the devaluation. In a normal depreciation under a flexible exchange-rate regime, it is difficult to observe the negative shortcomings that could be found in devaluation under a fixed-exchange-rate system. As such, VAR models were estimated by Ahmed *et al.* (2003) in comparing the responses of developing nations to devaluation. The economies used in the finding consist of East Asian and Latin American nations, which alternated between flexible and fixed-exchange-rate systems, and two kinds of industrial economies (those with sustained pegged exchange-rate systems and those consistently flexible). The outcome of their finding showed contractionary responses to devaluation shocks in developing nations while expansionary ones for the two kinds of industrial nations. Ahmed *et al.* (2003) presumed that the contractionary effects of the devaluations could not be attributed solely to the exchange-rate system. Some structures of less developed nations cause devaluations to produce unorthodox contractionary effects on their economies. From this, it is necessary to look at other policies, like the monetary policy, fiscal policy, as well as the commodities exported.

It is being postulated that developing nations could accomplish a high and sustainable growth rate via the pursuit of devaluation policy as the Eastern-Asian nations (Rodrik, 2008). He gave empirical evidence of the positive impact of undervalued RER on the economic growth of a nation. Working on a data set of 184 nations, Rodrik (2008) analysed the effect of RER undervaluation on their economic growth. By using an undervaluation index as an RER measure by adjusting the PPP-based RER measure with the Balassa-Samuelson effect. As per Balassa (1964) and Samuelson (1964), because developed nations have greater productivity of tradable commodities, their non-tradable products are more expensive than in less developed nations. As such, the RERs in developed nations are expected to be lower than in developing nations. By defining an undervaluation as the difference between the predicted and the observed RER, Rodrik (2008) estimated a panel data growth model for developed and developing nations via

the adoption of General Method of Moments (GMM) and Fixed Effects (FE) estimators. The research outcome showed that currency undervaluation stimulates the economic growth of a nation, especially for developing nations. He postulates that the trading sector was the core mechanism behind the result and that because the tradable sector suffered unduly from both market failures and institutional weakness, an increase in the profitability of the tradable sector via an undervaluation of the RER facilitates developing nations' economic growth.

Other studies (Gala, 2008; Di Nino *et al.*, 2011; Gluzmann *et al.*, 2012; Rapetti *et al.*, 2012) also used the undervaluation index as done by Rodrik (2008) in conducting a panel data analysis. Gala (2008) used a panel dataset of 58 developing nations from 1960 to 1999, with much attention paid to the theoretical channel via which the levels of RER could affect economic development. He found a positive liaison between RER undervaluation and economic growth. Ni Nino *et al.* (2011) used the more recent Penn World Table (PWT) dataset to extend the work of Rodrik (2008). They used alternative RER measures like the World Price Index (WPI) and the Consumer Price Index (CPI) based measures of the PWT dataset. Their result confirmed the results of Rodrik (2008). Rapetti *et al.* (2012) in adjusting Rodrik (2008) study, altered the definition of developed and developing nation samples. They emphatically showed that Rodrik (2008) work was sensitive to the criterion of separating the sample of developed from developing nations. Rodrik (2008) classified developed (developing) nations as those with a real per capita GDP of more (less) than \$6,000. If the cut-off level was between \$9,000 and \$15,000, the estimated coefficient will also be highly significant for developed nations. It suggests that a disproportionateness between developing and developed nations could depend on the chosen cut-off point of the GDP per capita. Gluzmann *et al.* (2012) looked at the effect of currency undervaluation on the different GDP components like investment, imports, exports, employment, and consumption so as to ascertain the channels of the effects. Their result showed that undervaluation did not affect the tradeable sector either through the promotion of exports or the creation of substitution from imports in developing nations. Rather, it led to an increase in savings, investment, and employment.

On the other hand, Woodford (2009) challenged Rodrik (2008) definition of developing nations as Rodrik (2008) definition of developing nations was based on the fact that their GDP per capita income was lower than \$6000. Woodford (2009) revealed that as the definition of developing nations changed to those with a GDP per capita less than \$8000, there was a one-third significant reduction of the undervaluation coefficient. More to it was the view that the least-income nations (less than \$1000 per capita income) were exempted from the sample; the coefficient was reduced by one-half and became insignificant. Thus, it was necessary to have a standardized definition of developed and developing nations. Also, Woodford (2009) unequivocally challenged the work of Rodrik (2008) because of the undervaluation index used.

Stating that the undervaluation index amplified the robustness and strength of the effect of RER on growth. Woodford (2009) emphasized that it was not necessary for adjustment to be made on the Balassa-Samuelson effect since Rodrik (2008) panel growth regression already had a nation-fixed effect, which contributed to their disparities in the level of RER because of differences in the per capita income.

2.6 CONCLUSION

This chapter looked at the real exchange rate, focusing on the history of the CFA franc. The 'Washington Consensus' by Williamson (1994) acknowledges the vital role of RER in the growth process. According to it, an appropriate real exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economic growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance. Contrary to the 'Washington Consensus' is the view that Rodrik (2008) championed, RER undervaluation promotes economic growth, and overvaluation harms it. This stance is in part due to the point of view that exchange rate – precisely an undervalued currency could be used in protecting home-based infant industries and the competitiveness of their exports.

To investigate the impact of the CFA franc on the economic growth of the CEMAC zone via the trade balance channel begins by knowing the state of the currency. Empirical work on the state of the CFA franc in the CEMAC Zone is scanty. Abdih and Tsangarides (2010) evaluated if the CFA franc is overvalued from its equilibrium rate, concluding that it was not overvalued. Their panel-based result failed to account for county-specific dynamics that might have policy implications. It is so because, as with the euro crisis, macroeconomic fundamentals could differ across the CFA franc nations. Some time series research on the CEMAC nations did not take into consideration all the six nations. In this research, we shall be looking at all the six nations, investigating if the CFA franc is aligned in each of them. Hence necessitating country-specific analysis to complement existing literature. The empirical results on the relationship between the RER and trade balance are mixed, as well as between the RER and economic growth. Thus, necessitating empirical work about the CEMAC Zone, as seen in the following empirical chapters.

CHAPTER 3

EMPIRICAL INVESTIGATION OF THE EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE AND MISALIGNMENT

3.1 INTRODUCTION

This chapter examines the extent of misalignment of the CFA francs (the real effective exchange rate - REER) in the CEMAC zone nations. The CEMAC zone nations being open emerging market economies, closely linked with global markets, the nations' economies are susceptible to external shocks and changes in the global trade patterns. Bases on the Behavioural Equilibrium Exchange Rate (BEER) framework of Clark and MacDonald (1998), this study uses a cointegration technique, which caters for endogeneity to estimate the equilibrium value of the CFA franc in each of the CEMAC nations. The study uses the Hodrick-Prescott (HP) filter to get the equilibrium real effective exchange rate (EREER). The difference between the REER and EREER is the exchange rate misalignment. The results are within the period 1980 to 2018, showing that prior to the 12th of January 1994 CFA francs devaluation, the currency experienced series of fluctuations between undervaluation and overvaluation. After the devaluation, the currency was undervalued, and thereafter it has been within its equilibrium. As of the year 2018, the currency was at equilibrium in all the CEMAC nations and should be of no concern to their monetary authorities.

The REER is among the most important categories in both macroeconomic and international economics analysis. The dynamic of the REER influences (and is in turn influenced by) the dynamics of both real and financial sectors of all economies. Empirically, the REER misalignments are purported to be the cause of the loss of competitiveness, growth slowdowns and currency crises in cases of overvaluation, an overheating and inflation in cases of undervaluation, sectoral misallocations of resources and global economic imbalances.

In the case of currency union which includes the sovereign nations, the dynamic of the REER takes on an additional importance. The divergent dynamic of the REER in the individual nations – both the actual and an equilibrium – will exacerbate both economic and political tensions and could result to the collapse of the monetary union and the underlying integration processes. This is because member of a currency union loose both the monetary policy to influence domestic economic dynamic and the nominal exchange rate as a tool for influencing unfavourable development vis-à-vis the rest of the global economy. This places an increasing burden on the remaining economic policy tools (which consist of both regulations in general and labour market

policies) and the fiscal policy.⁵⁰ In such circumstances, the individual governments try to influence the common monetary (and thus the exchange rate) policy in their favour. Because individual nations face different economic circumstances (and could have different economic preferences), attempting to influence the central monetary authority could result to rising tensions and disagreements between nations. This could eventually endanger the existence of the monetary union itself. Whether a currency union is in the process of increasing economic cohesion or an increasing divergence is an empirical question.

In entities like CFA francs - CEMAC (Economic and Monetary Community of Central Africa) zone, a degree of difference among member nations is natural. It is often because of different political, economic, and historical traditions, as they express themselves in differing labour markets, legal systems, social welfare, regulations, and economic policy institutions (Rusek, 2012). Get rid of these differences is often a very long-term process.⁵¹ The dynamics of the REER may indicate possible answers. Though the nominal exchange rate is same for all CEMAC zone nations, the real exchange rates could differ. This could be due to the differing dynamics of the unit of labour costs in the individual nations, and the different trade patterns generating different weights in the calculation of the “effective” real exchange rates. Although one would assume that as the CEMAC zone harmonisation increases (as it becomes a single economic area), the real effective exchange rate should also converge, and this process should be observed not only in the actual REER, but more importantly for their “equilibrium” values also.

The aim of this chapter is to determine the extent to which the CFA franc's REER is misaligned from its equilibrium level in the six CEMAC nations. This is achieved using the Behavioural Equilibrium Exchange Rate (BEER) framework of Clark and MacDonald (1998) to estimate the equilibrium value of the CFA franc consistent with economic fundamentals. The deviation of the observed exchange rate from this equilibrium level is interpreted as REER misalignment. Because the REER is seldom at equilibrium, we will assume it is at equilibrium when the differences between REER and EREER (misalignment) revolve around an absolute 5%. We use the Vector Autoregression (VAR) approach, which consists of the full-information maximum likelihood (FIML) method due to Johansen (1995).⁵² This econometrics methodology corrects

⁵⁰ *The use of microeconomic and fiscal policies to deal with unfavourable economic developments often lead to government unpopularity and increasing political and social tensions.*

⁵¹ *In the medium term, the cohesion processes are facilitated via removing the obstacles to the movements of goods and services and capital among the CEMAC member countries, by harmonisation of the good, services, capital, and labour market regulations among the member state (such as the implementation of OHADA laws).*

⁵² *MacDonald and Ricci (2003) used the Johansen FIML in estimating the equilibrium real exchange rate of South Africa. Eita and Sichei (2006) also used this approach to estimate the cointegration of Namibia.*

for autocorrelation and endogeneity parametrically using the vector error correction mechanism (VECM) specification.

The six CEMAC nations used are Cameroon, Central Africa Republic – CAR, Chad, Congo, Equatorial Guinea, and Gabon. The data used consist of the real effective exchange rate (REER) as the dependent variable, and the independent variables are government expenditure (or government debts - *GEXP*), terms of trade (*TOT*), net foreign assets (*NFA*), trade policy (proxy by openness - *OPEN*) and productivity differentials (*PROD*). The time series data used are secondary annual data from 1980 to 2018. This period enables us to observe the variables prior to the 1994 CFA franc devaluation, events during the devaluation, and the situation as of the year 2018. Data from 1980 to 2018 were available for Cameroon, CAR, and Gabon. The REER data for Equatorial Guinea was between the periods 1985 to 2018 because data prior to the year 1985 was not available. This dataset is good because it covers the entire period (before, during, and after the devaluation). Data for Chad and Congo (REER) are from 2004 to 2018. Though it will not be possible to know the situation of the exchange rate prior to the devaluation and immediately after the devaluation, it will tell us the present situation of the currency (i.e., is the currency at equilibrium or not). The rest of the chapter is as follows: section 3.2 deals with the equilibrium real effective exchange rate, section 3.3 focuses on the Behavioural Equilibrium Exchange Rate (BEER) approach, section 3.4 deals with the econometric approach, section 3.5 deals with the empirical result analysis, and section 3.6 is the conclusion of the chapter.

3.2 EQUILIBRIUM REAL EFFECTIVE EXCHANGE RATE:

The equilibrium REER is the relative price of tradable to non-tradable which for given (sustainable or equilibrium) values of other variables (like technology, international prices, trade taxes, capital and aid flow), results in the simultaneous achievement of both internal and external equilibrium (Edward, 1989; MacDonald and Clark, 1997). The internal equilibrium means that the market for non-tradable goods clears in the current period and is expected to be in equilibrium in future. This implies that there is no deviation from the natural rate of unemployment within the economy. While the external equilibrium is reached when the entirety of the present current account and the expected current account in the future satiates the intertemporal budget constraint; which states that the discounted value of the current account balances has to be equivalent to zero (Edward, 1989; MacDonald and Clark, 1997). That is, the current account balance (current and future) is compatible with long-run sustainable capital flows (Edward, 1989).

The present economic and econometric approaches for estimating the EREER generally follow one of these three basic analytical models developed in the economic literature. In a chronological perspective, the models are: Fundamental Equilibrium Exchange Rate (FEER) by

Williamson (1983), Natural Real Exchange Rate (NATREX) by Stein (1999), and Behavioural Equilibrium Exchange Rate (BEER) by Clark and MacDonald (1998). These models are presented in the literature survey chapter (section 2.3). The FEER model is derived from the standard economic assumption that the equilibrium REER is compatible to both the internal and external equilibria. In empirical work, the small multi-equilibrium macroeconomic model is specified and estimated using observed values of the relevant economic variables. The EREER is calculated using presumed long run (equilibrium) values of the economic variables. The degree of misalignment is calculated by comparing the actual REER with its calculated equilibrium value (that is the reason this approach is regarded as an equilibrium calculation and not equilibrium estimation). The FEER has been critique because; firstly, the use and the implied need to estimate that the multi-equation macroeconomic model introduces possible inconsistencies and thus biases into the values of estimated coefficients.⁵³ Secondly, the specification of both internal and external equilibria are often controversial.⁵⁴

The Natural Real Exchange Rate (NATREX) reflects an effort to address some of the shortcomings of the FEER approach whereby the internal equilibrium is preserved using the NAIRU concept. But the external is modelled as a dynamic interaction between the long-term values of domestic savings and investments, which determines the current account and thus the long-term capital flows. The long-term dynamic of domestic savings and investments is determined by economic fundamentals, while the short-term influences are excluded from the determination of the EREER. The NATREX approach of REER determination is regarded as “dynamic”, reflecting the long-term dynamics of domestic savings and investments. In the long-term domestic savings must equal domestic investments – the current account (i.e., the external position is balanced) (Rusek, 2012).

Both the FEER and the NATREX approaches define the EREER as one corresponding to some definition of the general macroeconomic equilibrium.⁵⁵ Contrarily to this is the Behavioural

⁵³ *This comes from the fact that the number of variables in even relatively small models is often large relative to the number of available observations. This makes the direct and consistent estimation of the multi-equation model unfeasible. Thus, the single equation estimations must be used, tying them together by methods like seemingly unrelated regressions and trying to restore the coefficient consistency with subsequent calibrations.*

⁵⁴ *Looking at the internal equilibrium, whereby the concepts such as output at its potential level or the Non-Accelerating Inflation Rate of Unemployment (NAIRU) level of unemployment are generally accepted as the internal equilibrium indicators. However, this view is often controversial mindful of the demographic and preference dynamic, changing work participation rates, changing retirement age etc. The external equilibrium is more disputed due to the unrealistic assumption of zero external balance in the medium term, given the domestic savings – investment nexus and the medium-term fiscal nexus. This assumption on the medium-term “external equilibrium” has strong normative elements which affects the calculation of the EREERs.*

⁵⁵ *Given its complexity and the simultaneous equations structure, the estimation of the NATREX models runs into similar difficulties as FEER approaches. To avoid some of the problems, most of empirical*

Equilibrium Exchange Rate (BEER) framework by Clark and MacDonald (1998), which view the equilibrium rate as one consistent with the prevailing level of economic fundamentals. The original BEER approach by Clark and MacDonald is not based on any specific exchange rate model, and as such could be regarded as a very general approach for modelling the equilibrium exchange rates. The BEER approach is often argued to have a number of advantages over the internal – external balance approaches (specifically the FEER). For instant, the FEER approach is a method of calculation rather than an estimated exchange rate model like the BEER approach. The BEER approach has the potential of capturing all the systematic and fundamental movements of the exchange rates and can be subject to rigorous statistical testing of various metrics, such as the speed of mean reversion. Also, the BEER is a highly tractable approach to gauging an equilibrium exchange rate, relying on a single equation approach using either time series or panel data. Contrarily, the FEER based estimate require the full-blown multi-nation macroeconomic model which could be cumbersome, though it has the advantages in terms of ensuring internal consistency of the estimates (MacDonald and Dias, 2007). Contrarily to the FEER approach, the BEER approach could produce measures of exchange rate misalignment that are free of any normative elements retaining to sustainability.

3.3 BEHAVIOURAL EQUILIBRIUM EXCHANGE RATE (BEER) APPROACH

The Behavioural Equilibrium Exchange Rate (BEER) approach by Clark and MacDonald (1998) will be used in estimating the equilibrium exchange rate for each of the CEMAC nations. The difference between the actual (prevailing) real effective exchange rate (REER) and the equilibrium real effective exchange rate (EREER or BEER) will let us know if the currency is misaligned or not. Depicting from Clark and MacDonald (1998) analysis, the exchange rate is characterised in terms of a dynamic reduced-form relationship that relates it to a set of independent variables (economic fundamentals).⁵⁶ The estimated reduced form equation is used in explaining the behaviour of the REER with the associated economic fundamentals as follows:

$$q_{it} = \beta'Z_{it} + \theta'T_{it} + \varepsilon_{it} \quad (3.1)$$

Whereby:

q_t is the observed actual real effective exchange rate in time t ($REER_t$).

research utilizing NATREX approach uses reduced form estimations. That of course raises both the question of a stability of estimated coefficients (given the long run dynamics of factors determining saving—investment nexus, the Lucas type critique is certainly possible) and value of fundamentals free of short term and cyclical variations.

⁵⁶ *These are variables having a direct impact on the exchange rate instead of using variables from a macroeconomic perspective.*

Z_t is a vector of the economic fundamentals expected to influence the REER in the medium-term to the long-term.⁵⁷

T_t is the vector of transitory factors affecting the REER in the short-term.

\mathcal{E} is the error term (random disturbance).

β and θ are the coefficients of the vectors.

Indices t and i refer to years and nations respectively.

Following Clark and MacDonald (1998), it is necessary to distinguish between the actual REER (q) and the current EREER q'_t . The q'_t value is when both the transitory and random terms are zero:

$$q'_t = \beta' Z_t \quad (3.2)$$

The related current misalignment, cm , is:

$$cm_t = q_t - q'_t = q_t - \beta' Z_{it} = \theta' T_t + \varepsilon_t \quad (3.3)$$

The cm is a sum of the transitory and random errors. Because the current values of the economic fundamentals could deviate from the sustainable (long-term) value, it is necessary to analyse the total misalignment (tm). The total misalignment is the deviation of the actual real effective exchange rate (REER) from the equilibrium real effective exchange rate (EREER).⁵⁸ For this to be estimated, Z is replaced with the equilibrium (long-term) values of the fundamentals \bar{Z} . That is, the total equilibrium exchange rate is estimated by filtering the fundamentals from speculative and cyclical factors. The calibration of the fundamentals at their desired level is attained by using a statistical filter such as Hodrick-Prescott (HP) filter⁵⁹, a Granger-Gonzalo decomposition or a Beveridge Nelson decomposition.

The Hodrick-Prescott (HP) filter with a smoothing factor of 100 is used to smooth the variables.⁶⁰

The HP filtering for the data is achieved by using Eviews12 econometric software application to

⁵⁷ The key term in the Z_t vector is often taken to be net foreign assets, terms of trade, and relative productivity to capture the long run related influences on the RER. While the real interest rate yields capture medium run or business cycle related influences on the RER.

⁵⁸ As earlier defined, the EREER is the level of the REER that is consistent with the long-term exchange rate fundamentals.

⁵⁹ Hodrick and Prescott (1997) introduced the Hodrick-Prescott filter. They applied the method to remove trends in the time series. In recent decades, in the research community of macro econometric time series analysis, we have seen growing interest in the Hodrick-Prescott (1997) filter. It is the most prominent smoothing method for economic time series, and recent studies of the filter include Phillips and Jin (2015), Hamilton (2018), Phillips and Shi (2019), Sakarya and de Jong (2019).

⁶⁰ The smoothing factor of 100 is what Hodrick and Prescott suggested for annual data. This smoothing method is defined by

HP: $\min_{x_1, \dots, x_T \in \mathbb{R}} \sum_{t=1}^T (y_t - x_t)^2 + \lambda \sum_{t=3}^T (\Delta^2 x_t)^2$

Whereby

get the sustainable or long-term equilibrium exchange rate (BEER or EREER). The difference between the REER and EREER (BEER) is the exchange rate misalignment. Thus, the total misalignment will encompass both the current misalignment and the misalignment between the actual and the long-term fundamentals:

$$tm_t = q_t - \beta' \bar{Z}_t \quad (3.4)$$

By adding and subtracting q'_t from the right-hand side of the above equation, the total misalignment could be decomposed into two components.

$$tm_t = (q_t - q'_t) + \beta'(Z_t - \bar{Z}_t) \quad (3.5)$$

Because $q_t - q'_t = \theta'T_t + \varepsilon_t$, the total misalignment in the above equation is re-written as:

$$tm_t = \theta'T_t + \varepsilon_t + \beta'(Z_t - \bar{Z}_t) \quad (3.6)$$

The above equation indicates that the total misalignment at any point in time could be decomposed into the effect of the transitory factors, the random disturbances, and the extent to which the economic fundamentals are away from their sustainable values. Different approaches to the EREER do not necessarily make this distinction explicit. For instant, the FEER approach focuses on the measures of total misalignment, while the Capital Enhanced Equilibrium Exchange Rate (CHEERS) approach focuses on the current misalignment.

Illustrating this approach, Clark and MacDonald (1998) took the risk adjusted real interest parity relationship, which has been used by numerous researchers to model equilibrium real exchange rates:

$$\Delta q_{t+k}^e = -(r_{t,t+k}^e - r_{t,t+k}^{*e}) + \lambda_t \quad (3.7)$$

Whereby: Δq_{t+k}^e is the difference between the RER expected in t for $t+k$ ($q_{t,t+k}^e$) and the observed RER in period t , q_t , where the latter is defined as the foreign currency price of a unit of domestic currency and a rise denotes an appreciation, $r_{t,t+k}^e$ is the ex-ante real interest rate ($r_{t,t+k}^e = i_t - \Delta p_{t+k}^e$). An asterisk denotes a foreign magnitude and λ_t is a measure of the risk premium, usually assumed to be a function of relative bond supplies. Equation (3.7) could be rearranged as an expression for the RER as:

$$q_t = q_{t,t+k}^e + (r_{t,t+k}^e - r_{t,t+k}^{*e}) - \lambda_t \quad (3.8)$$

If $q_{t,t+k}^e$ is interpreted as the 'long-term', systemic component of the RER, it could be assumed to be the outcome of the expected values of the fundamentals and could be replaced by \bar{q}_t as seen below:

$$q_t = \bar{q}_t - (r_{t,t+k}^e - r_{t,t+k}^{*e}) - \lambda_t \quad (3.9)$$

y_t, \dots, y_T denote T observations of an economic time series =, such as real exchange rate (RER), λ is a positive smoothing parameter that controls fidelity and smoothness, and Δ denotes a different operator such that $\Delta x_t = x_t - x_{t-1}$ and accordingly $\Delta^2 x_t = x_t - 2x_{t-1} + x_{t-2}$.

What determines \bar{q}_t ? Virtually all open economy macro models which have as their focus the long-term equilibrium effective exchange rate as a tie down condition that the current account be zero in equilibrium:

$$ca_t = tb_t + r_t^* nfa_t = 0, \quad (3.10)$$

or:

$$tb_t = -r_t^* nfa_t, \quad (3.11)$$

and that the RER will be more depreciated the larger is the steady state surplus:

$$q_t = -\alpha tb_t + BX_t, \quad (3.12)$$

Whereby X_t denotes other factors determining the RER. Equation (3.11) and (3.12) may then be used to solve for the REER as:

$$q_t = \alpha nfa_t + BX_t, \quad (3.13)$$

Where the RER is increasing in the net foreign asset position. This is the kind of relationship normally estimated in BEER type equations (MacDonald and Dias, 2007; Egert *et al.*, 2006; Clark and MacDonald, 1998).

Clark and MacDonald (1998) stipulate that the equilibrium RER is determined as a function of economic fundamentals.⁶¹ The *external RER fundamentals* are: i) international prices (terms of trade), ii) international transfers (openness), and iii) world real interest rates (net foreign assets). The *domestic or internal RER fundamental* is divided into variables that are policy-related and those that are independent of policy decisions. Policy-related RER fundamentals include i) import tariffs, export taxes, and quotas; ii) taxes and subsidies; iii) exchange and capital controls. iv) composition of government expenditure. We proxy all the policy-related variables as government expenditure. Among the non-policy fundamentals, technological progress is the most important (proxy as productivity differential). Thus, the fundamentals used in this research consist of government expenditure (or government debts - *GEXP*), terms of trade (*TOT*), net foreign assets (*NFA*), trade policy (proxy by openness - *OPEN*), and productivity differentials (*PROD*) Zhang (2010). The above-mentioned fundamentals are like those used by Clark and MacDonald (1998), which are:

⁶¹ Fundamental determinants of the equilibrium REER are those real variables that, in addition to the REER, play a significant role in determining a nation's internal and external equilibrium (Edwards, 1989). Empirical finding on the determinants of the exchange rate is vast and mixed. This is primarily due to the different time horizons considered and the methodologies applied in the studies (Komárek and Melecký, 2005). Some research works found that government expenditure, terms of trade, net foreign assets, trade policy, and productivity differentials were the most used variables (Edwards, 1989; Clark and MacDonald, 1998; Gala, 2008; Zhang, 2010; Di Nino *et al.*, 2011; Gluzmann *et al.*, 2012; Rapetti *et al.*, 2012). In addition, some other variables like investment and regulated prices, foreign debt, private expenditure, trade balance, and gross domestic production were at times used by some research work (Komárek and Melecký, 2005). Thus, the possible exchange rate determinants associated with the BEER approach are broad.

$$BEER = f[(r - r^*), tot, nfa, tnt, gdebt] \quad (3.14)$$

Whereby; $(r - r^*)$ is the interest rate differential, TOT is the term of trade, NFA is the net foreign assets, TNT is the tradable to non-tradable, and GDEBT is government expenditures.

The above equation (3.14) is similar to the internal and external equilibrium exchange rate determinant proposed by (Edwards, 1989) proxy as:

$$REER = f[TOT, NFA, GEXP, OPEN, PROD] \quad (3.15)$$

Based on the discussion above, we estimate the following econometric (empirical) model, which encompass all the variables:

$$REER_{it} = \alpha_0 + \alpha_1 TOT_{it} + \alpha_2 NFA_{it} + \alpha_3 GOVCON_{it} + \alpha_4 OPEN_{it} + \alpha_5 PROD_{it} + \varepsilon_{it} \quad (3.16)$$

Thus, the estimation of the BEER basically proceeds in four stages:

- 1) Estimating the statistical long-term relationship between the RER, the fundamentals, and the short-run variables, which is synonymous to estimating a reduced form RER model. This is often achieved using a VECM approach or a panel estimator.
- 2) Calculating the actual or current misalignment. The short-run variables are set to zero and the actual of fundamentals identified in step 1) are substituted into the estimated relationship. The actual misalignment is taken as the difference between the fitted and the actual value of the RER.
- 3) Identifying long-term or sustainable values for the fundamentals. This could be achieved by decomposing the series into permanent and transitory components (for example the HP filter or a Beveridge-Nelson decomposition) or using a subjective evaluation of the long-term values.
- 4) Calculate total misalignment. The long-term values of fundamentals are substituted into the estimated relationship, relating the RER to the fundamentals, and short-term variables are again set to zero. Total misalignment is the difference between the fitted and actual value of the RER when sustainable values of fundamentals are used. Total misalignment depends on the short-term effect and on the departure of fundamentals from their long-term value.

3.3.1 TYPES AND SOURCE OF DATA

This research deals with the CEMAC zone, which consists of six nations (Cameroon, Central Africa Republic – CAR, Chad, Congo, Equatorial Guinea, and Gabon). The time series data used are secondary annual data from 1980 to 2018. This period enables us to observe the variables prior to the 1994 devaluation, events during the devaluation, and the situation at present. The data collected were available until 2018 because data beyond that period were unavailable. Data within this period, 1980 to 2018, were available for Cameroon, CAR, and Gabon. The REER data of Equatorial Guinea is between the periods 1985 and 2018 because data prior to the year 1985 is not available. It is good because it covers the entire period (before,

during, and after - the present exchange rate). The data for Chad and Congo (REER) are from 2004 to 2018. Though it will not be possible to know the situation of the exchange rate prior to the devaluation and immediately after the devaluation, it will tell us the present situation of the currency (i.e., is the currency at equilibrium or not). Thus, this research question will deal with all six CEMAC nations, with the data of the variables and their sources explained below.

Real Effective Exchange Rate (REER) index:

This is the measure of the value of a nation's currency against a weighted average of foreign trade partners' currencies divided by a price deflator or index of costs. An increase in the REER implies that the nation's exports have become more expensive, and imports have become cheaper. This increase indicates a loss in the domestic nation's trade competitiveness. The reverse is true when the REER experiences a decrease. The REER movements based on different years can be interpreted differently. The primary criterion for a base year is that both internal and external equilibrium should be simultaneously met in the specific year. That is, the REER is assumed to be at both internal and external equilibrium when it has an index value of 100. If the value is above 100, the exchange rate is assumed to be overvalued, and if it is less than 100, it is assumed to be devalued. International financial organisations like the World Bank and IMF often publish the REER every ten years. The REER used in this research is the real effective exchange rate index for the base year 2010 = 100, with the data collected from the World Bank Development Indicator (WDI).

In this research, the REER "is the nominal index adjusted for relative changes in consumer prices. That is, the REER is the nominal effective exchange rate (NEER) index adjusted for relative movements in the national price or cost indicators of the home country, selected countries, and the euro area (expressed on the base year 2010 = 100) (World Bank, 2020)". An increase in the REER above the base year '100' represents an appreciation of the local currency, while a decrease represents a depreciation of the local currency. The data for all the CEMAC nations but for Chad and Congo were collected from the World Bank - World Development Indicators (WDI) database, last updated on 18/03/2020. The data for Chad is from Knoema ([Sub-Saharan Africa: Regional Economic Outlook \(AFRREO\), October 2019](#)). Data for Congo is from FRED Graph Observations (Federal Reserve Economic Data - Federal Reserve Bank of St. Louis, USA), updated on 21/10/2019.

Terms of Trade (TOT):

TOT measures how much-imported products a nation could get for a unit of exported products (Reinsdorf, 2009). The TOT is measured as - the ratio of the price of export to the price of import

(Coleman, 2008; Elbadawi, 1994; Edwards, 1989). In the real world, where nations export and import large amounts of goods, the TOT is computed as:

$$TOT = \frac{\text{Index of export prices}}{\text{Index of import prices}} \times 100$$

A rise of the TOT above 100 means it is improving, while a fall of the TOT below 100 means it is worsening. The TOT could also be expressed in terms of the number 1, with a figure above 1 indicating an improvement. While a figure below 1 indicates a worsening of the TOT. Improvement in a nation's TOT means that a unit of its exports sold can buy more units of the import products. A rise in the TOT creates benefits for a nation as few of its products chase more foreign products (i.e., an appreciation of the nation's exchange rate). However, a nation could suffer in terms of a fall in its export volume and a worsening of the balance of payments (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). A worsening of the TOT indicates that a nation export more of its products to import a given quantity of imports. That is the nation's exchange rate has depreciated and has a competitive advantage, mindful of the products exported. If the exported products are manufactured, then the competitive effect could have a positive impact on the nation's current account. However, suppose the nation's exports are mainly primary commodities that are sticky. In that case, a decline in the TOT or exchange rate depreciation worsens the nation's current account.⁶² Several empirical studies found that improvement in the TOT tends to appreciate the REER (Clark and MacDonald, 1999; De Gregorio and Wolf, 1994).

In this research, the TOT is the ratio of the export and import price index. $TOT = [(\text{Export value index (2000 = 100)} / \text{Import value index (2000 = 100)}) \times 100]$. The export values index is the current value of exports converted to U.S. dollars and expressed as a percentage of the average for the base period (2000). Import value indexes are the current value of imports converted to U.S. dollars and expressed as a percentage of the average for the base period (2000) (World Bank, 2020). They are multiplied by 100 such that values greater than 100 means the TOT is improving, while a value below 100 means that it is worsening. The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Net Foreign Assets (NFA):

⁶² TOT influence on the REER is in both income and substitution effects. If the substitution effect of TOT improvement on the demand and supply side dominates the income effect, it causes real exchange rate depreciation (positive). On the contrary, the improvement in the TOT increases the national income in terms of imported products, which could increase demand for tradable goods, causing a positive wealth effect and an appreciation in currency (negative effect) (Paya et al., 2003).

This is the value of assets owned by a nation abroad, less the value of domestic assets owned by foreigners. The *NFA* position of a nation is also defined as the cumulative change in its current account, which is the sum of the balance of trade, net current transfers over time, and net income over time (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). A nation's *NFA* position indicates whether it is a net debtor or creditor to the rest of the world. A negative *NFA* implies a net borrower, while a positive *NFA* shows that it is a net lender. The *NFA* position of a nation reflects the indebtedness of the nation.

$$NFA = \frac{\text{Net Foreign Asset}}{GDP}$$

The *NFA* position could drive changes in a nation's exchange rate because chronic current account deficits could prove unsustainable over time. A nation having a significant negative *NFA* position, and a growing current account deficit could get under attack from currency speculators seeking to drive it lower. At the same token, the exchange rate fluctuation could also have an impact on the *NFA* position. The depreciation of the nation's currency against those of other nations will increase the value of foreign currency-dominated assets and liabilities, while appreciation will decrease the value of the overseas assets and liabilities. Hence, if a nation is a net debtor, a currency depreciation will augment its foreign currency debt burden.

In this research, the *NFA* is the ratio of the net foreign assets to the gross domestic product (GDP) denominated in local currency (LCU). $NFA = (NFA \text{ current LCU} / GDP \text{ current LCU})$. *NFA* is the sum of foreign assets held by monetary authorities and deposit money banks, less their foreign liabilities. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (World Bank, 2020). The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Degree of Openness (OPEN):

OPEN measures the extent to which a nation depends on trade with other nations. That is, the degree to which non-domestic transactions (imports and exports) take place and affect the growth and size of a nation (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). The *OPEN* is measured by the actual size of all registered imports and exports within a nation. Thus, it is the ratio of the sum of imports and exports of goods and services to GDP.

The openness index is an economic metric calculated as the ratio of a nation's trade, the sum of exports plus imports, to the nation's gross domestic product:

$$OPEN = \frac{\text{Export} + \text{Import}}{GDP}$$

The liaison between trade openness and REER is that when a REER appreciates, the domestic products become more expensive for the rest of the world, and their demand, therefore,

decreases. On the other hand, an appreciated exchange rate makes foreign tradable products cheaper, thereby increasing imports unless the government raises their cost via tariffs or quotas. It is argued that trade liberalization leads to the depreciation of the REER (Gantman and Dabós, 2018; Dornbusch, 1974). A reduction in import tariffs leads to an imbalance in a nation's current account, which is due to the increasing demand for imports. As such, the need for the real exchange rate to depreciate is induced, with the intention to redress the current account deficit (making domestic products competitive).

Studies on the relationship between trade openness and REER found that import taxes (protectionism) appreciated the REER in a sample of Latin American nations, thereby supporting the hypothesis that trade liberalisation produces depreciation of the REER (Yusoff and Febrina, 2014; Zakaria and Ghauri, 2011; Li, 2004; Deveraux and Connolly, 1996). This is so because most developing nations import machinery and technological imports for their production process. An increase in the price of imported input via taxation causes the cost of production to increase, leading to an increase in the price of the final products. These products become more expensive and less competitive in the international market.

In this research, OPEN is the sum of exports and imports of goods and services as a percentage of GDP. $OPEN = [\text{Exports of goods and services (\% of GDP)} + \text{Imports of goods and services (\% of GDP)}]$. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. Imports of goods and services represent the value of all goods and other market services from the rest of the world. They include the value of merchandise and other services (World Bank, 2020). The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Government Consumption (GOVCON):

It is the purchase of goods and services, which includes public investment, public consumption, and transfer payments consisting of capital transfers and income transfers. A government spends money on the supply of goods and services that the private sector does not provide but are important for the nation's welfare. Government spending is done on infrastructure, health, welfare benefits, and national defence. Also, the government subsidises industries that cannot propel their operation with private sector funding, like agriculture or transportation. The total government expenditure is necessary for the economic activity of a nation. It affects the rate of economic growth and the level of production in the private sector. Thus, GOVCON is a ratio of GOVCON as a share of GDP:

$$GOVCON = \frac{GOVK}{GDP}$$

The volume and composition of government spending affects the value of the REER; depends on if the purchases are mainly in tradable or non-tradable products. In case government expenditures are mainly on non-tradable products, it could be associated with overvaluation. On the other hand, if government purchases are mainly on tradable products, this could lead to the deterioration of the trade balance due to increased imports, resulting to an underestimation of the REER (Cakrani *et al.*, 2013). Thus, the impact of government spending on the REER is unclear. This view is supported by empirical studies that showed that government expenditure could be associated with either overvaluation or undervaluation. In one of the studies, Edwards (1989) found that an increase in government spending induced the appreciation of the REER in 12 developing nations. On the other hand, Ravn *et al.* (2012, 2007) found that an increase in government spending led to the expansion in output and private consumption, a trade balance deterioration, and depreciation of the REER.

In this research, GOVCON is the general government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defence and security but excludes government military expenditures that are part of government capital formation. $GOVCON = [\text{General Government Final Consumption Expenditure (\% of GDP)}]$. The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Productivity Differentials (PROD):

According to the Balassa-Samuelson effect, a key explanatory factor of the REER is the difference in productivity. It is argued that because there is a productivity gap between high- and low-income nations and assume that differences in labour productivity are higher in tradable than non-tradable goods sectors, the REER in richer nations will be overvalued. Low profitability, low investment, and lack of technological enhancements prevents firms in developing nations from producing high-value-added and high-quality goods. This explains the inability of developing nations to improve their export performance and access new markets. As such, depreciation become the second-best option to improve their competitiveness in the international markets (Rodrik, 2008). Thus, low productivity leads to the REER devaluation and high productivity results in REER overvaluation.

In this research, PROD is proxy by GDP per capita (current US\$). GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of

fabricated assets or for depletion and degradation of natural resources (World Bank, 2020). Data are in current U.S. dollars and the data is from the World Banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

3.4 ECONOMETRIC APPROACH

In economics, it is always good to get the long-run relationship between variables to be better prepared on how to make both political and economic projections, as well as to know the various macroeconomic policies to be put in place to achieve the objectives (Gujarati, 2009). For this to be achieved, it is essential to perform a cointegration test. It is a test to verify that variables used in a model have a long-run and short-run relationship among themselves (Maddala, 2001). Different approaches could be used to determine the nature of the relationship between variables in a model, such as Vector Autoregression (VAR) or the Autoregressive Distributed Lag (ARDL) of Pesaran *et al.* (2001). The integration level of the variables determines the appropriate approach. The VAR approach is used when all the variables in the models are integrated of order one (i.e., the variables become stationary at the first difference - $I(1)$). On the other hand, the ARDL approach can be applied irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$) or integrated of order one (i.e., the variables become stationary at first difference - $I(1)$). However, the variables must not be integrated of order two (i.e., the variables are stationary at second difference – $I(2)$).

Based on the classical works of Clark and MacDonald (2004,1998), this study uses the Vector Autoregression (VAR) approach, which consists of the full-information maximum likelihood (FIML) method due to Johansen (1995).⁶³ This econometrics methodology corrects for autocorrelation and endogeneity parametrically using the vector error correction mechanism (VECM) specification. The estimation procedure for the VAR method entails the following steps:⁶⁴

The step to estimate the VAR method using EViews 12 are as following:

- 1) Perform some Diagnostic Test:
- 2) All series must be stationary at $I(1)$ and not at $I(2)$ - unit root tests.
- 3) Determine the optimal lag length (p) using the information criterion.
- 4) Perform the Johansen cointegration test by inputting the lag length (p) into the Johansen model.
 - a.) If there is no cointegration, the unrestricted VAR model (basic VAR) is estimated.

⁶³ MacDonald and Ricci (2003) used the Johansen FIML in estimating the equilibrium real exchange rate of South Africa. Eita and Sichei (2006) also used this approach to estimate the cointegration of Namibia

⁶⁴ This is done after the data are imported from Microsoft Excel to EViews12 econometric software application.

b.) If there is cointegration, the VECM with $(p-1)$ lag is specified. As such, (step a) above is skip.

5) Perform Stability Test by applying (*CUSUM and CUSUMQ graph*).

3.4.1 DIAGNOSTIC TESTS

To assess the reliability of the results, several diagnostic tests will be performed. The three main tests done are: VEC residual normality test, VEC residual heteroscedasticity test, VEC residual serial correlation (Autocorrelation) test. These tests will be performed on EViews 12, and the normality test result is composed of the results for Skewness, Kurtosis, and Jarque-Bera. We are interested in the Jarque-Bera test because it factors in both the Skewness, and Kurtosis in its computation. If the p -value > 0.05 , it implies that the residuals are normally distributed, and vice versa if the p -value < 0.05 . The p -value of both the heteroscedasticity test and the serial correlation test must also be greater than 5% for the model to be good.

Normality Test: The normality test allows us to determine if the data is normal or not. The normality test is a test for the normality of data (i.e., it is a specific statistical distribution called a normal distribution or Gaussian distribution or bell-shaped curve). The normal distribution is a symmetrical continuous distribution defined by the mean and standard deviation of the data. The normality test is not whether the data is exactly consistent with a normal distribution, rather if the data is close enough to normal that one could use statistical tools without concern. The normality test is a hypothesis test whereby:

Null hypothesis (H_0): the data is not different from a normal distribution and the p -value > 0.05 (i.e., the residual of the components is normally distributed).

Alternative hypothesis (H_1): the data is different from a normal distribution and the p -value < 0.05 (i.e., the residual of the components is not normally distributed).

Using EViews 12, the normality test result is composed of the results for Skewness, Kurtosis, and Jarque-Bera. We are interested in the Jarque-Bera (JB) test because it factors in both the Skewness, and Kurtosis in its computation.⁶⁵ If the p -value > 0.05 , it implies that the residuals are normally distributed, and vice versa if the p -value < 0.05 .

⁶⁵ In statistics, the Jarque-Bera is a goodness-of-fit test of whether a sample data has a skewness and kurtosis matching a normal distribution. This test is always non-negative, far from zero and it signals that the data do not have a normal distribution (Jarque and Bera, 1987). The JB test statistic is defined as:

$$JB = \frac{n}{6} \left(S^2 + \frac{1}{4} (K - 3)^2 \right)$$

Whereby

n is the number of observations (degree of freedom in general),

S is the sample skewness

K is the sample kurtosis:

Serial Correlation Test: Also known as autocorrelation test, is a test to measure the relationship between a variable's present value and any past values. In other words, it is a test to ensure that the past values of a time series do not influence the present value. Autocorrelation is an ideal method for uncovering trends and patterns in time series data that would have otherwise gone undiscovered. As such, this might cause our analysis to be biased since the time series is not independent, as errors in one period depend on an error in the previous period(s). Autocorrelation could often be removed by adding additional explanatory (independent) variables and/or changing functional form.

The null hypothesis (H0): there is no autocorrelation in the data, and the p -value > 0.05 .

The alternative hypothesis (H1): there is autocorrelation in the data, and the p -value < 0.05 .

In this research, the Breusch-Godfrey serial correlation Lagrange multiplier (LM) test will be used in EViews 12 to investigate the presence of autocorrelation in the time series.⁶⁶ This is a chi-squared test: if the test statistic has a p -value > 0.05 (observed R^2), the model is said to have no autocorrelation and vice versa.

$$S = \frac{\hat{u}_3}{\hat{\sigma}^3} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^3}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \right)^{3/2}},$$

$$K = \frac{\hat{u}_4}{\hat{\sigma}^4} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^4}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \right)^2},$$

Whereby, \hat{u}_3 and \hat{u}_4 are the estimates of third and fourth central moments, respectively.

\bar{x} is the sample mean, and $\hat{\sigma}^2$ is the estimate of the second central moment, the variance. In case the data is from a normal distribution, the *JB* statistic asymptotically has a chi-squared distribution with two degree of freedom. The statistic could be used to test the hypothesis that the data are from a normal distribution. The null hypothesis is a joint hypothesis of the skewness being zero and the excess kurtosis being zero. Thus, samples from a normal distribution have an expected skewness of 0 and an expected excess kurtosis of 0 (which is same as a kurtosis of 3). As stated by *JB* definition, any deviation from this increases the *JB* statistic.

⁶⁶ The Breusch-Godfrey (BG) test is often used to test for the presence if serial correlation that has not been included in a proposed model structure, which if present could imply that incorrect conclusions could be drawn from other tests or that sub-optimal estimates of model parameters could be obtained.

We consider the linear regression:

$$Y_t = \beta_1 + \beta_2 X_{t,1} + \beta_3 X_{t,2} + \mu_t$$

Where the errors might follow an $AR(\rho)$ autoregressive scheme, as follows:

$$\mu_t = \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \dots + \rho_p \mu_{t-p} + \varepsilon_t.$$

The simple regression model is first fitted by ordinary least squares to obtain a set of sample residuals $\hat{\mu}_t$.

If the following auxiliary regression model is fitted:

$$\hat{\mu}_t = \alpha_0 + \alpha_1 X_{t,1} + \alpha_2 X_{t,2} + \rho_1 \hat{\mu}_{t-1} + \rho_2 \hat{\mu}_{t-2} + \dots + \rho_p \hat{\mu}_{t-p} + \varepsilon_t$$

and if the usual R^2 statistic is calculated for the model, with the following asymptotic approximation could be used for the distribution of the test statistic

$$nR^2 \sim \chi_p^2,$$

when the null hypothesis $H_0 : \{\rho_i = 0 \text{ for all } i\}$ holds (i.e., there is no serial correlation of any order up to ρ). Thus, n is the number of data-points available for the second regression, that for $\hat{\mu}_t$,

$$n = T - \rho,$$

whereby T is the number of observations in the basic series. The value of n depends on the number of lags of the error term (ρ).

Heteroscedasticity Test: The opposite, being homoscedasticity – is used in statistics, especially in the context of linear regression or for time series analysis, to describe the case where the variance of errors or the model is not the same for all observations. One of the basic assumptions in modelling is that the variances are homogeneous and that the error of the model is identically distributed. In linear regression analysis, the fact that the error of the model (also named residuals) is not homoscedastic has the consequence that the model coefficients estimated using ordinary least squares (OLS) are neither unbiased nor those with minimum variance. The estimation of their variance is not reliable. If suspected that the variances are not homogeneous (a representation of the residuals against the explanatory variables may reveal heteroscedasticity). As such, it is imperative to perform a test for heteroscedasticity with the following null and alternative hypotheses:

The null hypothesis (H0): there is no heteroscedasticity (residuals are homoscedastic), and the p -value > 0.05 .

The alternative hypothesis (H1): there is heteroscedasticity in the data, and the p -value < 0.05 .

In statistics, the Breusch-Pagan is used to test for heteroskedasticity in a linear regression model. It tests if the variance of the errors from a regression is dependent on the values of independent variables.⁶⁷

3.4.2 TEST FOR STATIONARITY (UNIT ROOT TEST)

Stationarity of a series (i.e., a variable) implies that its mean, variance, and covariance are constant over time. This means that the series is *time-invariant*. However, if this is not the case, it means that the series is non-stationary. A non-stationary variable has a definite positive or negative trend over time and is said to have a unit root. To see why consider a variable whose time series is represented by a first-order, autoregressive scheme, AR (1) for short, i.e.

$$Y_t = \alpha Y_{t-1} + \varepsilon_t \quad (3.17)$$

where ε_t is a standard normal variable.

If α is less than one, then the time path is stationary, i.e., although it will fluctuate, the value of Y_t will tend to keep coming back to its mean value. Graphically, the time path of Y_t will have no

⁶⁷ We can fit a three-variable multiple linear regression with formula $\hat{y}_i = \hat{\beta}_0 x_{1i} + \hat{\beta}_2 x_{2i}$ we obtain regression residuals \hat{e}_i with formula $\hat{e}_i = y_i - \hat{y}_i$ are the estimated differences between actual y_i and fitted \hat{y}_i values. The Breusch-Pagan test auxiliary regression with formula $\hat{e}_i^2 = \hat{\gamma}_0 + \hat{\gamma}_1 x_{1i} + \hat{\gamma}_2 x_{2i}$. The *chi-square test* with joint null hypothesis that independent variables coefficients are equal to zero with formula $H_0: \hat{\gamma}_1 = \hat{\gamma}_2 = 0$. If joint null hypothesis is rejected, then regression errors are assumed heteroskedastic.

upward or downward trend, and the fluctuations around the constant mean value will be contained within constant bounds.

However, if α is equal to one, the time path of Y_t is non-stationary, and it will have an upward trend. As α is known as the root of the process, non-stationarity implies having a unit root. A time series is a level series if it does not have unit root (stationary or no random walk). A non-stationarity variable could be made stationary by differencing. This removes the trend in the series, taking the first difference:

$$\Delta Y_t = Y_t - Y_{t-1}.$$

Annual data's (such as exchange rate) first difference are always stationary and are said to be integrated of order 1 to make it stationary and is written as $I(1)$. In case it is still not stationary after the first difference, it will have to be difference twice to make it stationary, i.e., Y_t and ΔY_t are non-stationary, but $\Delta^2 Y_t$ is stationary. In this case, Y_t is said to be integrated of order 2, written $I(2)$.

There exist different ways of testing for stationarity:

- a) Informal testing (time plot): Plotting of the series on a graph to visualise its nature. If the graph shows trends, it could mean that the series has unit root and vice versa.
- b) Formal test: in order to examine the existence of unit root, we shall apply the following test:
 - The Augmented Dickey-Fuller '*ADF*' test.
 - Philips-Perron '*PP*' test.

Perform an ADF Test

To test a variable Y_t for a unit root the following regression equation is estimated:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \alpha_2 Y_{t-1} + \log \Delta Y_t + \varepsilon_t \quad (3.18)$$

i.e., the first difference of Y_t is regressed against a constant, a time trend ($t = 1, 2, \dots, T$), the first lag of Y_t , and, if necessary, lags of ΔY_t . Sufficient lags of ΔY_t must be included to ensure no autocorrelation in the error term. One lag (or even no lag) is usually sufficient with annual data. The test for a unit root, i.e., non-stationarity, is based on the t-stat on the coefficient of the lagged dependent variable, Y_{t-1} .

In the unit root test, both the null and alternative hypotheses are expressed as:

Null Hypothesis (H_0): series has unit root (i.e., if the p -value > 0.05).

Alternative Hypothesis (H_1): series does not have unit root (i.e., if p -value < 0.05).

The null hypothesis is rejected (i.e., the series does not have unit root) if the absolute value of the computed *ADF* and/or *PP* test statistic is greater than the test critical values. That is, when the probability value is less than 0.05 (p -value < 0.05), the model is stationary, and as such, the

null hypothesis is rejected (while the alternative hypothesis is accepted). However, if the *ADF* and/or *PP* are less than the test critical value (i.e., if the *p*-value > 0.05), it means that the model has unit root, and the null hypothesis is not rejected. The series should be difference to remove the unit root.

3.4.3 DETERMINE OPTIMAL LAG LENGTH

In economics, the dependence of a variable **Y** on another variable **X** is rarely instantaneous. That is, most often, the dependent variable **Y** responds to the independent variable **X** with a time-lapse. Such a lapse of time is referred to as a lag. This means that **Y** does not respond to **X** immediately. Thus, there is a lag in the response time. We need to be careful about the number of lags we put in our model because too many lags often lead to a loss of degree of freedom. It could also cause multicollinearity among the regressors; it could lead to serial correlation in the error terms and misspecification error. On the other hand, too few lags could result in specification errors.

Hence, the number of lags used in a model is empirical. Most often, the number of lags for annual data is typically small (1 or 2), for quarterly data (1 to 8 lags is appropriate), and for monthly data (6, 12, or 24 lags if there are sufficient data points). The optimal lags can be chosen using the following information criterion: Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ). The asterisk (*) on the values indicates the lag order selected by the information criterion, and the criterion with the lowest * value's lag length is chosen as the optimal lag length.

3.4.4 COINTEGRATION TEST

In this chapter, we used Johansen's cointegration test (1988, 1995), which allows us to determine the number of long-run equilibrium relationships between integrated variables of the same order. That is, the variables are all integrated in order one (**I(1)**). Johansen proposed two likelihood ratio tests, which represent the key statistics for testing for cointegration. These tests are the Trace statistic and the Maximum eigenvalue statistic. Johansen (1995) explains that the tests have optimal sequence starting with the null hypothesis $r = 0$ (no cointegration) against the alternative $r \leq 1$ (at least one cointegrating vector) and subsequent further order of cointegration $r = i$ against the alternative $r \leq i + 1$; the sequence stops at $r = i$ when the null cannot be rejected. These tests could be written as follows:

- The trace statistic tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors given by:

$$\lambda_{trace} = -T \sum_{i=r+1}^n (1 - \lambda_i)$$

Whereby T is the sample size and λ_i is the i -th largest canonical correlation.

- The Maximum eigenvalue tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of $r + 1$ cointegrating vectors:

$$\lambda_{max} = -T(1 - \lambda_t)$$

Thus, the Johansen cointegration test consists of detecting the number of cointegrating vectors between the dependent variable (REER) and the independent variables using statistical values like “Maximum Eigenvalue and/or Trace statistics.” If there exists a long-term relationship between the variables in the model, they are said to be cointegrated. Using the Johansen cointegration test in Eviews12, the Null and Alternative hypotheses are:

H_0 : no cointegrating equation, (i.e., p -value > 0.5)

H_1 : cointegrating equation, (i.e., p -value < 0.5) (H_0 is not true).

Decision criteria

Rejection at 5% level.

The null hypothesis is rejected if the value of the Trace statistic and Maximum Eigenvalue statistics are greater than that of the 5% critical value and the p -value < 0.05 . That is, there is cointegration, or there exists a long-term relationship among the variables in the model, and the alternative hypothesis is selected. Otherwise, the null hypothesis is not rejected, meaning that there is no long-term relationship among the variables used in the model.

In case the series are cointegrated, it means they exhibit a long-term relationship. That is, even if there were shocks in the short-term that may affect movement in individual series, they will, with time (in the long-term), converge (get back to the equilibrium). Hence, estimate both short-term and long-term models. The appropriate estimation techniques are the vector autoregressive (VAR) and vector error correction models (VECM). If series are cointegrated, the restricted VAR (vector error correction model – VECM) is used. Whereas, if the series is not cointegrated (that is, they do not exhibit a long-term relationship), the unrestricted VAR model will be used and not the VECM.

The unrestricted VAR shows the relationship between the variables in the short term. That is, it shows the short-term response of the REER to changes or shocks in the independent variables and does not deal with the long-term relationship, as seen below.

$$y_t = \alpha_0 + \sum_{i=1}^k \alpha_1 y_{t-i} + \sum_{i=1}^k \alpha_2 z_{t-i} + \sum_{i=1}^k \alpha_3 x_{t-i} + \sum_{i=1}^k \alpha_4 m_{t-i} + \sum_{i=1}^k \alpha_5 n_{t-i} + \sum_{i=1}^k \alpha_6 q_{t-i} + \varepsilon_t \quad (3.19)$$

Whereby the dependent variable (y) is a function of its lagged and the lagged values of other variables (independent) in the model. The VAR must be specified in level because VAR in

differences will be mis-specified. ε is the stochastic error term also called impulse, or innovation, or shock.

However, if the outcome of the Johansen cointegration test reveals that there is cointegration, we proceed to the restricted VAR (VECM). The result of the VECM consists of the estimates of both short-term and long-term dynamics of the time series, taking into consideration the coefficient of the error correction term (ECT). When specifying the VECM, we lose a lag because a VECM is the same as VAR in 1st difference as seen below:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{k-1} \alpha_1 \Delta y_{t-i} + \sum_{i=1}^{k-1} \alpha_2 \Delta z_{t-i} + \sum_{i=1}^{k-1} \alpha_3 \Delta x_{t-i} + \sum_{i=1}^{k-1} \alpha_4 \Delta m_{t-i} + \sum_{i=1}^{k-1} \alpha_5 \Delta n_{t-i} + \sum_{i=1}^{k-1} \alpha_6 \Delta q_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (3.20)$$

Whereby:

$$ECT_{t-1} = y_{t-1} - \alpha_2 z_{t-1} - \alpha_3 x_{t-1} - \alpha_4 m_{t-1} - \alpha_5 n_{t-1} - \alpha_6 q_{t-1} \quad (3.21)$$

The above equation for ECT_{t-1} , represents the cointegrating equation and long-run model.

Whereby:

$[\alpha_0 + \sum_{i=1}^{k-1} \alpha_1 \Delta y_{t-i} + \sum_{i=1}^{k-1} \alpha_2 \Delta z_{t-i} + \sum_{i=1}^{k-1} \alpha_3 \Delta x_{t-i} + \sum_{i=1}^{k-1} \alpha_4 \Delta m_{t-i} + \sum_{i=1}^{k-1} \alpha_5 \Delta n_{t-i} + \sum_{i=1}^{k-1} \alpha_6 \Delta q_{t-i}]$ is the short-term dynamic of the relationship between y_t and the independent variables. The second section of the equation represents the cointegration, that is the long-term information presented as $[-\lambda(y_{t-1} - \alpha_2 z_{t-1} - \alpha_3 x_{t-1} - \alpha_4 m_{t-1} - \alpha_5 n_{t-1} - \alpha_6 q_{t-1}) - \varepsilon_t]$. While λ is the speed of adjustment between the short term and the long-term, bearing a negative sign due to the convergence of y_t to the equilibrium after a short-term shock of the independent variables. ε_t is the white-noise term. The restricted VAR (i.e., vector error correction model – VECM) is applied if there exists a long-term relationship among the variables in the model. While the unrestricted VAR approach is used if there exists no long-term relationship (i.e., no cointegration).

The coefficient of ECT (λ) is the speed at which the dependent variable returns to equilibrium after a change in other variables. For a variable to converge back in the long-run, the coefficient of the ECT must be negative and statistically significant (i.e., the t -stats $\geq |2|$). This will imply that any shock happening in the short-term will be correct in the long-term as the variable converges to the equilibrium. The long-run model shows the long-run relationship among the variables (i.e., it shows how the dependent variable will in the long-term respond to the independent variables). The short-term model shows the short-term relationship among the variables (i.e., it shows how the dependent variable responds to changes in the independent variables in the short-term).

3.4.5 STABILITY TESTS

We check if the estimated regression equations are stable throughout the sample period of the study. Parameter stability tests play a vital role in ensuring the reliability of policy simulation based on the model. To test for stability following Bahmani-Oskooee and Goswami (2003), we apply the cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The advantage of this approach is that it selects the breakpoints recursively rather than arbitrarily. As per the CUSUM test, the recursive residuals are plotted against the breakpoints, while the CUSUMSQ plots the squared recursive residuals against the breakpoints. As a graphical illustration, these two statistics are then plotted with two straight lines which are bounded by a 5% significance level. If any point lay beyond the 5% significance level, the null hypothesis of stable parameters is rejected.⁶⁸

3.4.6 EQUILIBRIUM EXCHANGE RATE AND MISALIGNMENT

The equilibrium real effective exchange rate (EREER) is the rate that is consistent with its fundamental variables in the long term. The EREER is obtained by imposing the coefficients of the long-term equation on the permanent values of the fundamentals. The Hodrick-Prescott filter with a smoothing factor of 100 is used to smooth the variables using Eviews12 econometric software application.⁶⁹ The EREER is obtained from the REER (i.e., actual REER), and the difference between them is the misalignment.

⁶⁸ The CUSUM charts are constructed by calculating and plotting a cumulative sum based on the data. Let X_1, X_2, \dots, X_n represent n^{th} data points. From this, the sums S_0, S_1, \dots, S_n are calculated. The n data points lead to $n + 1$ (0 through n) sums. The cumulative sums are calculated as follows: Calculate the average:

$$\bar{X} = \frac{X_1 + X_2 + \dots + X_n}{n}$$

Start the cumulative sum at zero by setting $S_0 = 0$.

Calculate the other cumulative sums by adding the difference between the current value and the average to the previous sum, i.e.:

$$S_i = S_{i-1} + (X_i - \bar{X})$$

For $i = 1, 2, \dots, n$.

The cumulative sum is not the cumulative sum of the values. Rather, it is the cumulative sum differences between the value and the average. Because the average is subtracted from each value, the cumulative sum also ends at zero ($S_{24} = 0$). The CUSUM chart will then be interpreted as follows: the section on the CUSUM chart with an upward slope indicates the period the value is above average and vice versa.

⁶⁹ Let's suppose that the original time series $(y_t)_{t=0}^T$ is composed of a trend component T_t and a cyclical component c_t . That is,

$$y_t = T_t + c_t$$

the HP-filter isolates the cycle component by following minimization problem.

$$\min_{T_1, \dots, T_T} \sum_{t=1}^T (y_t - T_t)^2 + \lambda \sum_{t=2}^{T-1} [(T_{t+1} - T_t)(T_t - T_{t-1})]^2$$

Whereby λ is a positive smoothing parameter that penalizes variability in the trend. The unique solution to the minimization problem is:

$$\hat{T} = (I_T + \lambda F)^{-1} y$$

Where I_T is an $T \times T$ identity matrix and F is the pentadiagonal $T \times T$ matrix.

$$\text{Misalignment} = \text{REER} - \text{EREER}.$$

If the EREER is greater than the REER, the currency is said to be undervalued. If the EREER is less than the REER, the currency is said to be overvalued. Also, the REER could revolve around the EREER, meaning that the currency is around its equilibrium. When plotted on a graph, if the REER is above the EREER, it is assumed that the exchange rate is overvalued. When the REER is below the EREER, it is assumed to be undervalued. It is explained when the extracted misalignment is plotted on a graph. When the misalignment graph is above the zero line, it means overvaluation. When the graph is below the zero line, it means undervaluation. However, when it rotates around the zero line, it is assumed to be around its equilibrium. Because the REER is seldom at equilibrium, we will assume it is at equilibrium when the differences between REER and EREER (misalignment) revolve around an absolute 5%. Thus, this graphical representation shows the behaviour (movement) of the exchange rate throughout the estimation period.

3.5 EMPIRICAL RESULTS ANALYSIS

We determine the long-term relationship between RER and its fundamentals, as well as the degree of misalignment based on the analysis of Clark and MacDonald (1998). Because the CEMAC nations are small open developing economies, this study specifies the single equation for developing economies. The Vector Autoregression (VAR) approach - the full-information maximum likelihood (FIML) method due to Johansen (1995) will be used as discussed above. We estimate the following econometric (empirical) model, which encompasses all the variables:

$$\text{REER}_{it} = \alpha_0 + \alpha_1 \text{TOT}_{it} + \alpha_2 \text{NFA}_{it} + \alpha_3 \text{GOVCON}_{it} + \alpha_4 \text{OPEN}_{it} + \alpha_5 \text{PROD}_{it} + \varepsilon_{it} \quad (3.22)$$

Where REER is the dependent variable, and the other variables are the economic fundamentals that are expected to influence the exchange rate in the medium to long-term (independent variables). α_0 is the constant, α_s being the coefficients of the variables, and ε_{it} is the random disturbance. We begin with the diagnostic test as seen below.

3.5.1 DIAGNOSTIC TEST RESULTS

To ascertain that the data used in this section are fit, we perform the following diagnostic (residual) tests: normality test, serial correlation (autocorrelation) test, and heteroscedasticity test. The normality test investigates whether the data is normally distributed. The normality test result consists of the results for Skewness, Kurtosis, and Jarque-Bera. We are interested in the Jarque-Bera test because it factors both the Skewness and Kurtosis in its computation. The autocorrelation test is a test to ensure that the past values of a time series do not influence the

The value of λ depends on the frequency of the data. In the literature, the following values are suggested 100 for yearly data, 1600 for quarterly data, and 14400 for monthly data.

present value. The presence of autocorrelation will mean that our analysis is biased since the time series is not independent, as errors in one period depend on errors in the previous period(s). The heteroscedasticity test is a test to ensure that the variance of the model is homogeneous and that the errors in the model are identically distributed, as discussed above. The results of the three tests are summarized in table 3.1 below.

Table 3.1: Diagnostic Test Results

Diagnostic Test	Cameroon	CAR	Gabon	Equatorial Guinea
Normality Test <i>P</i> -value	0.0626	0.0146	0.0805	0.1575
Autocorrelation <i>P</i> -value	0.4463	0.4980	0.3253	0.7698
Heteroscedasticity <i>P</i> -value	0.3810	0.2994	0.4363	0.3068

Source: Computation from time-series data using EViews 12

From the above diagnostic test, the results of all the nations but for CAR are good because the *p*-value of the test is greater than 0.05. It means that the models are fit to be used in this research. As for the model of CAR, but for the normality test with a *p*-value less than 0.05, the *p*-value of both the autocorrelation test and the heteroscedasticity test are greater than 0.05. It means that we could still use the model in this research. Thus, we proceed with the unit root test.

3.5.2 UNIT ROOT TEST

An analysis for the presence of unit root is performed using the *Augmented Dickey-Fuller* (ADF) and *Phillips-Perron* (PP) test for the variables of the CEMAC nations using the EViews 12 econometric software application. The test results are summarised in table 3.2 in appendix A. A variable is stationary when the absolute value of the *t*-statistic of both the ADF and PP tests is greater than the 5% critical value. Alternatively, when the *t*-statistic value is less than the 5% critical value, the variable has a unit root (non-stationary). Stationarity is obtained via differencing the variable. From the table on the ADF and PP tests, the absolute values of all the variables are stationary after their first difference. It justifies why we use the VAR approach to cointegration, as all the variables are stationary at their 1st difference. In case the series have cointegration, it means that they exhibit a long-term relationship. That is, even if there were shocks in the short-term that may affect movement in individual series, with time, they converge (get back to the equilibrium - in the long term).

3.5.3 OPTIMAL LAG LENGTH

Before the Johansen cointegration test is performed, the optimal lag length is to be established. Applying the wrong lag (too many lags) in the analysis could result in a loss of degree of freedom, cause multicollinearity among the regressors, serial correlation in the error terms, and misspecification error. On the other hand, too few lags could result in specification errors. As such, the right lag must be applied to avoid the above-mentioned errors. The optimal lag length

of Cameroon is (1), CAR is (3), Gabon is (3), and Equatorial Guinea is (1), as seen in table 3.3 below. Due to insufficient time series data for Chad and Congo, we were unable to obtain their optimal lag length. Each of these two nations had time series data only for 15 years (15 observations), which was not enough to perform an optimal lag length analysis. Without the optimal lag length result for each of these two nations, it becomes difficult to proceed with their analysis. Thus, the rest of the analysis will be on the other four CEMAC nations (Cameroon, CAR, Gabon, and Equatorial Guinea).

Table 3.3: Optimal Lag Length Results.

CEMAC Nations	Optimal lag value (AIC)	Optimal Lag length
Cameroon	30.30058*	1
CAR	30.60804*	3
Gabon	38.71170*	3
Equatorial Guinea	31.02811*	1

Source: Computation from time-series data using EViews 12

3.5.4 COINTEGRATION TEST

The cointegration test verifies that variables used in a model have a long-run and short-run relationship between themselves, as explained in the econometric approach section above. Johansen's cointegration approach is used in this chapter.⁷⁰ The Trace statistic and Maximum eigenvalue statistic of the Johansen cointegration test for the four CEMAC nations are presented in tables 3.4 below. The null hypothesis states that there is no cointegrating equation(s) at a 0.05 level. While alternative hypothesis (*) denotes the rejection of the null hypothesis at the 0.05 level (i.e., there is cointegration in the model).

⁷⁰ In case the series are cointegrated, it means they exhibit a long-term relationship. That is, even if there were shocks in the short term that may affect movement in individual series, they will with time (in the long term), converge (get back to the equilibrium). Hence, estimate both short-term and long-term models. The appropriate estimation techniques are the vector autoregressive (VAR) and vector error correction models (VECM). If series are cointegrated, the restricted VAR (vector error correction model – VECM) is used. Whereas, if the series is not cointegrated (that is they do not exhibit a long-term relationship), the unrestricted/ basic VAR model will be used and not the VECM.

Table 3.4: Johansen Cointegration Test Results.

Cameroon									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized number of cointegrating equations	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability Value	Hypothesized number of cointegrating equations	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability Value
None *	0.636113	102.7550	95.75366	0.0151	None	0.636113	37.40370	40.07757	0.0971
At most 1	0.520662	65.35126	69.81889	0.1079	At most 1	0.520662	27.20790	33.87687	0.2524
At most 2	0.352980	38.14336	47.85613	0.2958	At most 2	0.352980	16.10902	27.58434	0.6565
At most 3	0.294898	22.03434	29.79707	0.2966	At most 3	0.294898	12.92826	21.13162	0.4588
At most 4	0.217002	9.106075	15.49471	0.3557	At most 4	0.217002	9.051151	14.26460	0.2819
At most 5	0.001483	0.054924	3.841465	0.8147	At most 5	0.001483	0.054924	3.841465	0.8147
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level					Max-eigenvalue test indicates no cointegration at the 0.05 level				
CAR									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized number of cointegrating equations	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability Value	Hypothesized number of cointegrating equations	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability Value
None *	0.939366	277.1227	95.75366	0.0000	None *	0.939366	98.10158	40.07757	0.0000
At most 1*	0.895780	179.0211	69.81889	0.0000	At most 1*	0.895780	79.14395	33.87687	0.0000
At most 2*	0.660673	99.87719	47.85613	0.0000	At most 2*	0.660673	37.82767	27.58434	0.0017
At most 3*	0.639803	62.04952	29.79707	0.0000	At most 3*	0.639803	35.73865	21.13162	0.0002
At most 4*	0.349398	26.31087	15.49471	0.0008	At most 4*	0.349398	15.04499	14.26460	0.0376
At most 5*	0.275216	11.26588	3.841465	0.0008	At most 5*	0.275216	11.26588	3.841465	0.0008
Trace test indicates 6 cointegrating eqn(s) at the 0.05 level					Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level				
Gabon									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized number of cointegrating equations	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability Value	Hypothesized number of cointegrating equations	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability Value
None *	0.876948	220.0275	95.75366	0.0000	None*	0.876948	73.33024	40.07757	0.0000

At most 1*	0.837024	146.6972	69.81889	0.0000	At most 1*	0.837024	63.49540	33.87687	0.0000
At most 2*	0.691983	83.20182	47.85613	0.0000	At most 2*	0.691983	41.21597	27.58434	0.0005
At most 3*	0.607593	41.98585	29.79707	0.0012	At most 3*	0.607593	32.74096	21.13162	0.0008
At most 4	0.169361	9.244897	15.49471	0.3432	At most 4	0.169361	6.494609	14.26460	0.5506
At most 5	0.075572	2.750289	3.841465	0.0972	At most 5	0.075572	2.750289	3.841465	0.0972
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level					Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level				
Equatorial Guinea									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized number of cointegrating equations	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability Value	Hypothesized number of cointegrating equations	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability Value
None *	0.538068	52.13600	47.85613	0.0188	None	0.538068	24.71483	27.58434	0.1116
At most 1	0.368502	27.42117	29.79707	0.0917	At most 1	0.368502	14.70914	21.13162	0.3098
At most 2	0.228496	12.71204	15.49471	0.1258	At most 2	0.228496	8.301220	14.26460	0.3489
At most 3*	0.128760	4.410815	3.841465	0.0357	At most 3*	0.128760	4.410815	3.841465	0.0357
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level					Max-eigenvalue test indicates 0 cointegrating eqn(s) at the 0.05 level				

Source: Computation from time-series data using Eviews 12

The trace statistics for Cameroon show the presence of a cointegrating equation in the model, while the maximum eigenvalue shows that there is 0 cointegrating equation in the model. Because this result is not conclusive, we will perform the VECM, and from the ECT, we will determine if there exists a long-term relationship in the model.⁷¹ Both the trace statistics and the maximum eigenvalue of CAR shows that there are 6 cointegrating equations, meaning there is cointegration (thereby applying the VECM). The trace statistics and the maximum eigenvalue of Gabon shows that there are 4 cointegrating vectors, and the VECM will also be used. The trace statistics for Equatorial Guinea shows that there is 1 cointegrating vector, while the maximum eigenvalue shows that there is 0 cointegrating vector (implying no consensus on this result). Just as with the case of Cameroon, we will perform the VECM. The VECM used is as seen below:

$$\begin{aligned} \Delta REER_t = & \alpha_0 + \sum_{i=1}^{k-1} \alpha_1 \Delta TOT_{t-i} + \sum_{i=1}^{k-1} \alpha_2 \Delta NFA_{t-i} + \sum_{i=1}^{k-1} \alpha_3 \Delta GOVCON_{t-i} + \\ & \sum_{i=1}^{k-1} \alpha_4 \Delta OPEN_{t-i} + \sum_{i=1}^{k-1} \alpha_5 \Delta PROD_{t-i} - \theta (REER_{t-1} - \sigma_1 TOT_{t-1} - \sigma_2 NFA_{t-1} - \\ & \sigma_3 GOVCON_{t-1} - \sigma_4 OPEN_{t-1} - \sigma_5 PROD_{t-1}) - \varepsilon_t \end{aligned} \quad (3.23)$$

Whereby:

$[\alpha_0 + \sum_{i=1}^{k-1} \alpha_1 \Delta TOT_{t-i} + \sum_{i=1}^{k-1} \alpha_2 \Delta NFA_{t-i} + \sum_{i=1}^{k-1} \alpha_3 \Delta GOVCON_{t-i} + \sum_{i=1}^{k-1} \alpha_4 \Delta OPEN_{t-i} + \sum_{i=1}^{k-1} \alpha_5 \Delta PROD_{t-i}]$ is the short-term dynamic of the relationship between REER and the independent variables. The second section of the equation represents the cointegration, that is the long-term information presented as $[-\theta (REER_{t-1} - \sigma_1 TOT_{t-1} - \sigma_2 NFA_{t-1} - \sigma_3 GOVCON_{t-1} - \sigma_4 OPEN_{t-1} - \sigma_5 PROD_{t-1}) - \varepsilon_t]$. While θ is the speed of adjustment between the short-term and the long-term, bearing a negative sign due to the convergence of REER to the equilibrium after a short-term shock on currency devaluation, causing REER to decrease. The dynamic eventually changes in the long term, and REER improves in the long term. ε_t is the white-noise term. The restricted VAR (i.e., vector error correction model – VECM) is applied if there exists a long-term relationship among the variables in the model. To ascertain if there exists a long-term relationship in the REER models of the four CEMAC nations, we look at the coefficient of their $ECT_{t-1}(\theta)$, as seen below.

Table 3.5: Coefficient of Error Correction Term

Nations	REER	ECT	t-statistic	P - Value
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⁷¹ From the VECM, if the coefficient of the ECT is negative and statistically significant, it means that a shock in any of the fundamentals in the short term will cause the REER to diverge in the short term. In the long term, it will be corrected, and the REER converge to its equilibrium. On the other hand, if the coefficient of the ECT is positive, it means that a shock in the short term will cause the REER to diverge in both the short-term and long term. This will mean that the REER will not converge back to equilibrium.

		Coefficient ()		
Cameroon	1.000000	0.077252	1.60494	0.1103
CAR	1.000000	-0.103846	-2.86504	0.0049
Gabon	1.000000	0.029311	1.76199	0.0804
Equatorial Guinea	1.000000	-0.244693	-4.23747	0.0000

Source: Computing from time-series data using EViews 12.

From the above results with the REER as the dependent (target) variable, the coefficient of the ECT result of Cameroon is positive (0.077) and is statistically insignificant as the value of the *t-statistic* (1.605) is less than ($|2|$). This is also supported by the *p-value* greater than 5% (11%). This implies that there is no long-term relationship between the REER and its fundamentals. This helps solve the doubt we earlier had in the trace statistics and the maximum eigenvalue of the Johansen cointegration test. This means there is no long-term relationship between REER and the independent variables (i.e., the variables do not impact REER in the long term). As such, we will perform the unrestricted/ basic VAR to look for the short-term relationship in the model.

The coefficient of the ECT of Gabon is also positive (0.029) and statistically insignificant, with a *t-statistic* less than 2 (i.e., 1.761) and a *p-value* greater than 5% (8%). This also means that there is no long-term relationship between the REER and its fundamentals. As such, we will also perform the unrestricted/ basic VAR to look for the short-term relationship in the model.⁷²

As earlier mentioned, due to insufficient time series data for both Congo and Chad, there optimal lag length tests could not be performed, and as such, both the Johansen cointegration test and VAR test could not be performed.

The coefficient of the ECT of CAR and Equatorial Guinea are ($|-0.104|$ and $|-0.25|$ respectively). These results are statistically significant as the *t-statistics* are ($|-2.86|5$ and $|-4.237|$), respectively which is greater than ($|2|$). This means that there are long-term relationships between the REER and its fundamentals in both nations, necessitating the performance of restricted VAR (i.e., VECM). Thus, the long-run model is seen below.

Long-Run Relationship between REER and its Fundamentals

The long-run model for the relationship between REER and its fundamentals for CAR and Equatorial Guinea is as seen below.

Table 3.6: Long-Run Estimates

Variables	TOT	NFA	GOVCON	OPEN	PROD
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⁷² Though the Johansen cointegration results showed the presence of cointegration in the model, it was from a generic perspective and not specific between REER and its independent variables model. Thus, the cointegration could be between the other variables as target variables and not REER as the target variable.

CAR	2.601 [4.436]	991.291 [6.055]	-7.085 [-2.024]	0.590 [0.440]	0.599 [4.439]
Equatorial Guinea	-0.539 [-3.692]	137.939 [2.664]			-0.004 [-4.518]

Source: Computing from time-series data using EViews 12.
Values in the brackets are the associated *t*-statistics.

CAR

The above long-run estimate table shows that there exists a long-term relationship between REER and its fundamentals, as their coefficient are statistically significant. But for OPEN, whose *t*-statistic is less than |2| (i.e., [0,440]), meaning it is statistically insignificant. This means that OPEN does not have an impact on the CFA franc in the long-term. This is in contrast with the prescriptions of economic theory that OPEN has a negative pressure on REER.⁷³

The result shows that there is a positive relation between TOT and REER. A 1% increase in TOT will cause the REER to increase by 2.6% *ceteris paribus*. This means that an improvement in the TOT causes an appreciation of the CFA franc and vice versa. A rise in the TOT creates benefits for a nation as few of its products chase more foreign products (i.e., an appreciation of the nation's exchange rate) and vice versa (Couharde and Sallenave, 2013; Elbadawi *et al.*, 2012; Coleman, 2008).

The result of NFA shows that there is a positive relationship between it and the REER. A 1% increase in NFA will result in a great appreciation of the CFA franc and vice versa, *ceteris paribus*. This result is consistent with the theory, and we can say that investments in CAR allow the acquisition of capital goods, which in turn will contribute to increasing the production capacity for export in the long term (Wonyra, 2018).

Government spending (GOVCON) has a negative relationship with REER. That is, government spending depreciates the CFA franc as a 1% increase in government spending reduces the value of the exchange rate by 7.085%. This could be because the expenditures are often intended for the purchase of imported goods and services. The more import is done, the more foreign currency is demanded for the purchase purpose. This results in the appreciation of foreign currency and the depreciation of CFA franc (Cakrani *et al.*, 2013).

⁷³ Trade openness should allow a reduction in trade barriers and favour imports, which in turn will lead to a depreciation of the exchange rate (Gantman and Dabós, 2018; Dornbusch, 1974). On the other hand, a positive effect could be justified by the fact that trade openness may lead to the importation of capital goods, which in the long term will promote exports and exert upward pressure on the actual real exchange rate of the CFA franc (Wonyra, 2018; Yusoff and Febrina, 2014).

Furthermore, PROD has a positive impact on REER, with 1% increase in PROD leading to 0.599 appreciation of CFA franc and vice versa, *ceteris paribus*. The result also confirms the existence of the Balassa–Samuelson effect in the CFA franc since an increase in the productivity gap between tradable and non-tradable goods implies an appreciation of the real equilibrium exchange rate (Couharde and Sallenave, 2013; Elbadawi et al., 2012).

Equatorial Guinea

The result shows that there is a negative relation between TOT and REER. A 1% increase in TOT will cause the REER to decrease by 0.539% *ceteris paribus*. This means that an improvement in the TOT causes a depreciation of the CFA franc and vice versa. A rise in the TOT, especially for developing nations that export primary products that are sticky and less competitive, will result in the depreciation of the currency as less of the currency is demanded to purchase the nation's products. As such a negative relationship between TOT and REER.

The result of NFA shows that there is a positive relationship between it and the REER. A 1% increase in NFA will result in an appreciation of the CFA franc and vice versa, *ceteris paribus*. This shows that if CAR is a net borrower, the CFA will be devalued. This result is consistent with the theory, and we can say that investments in CAR allow the acquisition of capital goods, which in turn will contribute to increase the production capacity for export in the long term (Wonyra, 2018).

PROD has a negative impact on REER, with 1% increase in PROD leading to 0.004% depreciation of CFA franc and vice versa, *ceteris paribus*. This result is in contrast to what is expected of developing nations, which produce primary products that are less competitive and sticky.

Short-Run Relationship between REER and its Fundamentals

In contrast to the long-run relationship, the short-run relationship estimate shows the following effects of the different variables of the estimated models for the four CEMAC nations.

Table 3.7: Short-Run Estimates

CAR				Equatorial Guinea			
Variables	Coefficient	t-statistic	P-value	Variables	Coefficient	t-statistic	P-value
TOT	-0.4172	-3.4483	0.0008	TOT	0.0085	0.2456	0.8064
NFA	17.2328	0.2178	0.8279	NFA	-30.3590	-1.6249	0.1072
GOVCON	2.364	2.5103	0.0133	GOVCON			
OPEN	-0.4176	-0.9261	0.3561	OPEN			
PROD	-0.0179	-0.3725	0.7101	PROD	0.0011	2.4324	0.0167
Cameroon				Gabon			
Variables	Coefficient	t-statistic	P-value	Variables	Coefficient	t-statistic	P-value
TOT	-0.1674	-2.4965	0.0134	TOT	-0.2322	-1.0513	0.2951
NFA	-24.6641	-0.4988	0.6185	NFA	-0.3172	-1.4422	0.1516
GOVCON	-0.1564	-0.0841	0.9331	GOVCON	-0.1496	-0.5040	0.6151

OPEN	0.3239	1.2602	0.2092	OPEN	-0.0468	-0.1950	0.8457
PROD	-0.0112	-0.9972	0.3200	PROD	-81.5801	-09.0554	0.3668

Source: Computing from time-series data using EViews 12.

Note: t -statistic $\geq |2|$ implies that there is a short-term relationship between the dependent variable and REER, and vice versa.

The above short-term estimates consist of the restricted VAR (VECM) for CAR and Equatorial Guinea, and the unrestricted VAR (basic VAR) for Cameroon and Gabon.⁷⁴ From the above table, the p -value less than 5% shows that there exists a short-term relationship between the REER and the independent variable. When the p -value is more than 5%, it means that there is no short-term relationship between the REER and the independent variable.

The test result of CAR shows that TOT and GOVCON have a short-term relationship with the REER (as their p -value < 0.05 , *ceteris paribus*). This means that a shock on the TOT and GOVCON causes the REER to deviate from its equilibrium value in the short term and will eventually converge back to the equilibrium in the long term as the p -value of TOT and GOVCON are 0.0008 and 0.0133 respectively (they are less than 0.05). The signs of their coefficient are opposite to those of their long-term relationship (these are as expected). A 1% increase in TOT will cause the REER to devalue by -0.417% in the short term and will appreciate in the long term, *ceteris paribus*. A 1% increase in GOVCON will cause the REER to appreciate by 2.364% in the short term and will depreciate in the long term, *ceteris paribus*. The result shows that there is no short-term relationship between NFA, OPEN, and PROD with REER. A shock on the NFA, OPEN, and PROD will not cause the REER to move away from its equilibrium. This is because the t -statistics of these three variables are statistically insignificant as they are less than $|2|$ (i.e., 0.2178, -0.9261, and -0.3725, respectively).

The result of Equatorial Guinea shows that out of the three independent variables used, only the PROD has a short-term relationship with the REER. A 1% increase in PROD leads to a 0.001% decrease in REER (devaluation), *ceteris paribus*. This result is like that observed in CAR's PROD in the short-term. While TOT and NFA do not have any impact (relationship) on the REER in the short term as their t -statistics are statistically insignificant (i.e., the t -statistic $< |2|$). Though there is no short-term relationship between TOT and NFA with REER, there exists a long-term relationship.

The unrestricted VAR results of Cameroon shows the presence of a short-term relationship between TOT and REER. A 1% increase in TOT leads to a 0.1674% devaluation and vice versa, *ceteris paribus*. The result shows that there is no short-term relationship between the

⁷⁴ As there is no long-term relation in both Cameroon and Gabon models, we use the unrestricted VAR. The VECM was used for CAR and Equatorial Guinea models.

other variables and REER (i.e., the variables do not impact the REER as their t -statistic $< |2|$ - statistically insignificant).

The unrestricted VAR results of Gabon show that there is no short-term relationship between any of the variables and the REER, as the models are statistically insignificant with t -statistic $< |2|$. This means that there is no short-term relationship between REER and its independent variables (i.e., none of the variables used impact the REER). Because we are interested in the state of the REER of the CEMAC nations, we proceed to investigate the presence of the equilibrium exchange rate, as seen in the next section.

3.5.5 EQUILIBRIUM EXCHANGE RATE AND MISALIGNMENT

Because the equilibrium real effective exchange rate (EREER) is a continuous process and not a fixed value, the behavioural equilibrium exchange rate (BEER) approach by Clark and MacDonald (1998) was used to track the movements of the exchange rate over time. To ascertain if the actual REER is at equilibrium or not, the Hodrick-Prescott filter with a smoothing factor of 100 was used to smooth the variables on Eviews12 econometric software application. This helps to extract the EREER from the actual REER. The difference between the actual REER and the EREER will be the misalignment. Because the REER is seldom at equilibrium, we assumed it is at equilibrium when the differences between REER and EREER revolve around absolute 5% as seen in table 3.8 in the appendix A.

Cameroon

Beginning with Cameroon's result on the HP filter on table 3.8 in the appendix A, the exchange rate was overvalued in 1980 by (7.44%). From 1981 to 1985, the currency was undervalued with the lowest value being (-12.12%) in 1982. From 1986 till 1993, prior to the 1994 devaluation, the currency was overvalued, with the highest overvaluation being (21.73%) in 1987 and the lowest overvaluation being (4.95%) in 1986, which is at equilibrium since we stated that values within $|5\%|$ are at equilibrium. The 12th January 1994 CFA franc devaluation by 50% caused the currency to be undervalued by (-30.67%), which is the lowest value experienced throughout the research period. This means that though the currency was overvalued by (12.36%) in 1993, the 1994 devaluation was much more than the required amount. As such, after the devaluation, the currency was not at its equilibrium but rather was undervalued by (-30.67%). It took four years for the devaluation to go off and for the currency to start revolving around its equilibrium at a 5% interval (i.e., the currency was undervalued between the period 1994 with a value of -30.67% to the year 1997 with value -9.11%). From 1998 onward, the currency revolved around its equilibrium (at a 5% within its equilibrium), with some few years of misalignment (the year 2000 had an undervaluation of -5.80% - post euro, and the year 2009 had an overvaluation of 5.91% - post 2008 global financial crisis). As of the

year 2018, the currency was 1.85% above its equilibrium value, which means the actual REER revolves around the equilibrium REER (BEER) as presented in the graphs below. Thus, as of the year 2018, the CFA franc was at equilibrium, meaning that Cameroon government via its Central bank should not be concerned about the state of the currency. Nevertheless, since there is no fixed exchange rate, the central bank ought to be vigilant and proactive to identify any major movement in the currency and improvise for possible amendments.

CAR

From CAR result of the HP filter, the exchange rate was overvalued in the year 1980 by (9.80%) as seen on table 3.8 in the appendix A. From the year 1981 to 1984, the currency was undervalued, with the lowest value being (-11.98%) in 1981. From 1985 till 1993, prior to the 1994 devaluation, the currency was overvalued, with the highest overvaluation being (18.6%) in the year 1986 and the lowest overvaluation being (1.25%) in 1989. In 1993, prior to the devaluation, the CFA franc was (9.68%) overvalued. The 1994 CFA franc devaluation by 50% caused the currency to be undervalued by (-32.46%), which is the lowest value experienced throughout the research period. It took just two years for the currency to recover from the undervaluation and converge around the equilibrium REER (i.e., the currency was undervalued in the periods 1994 and 1995 by -32.46% and -10.98%, respectively). From 1996 onward, the currency revolved around its equilibrium with three periods of overvaluation (i.e., the years 2003, 2008, and 2009 were overvalued by 5.78%, 6.33%, and 6.83% respectively, whereby the 5% trench-hold is surpassed). In the year 2011, the currency was undervalued by (-5.14%). As of the year 2018, the currency was (3.73%) above its equilibrium value (i.e., it is within its equilibrium). This mean that CAR government via its Central bank should not be concerned about the state of the currency.

Gabon

From Gabon result of the HP filter, the exchange rate was overvalued in 1980 by (9.70%) as seen in table 3.8 in appendix A. From 1981 to 1985, the currency was undervalued, with the lowest value being (-12.20%) in 1981. From 1986 through to 1990, prior to the 1994 devaluation, the currency was misaligned – overvalue, with the highest overvaluation being (41.14%) in 1990, and an undervaluation of (-7.56%) in 1988. The 1994 CFA franc devaluation by 50% might not have been necessary for Gabon since the currency was around its equilibrium of (2.22%) in 1993. Moreover, prior to that the currency was around its equilibrium in both the years 1991 and 1992 by (2.87%) and (-3.36%) respectively. But the periods prior to the 1990s had series of huge misalignments, which might have instigated the devaluation process for the nation and the region. Thus, the devaluation caused the currency to be undervalued by (-35.68%), which is the lowest value experienced by Gabon throughout the

research period. It took four years for the currency to get back to its equilibrium (i.e., from 1994 to 1997, the currency was undervalued). From 1998 onward, the currency revolved around the equilibrium with the years 2008 and 2009 being overvalued by (6.70%) and (7.36%) respectively. In the year 2018, the currency was (4.59%) above the equilibrium, meaning that the currency is revolving around the equilibrium.

Prior to the 1994 devaluation, the currency was just (2.22%) overvalued in the year 1993 (i.e., it was within equilibrium), yet it was devalued. This means that, as of the year 2018, the currency was more overvalued than it was in the year 1993, thereby necessitating a devaluation for Gabon. However, the main difference between both periods is that in the period prior to the 1994 devaluation, the currency was severely misaligned with continuous period of overvaluation between the years 1986 to 1990, but for the year 1988 when it was devalued.⁷⁵ Meanwhile in the year 2018, the currency has been around the equilibrium, with no spike of misalignment.⁷⁶ Gabon is part of the CEMAC zone, and all the other nations were faced with overvaluation prior to the year 1994 devaluation. As such, the devaluation could not have been done without impacting Gabon. However, it might be good if the CFA franc was devalued on a country-by-country basis, instead of having a one-fit-all approach of 50% devaluation across-board. But these are parts of the characteristics of a currency union – the monetary policies (currency devaluation) are made for the entire currency zone and not for specific nations.

Equatorial Guinea

From Equatorial Guinea result of the HP filter, the exchange rate was overvalued in the year 1985 by (15.02%) as seen in table 3.8 in appendix A. From the year 1986 to 1992, the currency was within equilibrium, with only the years 1987 and 1988, which were undervalued by (-7.21% and -5.50% respectively). The only time the currency was overvalued was in the year 1993 (by 7.56%). If the currency was devalued in this country because of this one-off overvaluation, then it might not have been the best idea. Just as in the case of Gabon, the currency was devalued for the entire CFA francs zone, and Equatorial Guinea could not be left aside.

The 1994 devaluation caused the currency to be undervalued by (-12.14%) and went back to its equilibrium from 1995. From the year 1995 till 2018, the currency revolved around the equilibrium, with the years 2000, 2001, and 2002 being undervalued by (-8.88%), (-8.20%), and (-5.34%) respectively, while being overvalued in 2005 by (5.31%). As of the year 2018,

⁷⁵ *This was not only for Gabon, but also for the other CEMAC nations.*

⁷⁶ *The currency has been at equilibrium from the year 2010 till the year 2018. Moreover, the other CEMAC nations' currencies are also at equilibrium. Thus, there will be no need for any devaluation.*

the currency is within its equilibrium, with the value (-0.7%). Hence, the currency should be of no concern to the nation's monetary authorities.

Chad

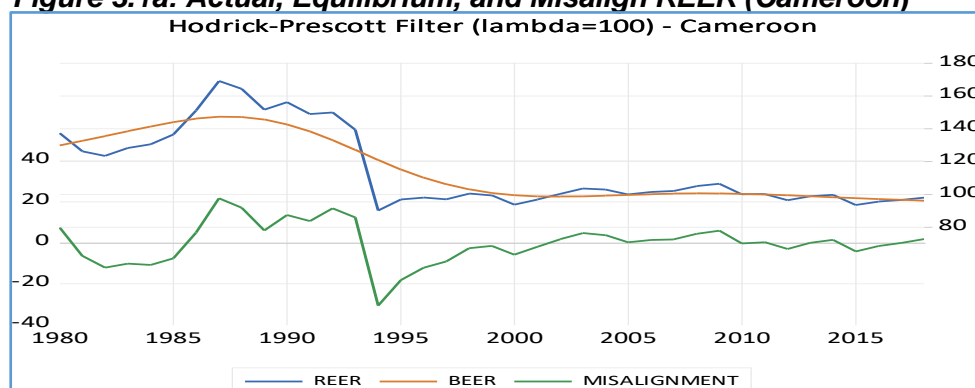
From Chad result of the HP filter, the exchange rate was within its equilibrium in the year 2004 (-4.31%). Throughout the period, the currency was revolving within the equilibrium, with the years 2007 and 2011 being undervalued by (-6.20%) and (-5.70%), respectively. As of the year 2018, the currency was within its equilibrium (-4.45%) and should be of no concern to the nation's monetary authorities.

Congo

From Congo result of the HP filter, the exchange rate was undervalued between the years 2004 and 2005, (-7.01%) and (-6.82%) respectively. From the year 2006 onward, the currency went through series of overvaluation and undervaluation, with only the years 2013 and 2014 being around the equilibrium value. The currency seems volatile in this country and should be constantly looked at. However, the currency was within equilibrium in the year 2018, with the value being (1.08%).

The BEER approach graphically details the trend of the actual REER, EREER, and the misalignment over time beginning from the year 1980 to 2018. The above results for the six nations are graphically presented below, thereby showing the movement or behaviour of the REER, BEER, and misalignment:

Figure 3.1a: Actual, Equilibrium, and Misalign REER (Cameroon)



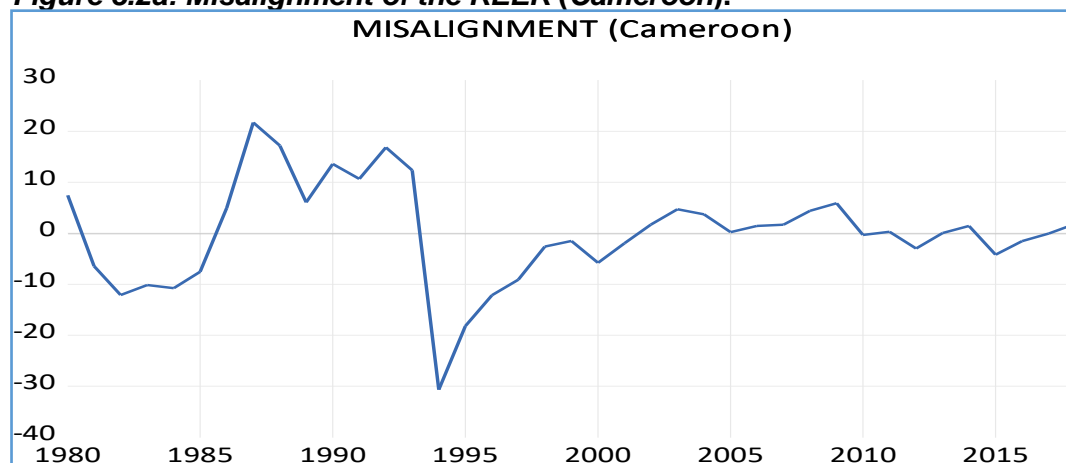
Source: Extracted from table 3.8 The Hodrick-Prescott Filter (Cameroon).

The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

From the above figure for Cameroon, when the actual REER is above the EREER, it is said to be overvalued. When the actual REER is below the EREER, it is undervalued. The actual REER experienced a sharp drop in the year 1994 due to the 50% devaluation that occurred on the 12th January 1994. Before the devaluation, the actual REER went through a series of

undervaluation to overvaluation. After the 1994 devaluation, the actual REER experienced a period of undervaluation, after which it began revolving around the equilibrium. The misalignment of the real effective exchange rate is in figure 3.2a below.

Figure 3.2a: Misalignment of the REER (Cameroon).

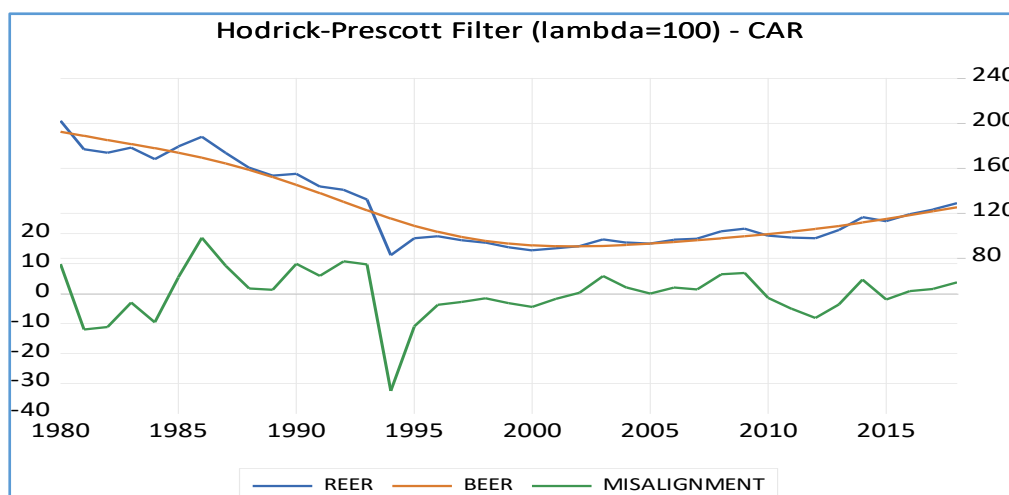


Source: Extracted from figure 3.1a above (Cameroon).

The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

The real exchange rate is likely to differ from the equilibrium level at any time due to changes in its fundamental determinants, and changes in other macroeconomic factors and policies. In the year 1980, Cameroon had an overvalued REER. From 1981 to 1985, it experienced an undervalued REER. Between 1986 and 1993, the exchange rate was overvalued, with the peak being in the year 1987 (21.73%). After the 1994 devaluation, the REER was undervalued till the year 2001. From the year 2002 till 2018, the REER has been revolving around the equilibrium apart from the year 2009 when it was (5.91%) overvalued. This implies that for the past 14 years, the CFA franc has been moving around its equilibrium, and there is no need for the government to be concerned about the exchange rate. However, since the exchange rate is influenced by the fundamentals, emphasis should be placed on the movements of the fundamentals.

Figure 3.1b: Actual, Equilibrium, and Misalign REER (CAR)

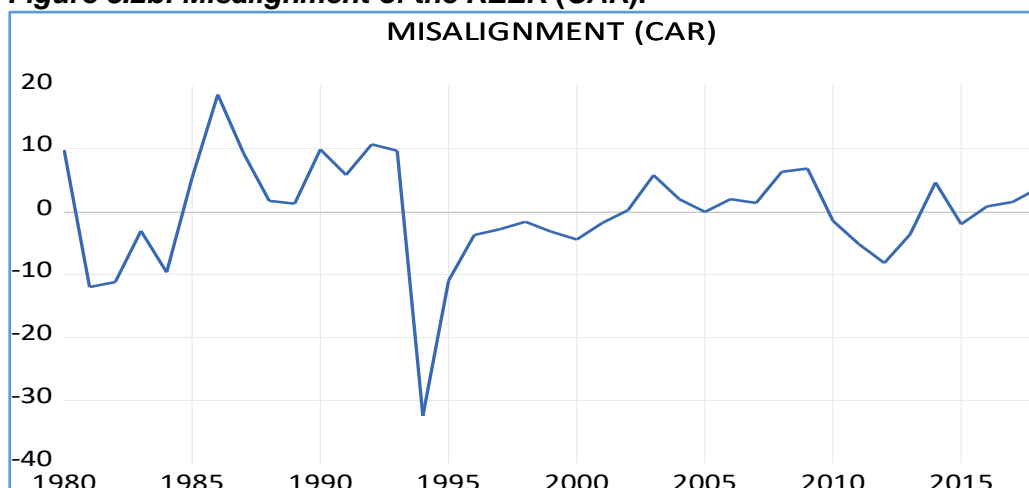


Source: Extracted from table 3.8 The Hodrick-Prescott Filter (CAR).

The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

From the above figure for CAR, the actual REER was above the equilibrium (overvalued) in 1980.⁷⁷ The actual REER experienced a sharp drop in 1994 due to the devaluation that occurred during that year. Before the devaluation, the actual REER went through a series of undervaluation and overvaluation, just like the situation in Cameroon. After the devaluation, the actual REER experienced a period of undervaluation, after which it began revolving around the equilibrium. The misalignment of the real exchange rate is extracted and shown in figure 3.2b below.

Figure 3.2b: Misalignment of the REER (CAR).



Source: Extracted from figure 3.1b above.

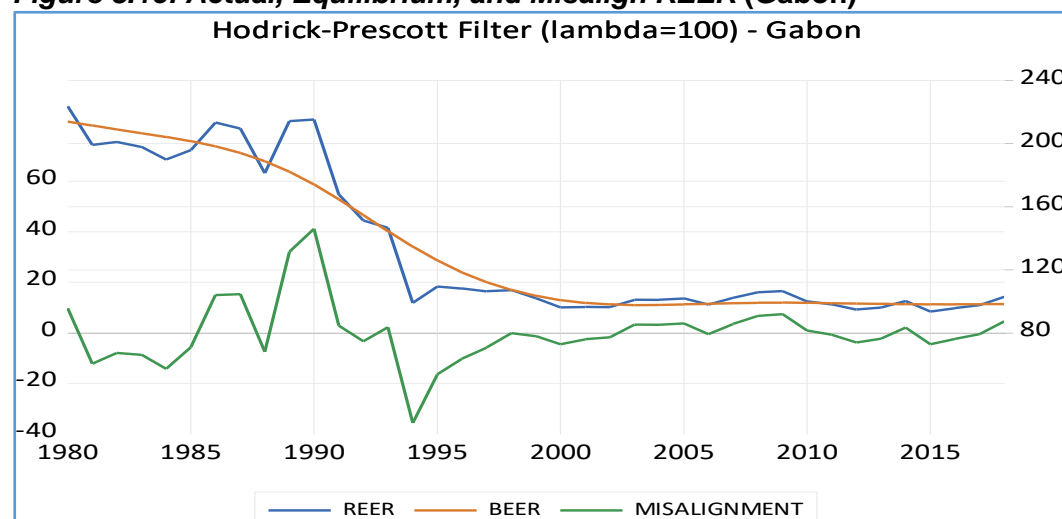
The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

In the year 1980, CAR had an overvalued REER of (9.80%). From 1981 to 1984, it experienced an undervalued REER. Between the periods 1985 to 1993, the exchange rate was overvalued,

⁷⁷ When the actual REER is below the EREER (BEER), it is undervalued.

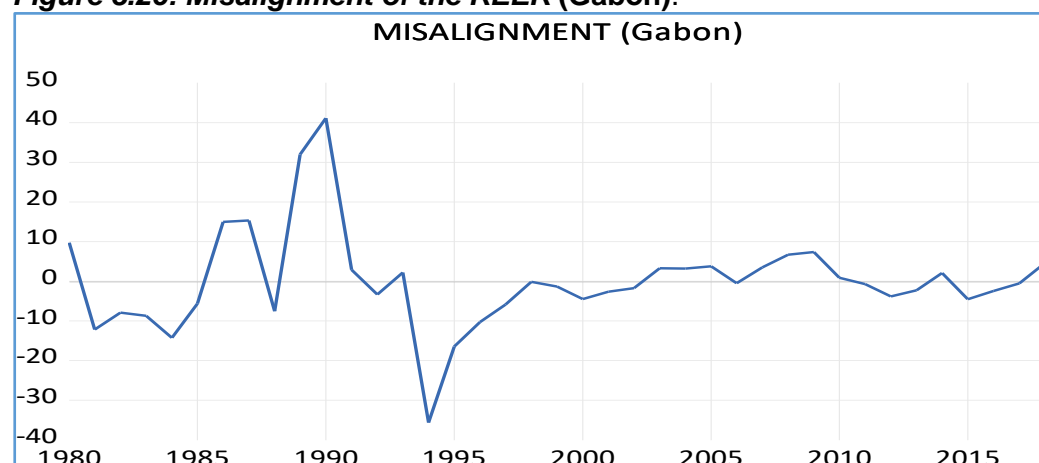
which might have been a contributing factor for the 1994 CFA franc devaluation. After the 1994 CFA franc devaluation, the REER was undervalued until 2001. From the year 2002 until 2016, the REER has been experiencing series of fluctuations between overvaluation and undervaluation. As of the year 2018, the currency was within equilibrium (3.73%). Thus, it should not be a point of concern for the nation's authorities.

Figure 3.1c: Actual, Equilibrium, and Misalign REER (Gabon)



Source: Extracted from table 3.8 The Hodrick-Prescott Filter (Gabon). The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

Figure 3.2c: Misalignment of the REER (Gabon).

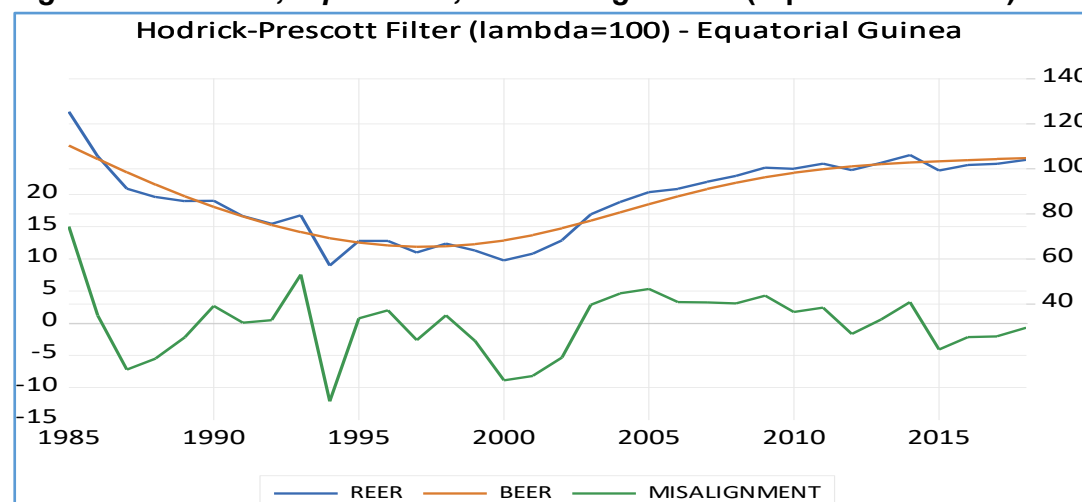


Source: Extracted from figure 3.1c above. The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

From figure 3.1c and figure 3.2c above for Gabon, the actual REER was above the equilibrium (overvalued) in the year 1980. Between the periods 1981 to 1985, the currency was undervalued. While between the years 1986 and 1993, the currency was overvalued with two incidents of undervaluation, which were the years 1988 and 1992. Prior to the 1994 devaluation, the currency revolved around the equilibrium by (2.22%) in 1993. Between the

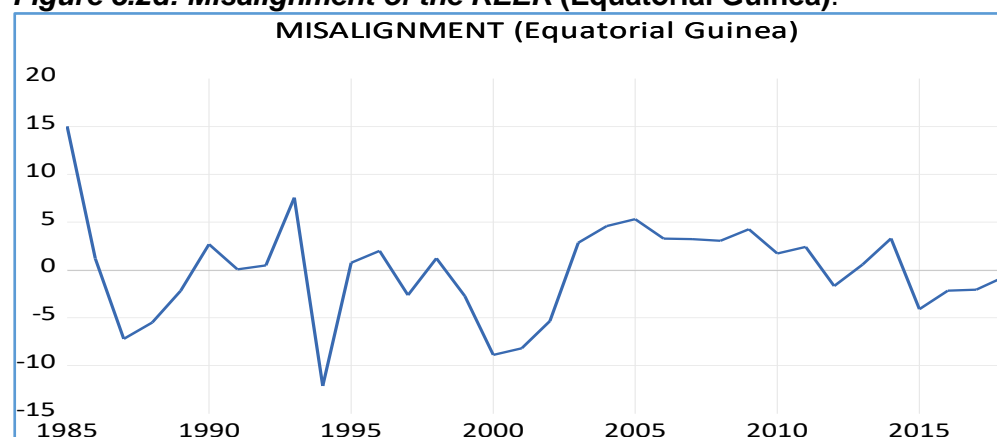
years 1994 and 1997, the currency was undervalued, while between the period 1998 and 2018 it fluctuated around the equilibrium. Thus, it should not be a point of concern for the nation's authorities.

Figure 3.1d: Actual, Equilibrium, and Misalign REER (Equatorial Guinea)



Source: Extracted from table 3.8 The Hodrick-Prescott Filter (Equatorial Guinea). The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

Figure 3.2d: Misalignment of the REER (Equatorial Guinea).



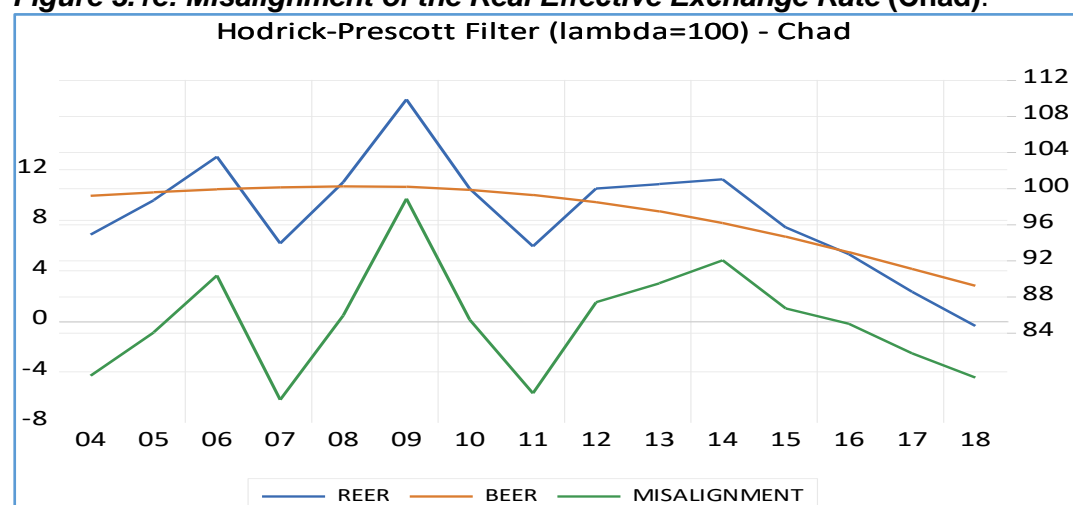
Source: Extracted from figure 3.1d above.

The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

From the above figure 3.1d and 3.2d for Equatorial Guinea, the actual REER was overvalued in 1985 by (15.02%). The currency experienced series of fluctuations between misalignment and equilibrium till the year 1993 prior to the devaluation. The currency was overvalued by (7.56%) in 1993, prior to the devaluation, and the 1994 devaluation caused the currency to be devalued by (-12.14%). Immediately after the devaluation, the currency got back to equilibrium from 1995 and continued to revolve around the equilibrium with some few misalignments. As

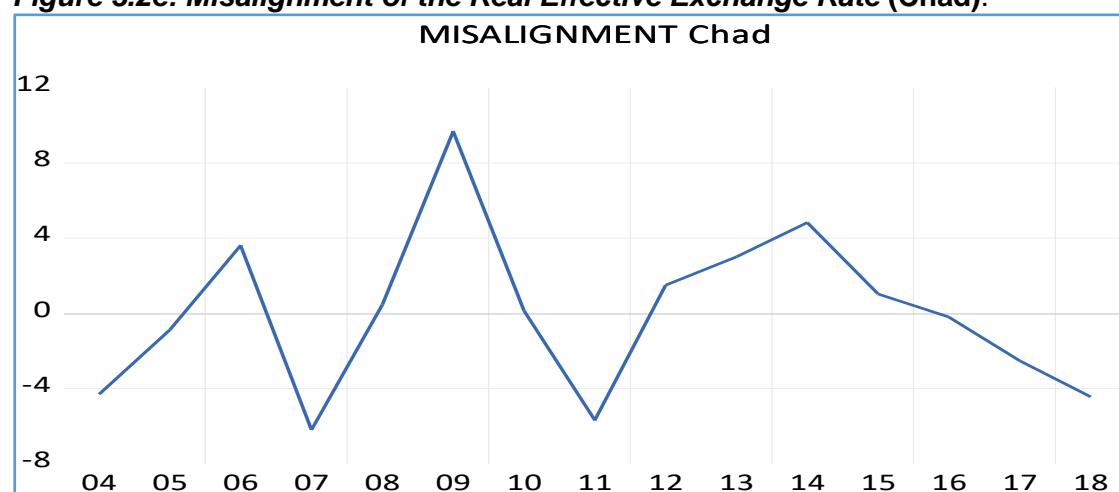
of the year 2018 the currency was at equilibrium with value (-0.70%). Thus, it should not be a point of concern for the nation's authorities.

Figure 3.1e: Misalignment of the Real Effective Exchange Rate (Chad).



Source: Extracted from table 3.8 The Hodrick-Prescott Filter (Chad).
The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

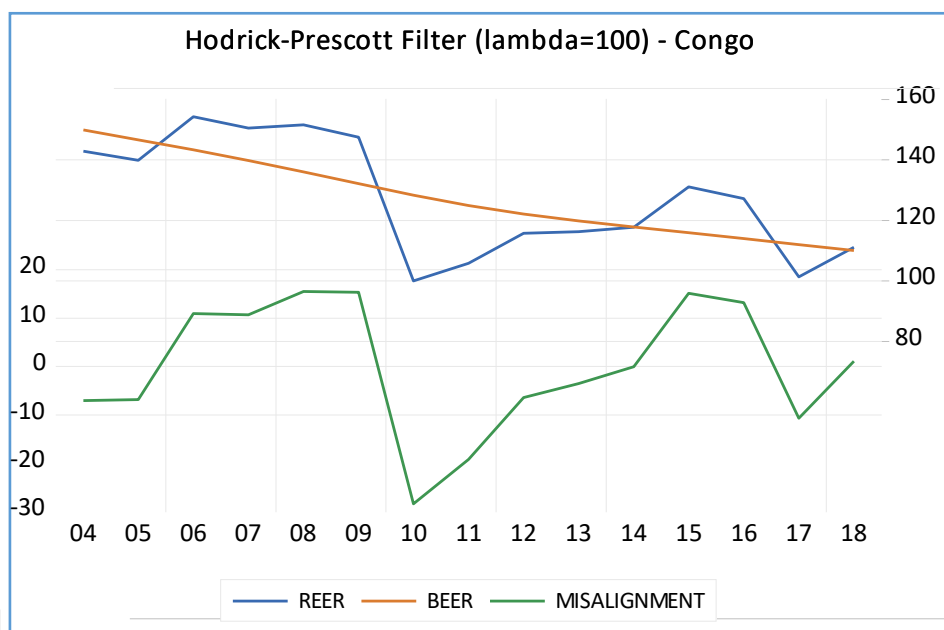
Figure 3.2e: Misalignment of the Real Effective Exchange Rate (Chad).



Source: Extracted from figure 3.1e above
The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

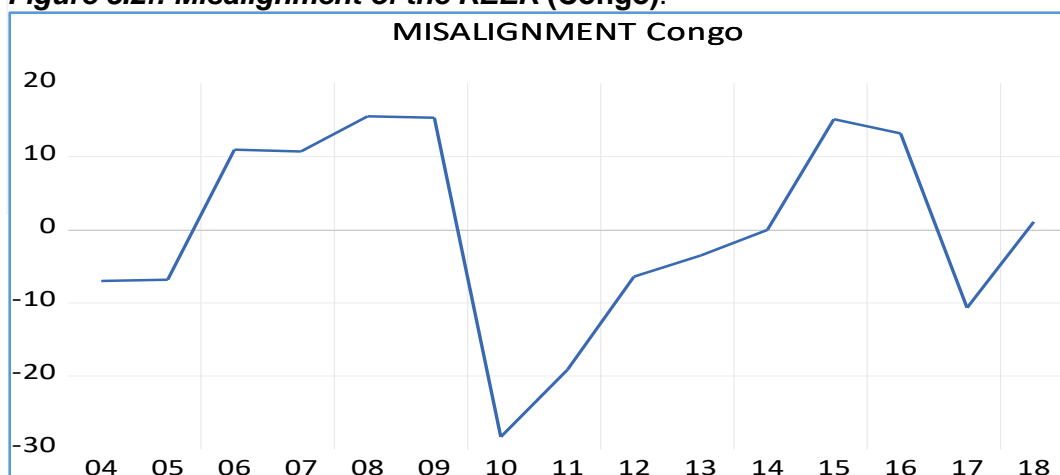
From the above figure 3.1e and 3.2e for Chad, we cannot ascertain the state of the currency prior to the 1994 devaluation due to the unavailability of data. But these graphs show that the currency has been revolving around the equilibrium throughout the period, with the years 2007 and 2011 being undervalued at (-6.20%) and (-5.70%) respectively, and the year 2009 being overvalued by (9.70%). As of the year 2018, the currency was at equilibrium with value (-4.48%). Thus, it should not be a point of concern for the nation's authorities.

Figure 3.1f: Actual, Equilibrium, and Misalign REER (Congo).



Source: Extracted from table 3.8 The Hodrick-Prescott Filter (Congo). The blue line represents the REER, the red line represents the BEER (EREER), and the green line represents the misalignment.

Figure 3.2f: Misalignment of the REER (Congo).



Source: Extracted from figure 3.1f above

The currency is said to revolve around the equilibrium when the blue line (misalignment) revolves around the zero-horizontal line.

From the above figure 3.1f and 3.2f for Congo, just as with the case of Chad, we cannot ascertain the state of the currency prior to the 1994 devaluation due to the unavailability of data. However, these graphs show that the currency has gone through series of undervaluation, overvaluation, and equilibrium. However, as of 2018, the currency was around the equilibrium (1.08%). Thus, it should not be a point of concern for the nation's authorities.

The results of the BEER approach for the six CEMAC nations point some similarities among all the nations with some few discrepancies. Looking at the three nations with data beginning in the year 1980; Cameroon, CAR, and Gabon currency were overvalued by 7.44%, 9.80%,

and 9.70%, respectively. The four nations with data prior to the devaluation had overvalued currency, but for Gabon (i.e., in the year 1993; Cameroon, CAR, and Equatorial Guinea were overvalued by 12.37%, 9.680%, and 7.56%, respectively, while Gabon was within equilibrium with value of 2.22%). The devaluation was aimed at curbing the overvaluation faced by the nations. Instead of the devaluation getting the currency to equilibrium, they were deeply undervalued with, Cameroon, CAR, Gabon, and Equatorial Guinea having (-30.67%), (-32.46%), (-35.68%), and (-12.14%) respectively.⁷⁸ Equatorial Guinea's devaluation was not much relative to the other three nations, and it revolved around its equilibrium after just a year. Whereas the other three nations took two to four years to revolve around the equilibrium (Cameroon, CAR, and Gabon took 4, 2, and 3 years respectively). As of 2018, all the six nations revolved around the equilibrium, with their REER misalignment being less than 5% (Cameroon, CAR, Gabon, Equatorial Guinea, Chad, and Congo having 1.85%, 3.73%, 4.59%, -0.70%, -4.45%, and 1.08% respectively). Thus, the CFA franc is at equilibrium in all the six CEMAC nations as of the year 2018.

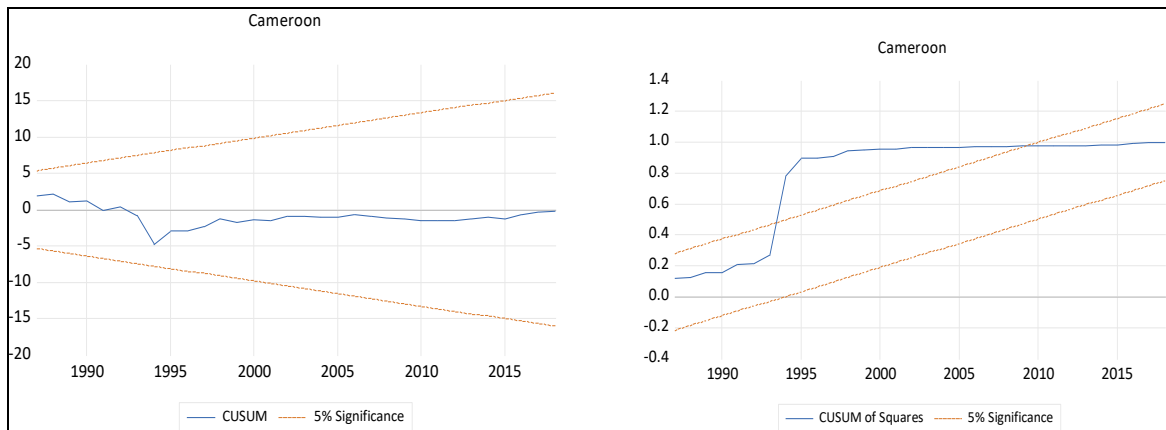
3.5.6 STABILITY TESTS

We check if the estimated regression equations are stable throughout the sample period of the study. Parameter stability tests play a vital role in ensuring the reliability of policy simulation based on the model. To test for stability following Bahmani-Oskooee and Goswami (2003), we apply the cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The advantage of this approach is that it selects the break points recursively rather than arbitrarily. According to the CUSUM test, the recursive residuals are plotted against the breakpoints, while the CUSUMSQ plots the squared recursive residuals against the breakpoints. As a graphical illustration, these two statistics are then plotted with two straight lines, which are bounded by 5% significance level. If any point lies beyond the 5% significance level, the null hypothesis of stable parameters is rejected. The stability test results of the four CEMAC nations are graphically presented in figures 3.3 below.

Figures 3.3: CUSUM and CUSUMSQ

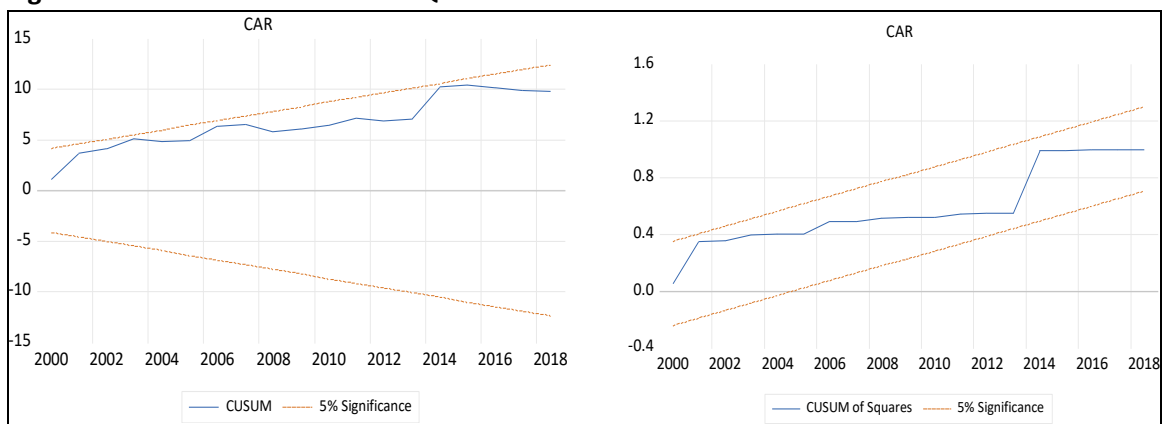
Figure 3.3a: CUSUM and CUSUMSQ for Cameroon

⁷⁸ As stated by Rodrik (2008), due to institutional weakness and market failure faced by developing nations, they usually turn to currency devaluation as the second-best option. So, if the devaluation was done not only to get the currency back to equilibrium but to get it devalued in order for their products to be more competitive in the international market, then the devaluation was necessary. However, we need to evaluate if the degree of devaluation is commensurate or enough to impact on international competitiveness. Was the devaluation able to improve the trade balance, attract foreign investors, and improve economic growth? Also, the opportunity cost of currency reserve so as for the devaluation to be effective needs to be taken into cognition.



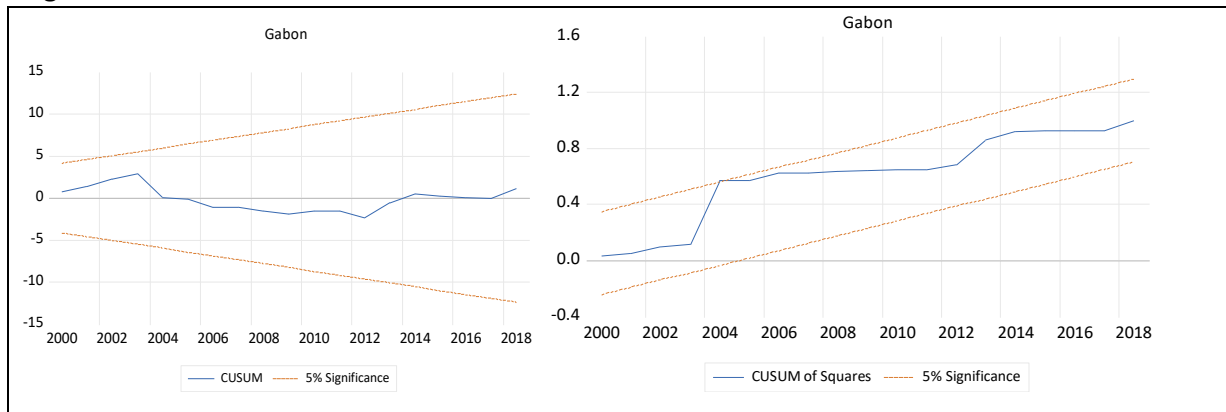
Source: Computation from time-series data using EViews 12

Figure 3.3b: CUSUM and CUSUMSQ for CAR



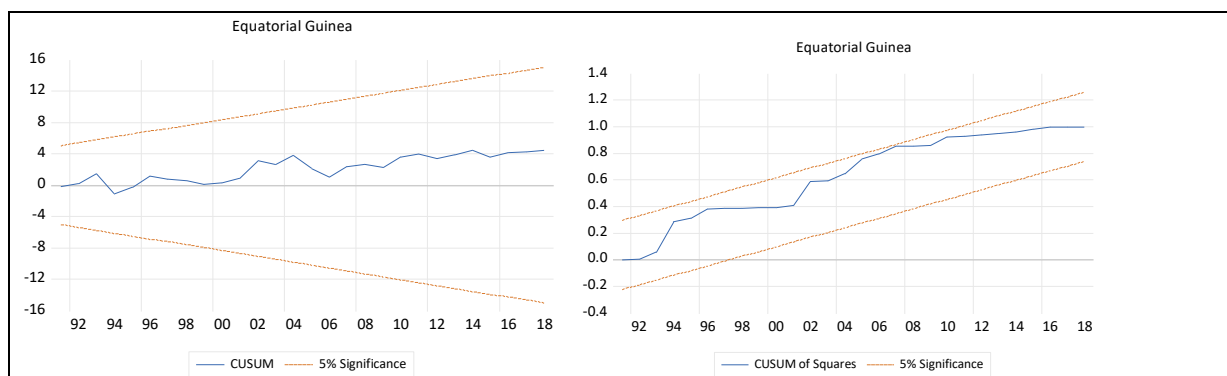
Source: Computation from time-series data using EViews 12

Figure 3.3c: CUSUM and CUSUMSQ for Gabon



Source: Computation from time-series data using EViews 12

Figure 3.3d: CUSUM and CUSUMSQ for Equatorial Guinea



Source: Computation from time-series data using EViews 12

The stability test results of the four CEMAC nations are good, as the plots of both CUSUM and CUSUMSQ statistics fall within the 5% critical values. The stability test result is summarised below in table 3.9 below.

Table 3.9: Stability Test Results Based on CUSUM and CUSUMSQ Test

Country	CUSUM	CUSUMSQ
Cameroon	Stable	Unstable
CAR	Stable	Stable
Gabon	Stable	Stable
Equatorial Guinea	stable	stable

Source: Extracted from EViews 12

The result above reveals that the CUSUM statistic provides stable results for all the four nations. While the CUSUMSQ statistics provides stable result for all the nations but for Cameroon. Thus, the models for the four CEMAC nations are stable.

3.6 CONCLUSION

This chapter was focused at investigating the state of the CFA francs (i.e., if it is aligned or not) in the CEMAC zone nations (Cameroon, Central Africa Republic – CAR, Gabon, Equatorial Guinea, Chad, and Congo). Based on the classical works of Clark and MacDonald (1998), we used the Vector Autoregression (VAR) approach, which consists of the full-information maximum likelihood (FIML) method due to Johansen (1995).⁷⁹ This econometrics methodology corrects for autocorrelation and endogeneity parametrically using the vector error correction mechanism (VECM) specification. It was used to investigate both the long-term and short-term relationship between the REER and its fundamentals in four CEMAC nations (Cameroon, Central Africa Republic – CAR, Gabon, Equatorial Guinea). The fundamentals used are government expenditure (or government debts - *GEXP*), terms of trade (*TOT*), net foreign

⁷⁹ MacDonald and Ricci (2003) used the Johansen FIML in estimating the equilibrium real exchange rate of South Africa. Eita and Sichei (2006) also used this approach at estimating the cointegration of Namibia.

assets (*NFA*), trade policy (proxy by openness - *OPEN*), and productivity differentials (*PROD*). The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were done, and the results showed that all the variables were non-stationary at level, and stationary at their first difference. The VECM result showed the presence of long-term relationship between REER and all its fundamentals in CAR and Equatorial Guinea models (but for *OPEN*, which had no long-term relationship). While there is no long-term relationship between REER and its fundamentals in the models of Cameroon and Gabon. The result of Cameroon, CAR, and Equatorial Guinea shows the presence of short-term relationship between some of the fundamentals and REER. While the result of Gabon shows that there are no short-term relations between the fundamentals and REER.

The behavioural equilibrium exchange rate (BEER) approach by Clark and MacDonald (1998) was used to ascertain the state of the CFA francs in all the CEMAC nations. The results were within the period 1980 to 2018, showing that prior to the 12th January 1994 devaluation, the currency experienced series of fluctuations between undervaluation and overvaluation. After the devaluation, the currency was undervalued, and thereafter, it has been within its equilibrium. Thus, as of the year 2018, the CFA franc was within the equilibrium (i.e., 1.85%, 3.73%, 4.59%, -0.70%, -4.45%, and 1.08% misalignment for Cameroon, CAR, Gabon, Equatorial Guinea, Chad, and Congo respectively)⁸⁰. It should be of no concern to the CEMAC nations' monetary authorities since they are all within the 5% threshold. However, the results of Equatorial Guinea and Gabon revealed that prior to the devaluation, the currency was within equilibrium and did not warrant devaluation. Because CEMAC is a common currency zone, decisions made impact the entire Zone. The CFA franc could not be devalued (treated) on a country-by-country base.

⁸⁰ *Because the REER is seldom at equilibrium, we assumed it is at equilibrium when the misalignment (differences between REER and EREER) revolves around absolute 5%.*

CHAPTER 4

EMPIRICAL ANALYSIS OF THE IMPACT OF REER ON TRADE BALANCE

4.1 INTRODUCTION

The chapter investigates if currency devaluation (CFA franc devaluation) had an impact (improvement) on the trade balance (TB) of CEMAC nations. This was done by investigating for the presence of *J*-curve in the TB of three CEMAC nations used.⁸¹ The aggregate bilateral trade data approach by Rose and Yellen (1989) was used to examine for the presence of the *J*-curve in the TB relationship between each of the three CEMAC nations and their individual main trade partners.⁸² To have an overview of the impact of CFA franc devaluation on the CEMAC nations' TB, we used the aggregate trade data approach by Magee (1973). The presence of the *J*-curve will mean that the CFA franc devaluation could lead to the improvement of the CEMAC nations' TB in the long-run.⁸³ The Autoregressive Distributed Lag (ARDL) approach by Pesaran *et al.* (2001) was used to investigate the presence of cointegration in the models. The results revealed the presence of the *J*-curve in the TB between Cameroon and her individual main trade partners, and Cameroon and her main trade partners jointly (i.e., in the aggregate bilateral trade data approach by Rose and Yellen (1989), and the aggregate trade data approach by Magee (1973)). This means that the CFA franc devaluation improved Cameroon's TB and policymakers could use it as a tool to improve the nation's TB. While the results of both Central Africa Republic (CAR) and Gabon reveals the absence of the *J*-curve in their TB using the aggregate bilateral trade data and aggregate trade data approaches. Thus, their policymakers should use other policy tools but for currency devaluation to improve their nations TB.

There is a consensus among economists that international trade acts as an engine for the economic growth of nations (Metougue, *et al.*, 2020). As such, nations and regional policymakers put in place institutional structure and programs that serves as platforms to boost international trade in their national and regional economies. Among other policies instituted by the CEMAC region (part of the CFA franc zone) was the devaluation of the CFA franc currency.

⁸¹ The nations used were Cameroon, Central Africa Republic – CAR, and Gabon. The other three CEMAC nations (Chad, Congo, and Equatorial Guinea) were not used due to lack of data.

⁸² A real effective exchange rate (REER) devaluation often causes a nation's trade balance to worsen in the short-term before improving in the long-run, thereby having a *J*-curve-like effect on a nation's trade balance.

⁸³ The absence of the *J*-curve implies that the devaluation does not improve the trade balance with the individual trade partner and that the government could use other policies to improve their trade balance (deficit) (Dhahir *et al.*, 2015; Ziramba and Chifamba, 2014; Magee, 1973).

One of the aims of currency devaluation is to address a nation's trade deficit, thereby improving its TB (and the current account of balance of payment - BoP). The trade deficit in itself is not a big problem because most nations will have a deficit at one time or the other. Nations such as the United States of America (USA) often attract foreign investments to improve their capital account. This offsets the trade deficit of their current account and getting their BoP to equilibrium (i.e., the BoP gets to zero) (Bhatt, 2020). A trade deficit is neither inherently entirely good nor bad. Initially, a deficit is not a bad thing, but with time, it could affect an economy via job outsourcing and a falling economy. However, it becomes a problem when the deficit is persistent and the nation continuously attracts capital (foreign investment) that could buy up existing businesses, natural resources, and other assets. In case this buying continues, foreign investors could eventually own almost everything in the nation. By so doing, foreigners own and manage the affairs of the nation. This is not safe enough, as the foreigners might have control of the nation's security matters.

The *J*-curve effect is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC)⁸⁴ holds, it is likely that following a devaluation, an initial drop in the TB occurs before an improvement follows (Ziramba and Chifamba, 2014; Baek *et al.*, 2006). The response of the TB over time looks like a tilted J shape. The *J*-curve event is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). The presence of the *J*-curve is achieved when:

- a) The coefficient of REER is positive and statistically significant (i.e., the *t*-statistics $\geq |2|$) in the long run,
- b) While the short run coefficient of REER is negative and statistically significant (i.e., the *t*-statistics $\geq |2|$).

This is achieved when the coefficient of the error correction term (ECT) of the model is negative (with TB being the target variable) and statistically significant (with the *t*-stat $\geq |2|$, and the *p*-value < 0.05).⁸⁵ This will mean that a shock in the REER will cause TB to deviate in the short term before recovering and/or moving in the opposite direction in the long term. Thus, necessitating a check of both the long-run and short-run relationship.

⁸⁴ The condition states that devaluation improves the TB if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, (i.e., if: $|\eta_x + \eta_m| > 1$).

⁸⁵ The ECT is the speed at which a dependent variable returns to equilibrium after a change in other variables. If ECT has a negative sign and is statistically significant, it implies that any shock happening in the short-term will be corrected in the long-term.

The Autoregressive Distributed Lag (ARDL) approach by Pesaran *et al.* (2001) is used to investigate the presence of cointegration in the models. It allows us to determine the number of long-run equilibrium relationships between integrated variables irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$) or integrated of order one (i.e., the variables become stationary at first difference - $I(1)$).⁸⁶

The variables used are in their log form, with log trade balance (LNTB) being the dependent variable. The independent variables used are log real effective exchange rate (LNREER), log domestic income (LNDI), which is a proxy for each of the CEMAC nations' gross domestic production (GDP), and log foreign income (LNFI) for the individual trade partner's gross domestic product. The CEMAC nations used in this chapter are Cameroon, Central Africa Republic (CAR), and Gabon.⁸⁷ The dataset analyzed in this chapter are secondary, sourced from the World Bank – World Development Indicators. They are annual observations covering the period 1980 to 2018. This gives a total of 39 observations, which is enough for analysis purposes. The CEMAC nations not used are Equatorial Guinea, Chad, and Congo.⁸⁸ The rest of the chapter is as follows: section 4.2 deals with the relationship between REER and trade balance, section 4.3 deals with the J-curve effect, section 4.4 deals with the empirical model, section 4.5 deals with the econometric approach. Section 4.6 deals with the bilateral aggregate trade data approach results and analyses. Section 4.7 deals with aggregate trade data approach results and analyses. Section 4.8 deals with policy recommendations, while section 4.9 deals with the chapter's conclusion.

⁸⁶ Thus, Pesaran *et al.* (2001) compute two sets of critical values for a given significance level. One set assumes that all variables are $I(0)$ and the other set assumes they are all $I(1)$. If the computed F -statistic exceeds the upper critical bounds value, it implies there is cointegration. If the F -statistic is below the lower critical bounds value, it implies no cointegration. Lastly, if the F -statistic falls into the bounds, then the test becomes inconclusive. In such situation, one could look at the error-correction term in the ARDL's short-term representation (Kremers *et al.*, 1992). If the error-correction term is negative and statistically significant, it means that the variables are quick on approaching their long-term stabilizing condition and can be used to establish cointegration.

⁸⁷ Cameroon's main trade partners are China, France, India, Netherlands, and Spain. CAR main trading partners are Cameroon, China, France, India, and Nepal. While Gabon's main trade partners are China, Ireland, the Korean Republic, the Netherlands, and the United States of America (USA).

⁸⁸ The TB data of Equatorial Guinea is available between the periods 2005 to 2018, giving only 14 observations, which are not enough to perform the optimal lag length test – leading to the Autoregressive Distributed Lag (ARDL). As such, we will not be able to proceed with the test. Although both Chad and Congo TB data are available from the period 1980 to 2018, but their data for the REER is available only between the periods 2004 to 2018, giving 15 observations. These 15 observations are also not enough to perform an optimal lag length test leading to the ARDL test. As such, we will not be able to proceed with these three nations because the principal variables (i.e., REER, or TB) needed for the J-curve analysis do not have enough observations. The data used in this chapter have been transformed to their log form.

4.2 RELATIONSHIP BETWEEN REER AND TRADE BALANCE

It is highly contested among economists that currency devaluation improves a nation's trade balance (TB) deficit, leading to a reduction of the current account deficit and improving economic growth (Kurtović, 2017; Bahmani-Oskooee, 1985). An undervalued exchange rate is viewed as an improvement in price competitiveness and a means towards faster economic growth, as championed by Rodrik (2008) and supported by others (Kurtović, 2017; Grekou, 2015; Schroder, 2013; Cakrani *et al.*, 2013; Levy-Yeyati *et al.*, 2013). A REER devaluation could lead to the deterioration of TB in the short run while improving TB in the long run (Šimakova and Stavarek, 2015; Šimakova, 2013).

Quantifying the short-term and long-term responsiveness of the TB to changes in the exchange rate is vital to economic policy for numerous reasons. First, it establishes if there exists a stable long-term relationship between the exchange rate and TB. In case a stable long-term relationship does not exist, then devaluating a currency might not be a reasonable way of improving a nation's competitiveness in the long-run perspective. Second, if the long-term relationship exists, it is essential to establish if devaluation could lead to a net improvement of TB in the long term (causality) or not.⁸⁹ Third, quantifying the extent of the TB improvement is desirable because it enables one to weigh the TB benefit against the cost of devaluation (like foreign reserve accumulation) (Stučka, 2004). Fourth, the estimate of the short-term dynamics provides information regarding the immediate and medium-term impacts of exchange rate changes on the TB (i.e., does a devaluation have a short-term adverse impact on the TB). If it does, it is reasonable to estimate the persistence and the extent of such adverse impact.

It is also important to know so that when TB gets negative in the short term, there will not be much concern because it will improve in the long term. If this understanding of the short-term negative impact is absent, there could be panic and a rush to reverse the devaluation policy (or implementation of other policies), thinking that it will lead to a further deficit of TB. This is often an empirical question, and the literature refers to it as the *J*-curve effect. The economic concept of the *J*-curve and the exchange rate devaluation are closely related, with Magee (1973) being the first researcher to introduce the *J*-curve phenomenon.

The two aspects of the TB responsiveness to changes in the exchange rate are the long-term and the short-term response. The long-term describes the steady state between the new level of the REER and the TB. Once the steady state is attained, the dynamic responses are worn

⁸⁹ A long-term relationship could either result in the presence of a *J*-curve or an *S*-curve. An *S*-curve occurs when a currency devaluation leads to an initial improvement in the TB in the short-term and a drop in the long-term (thereby producing an *S*-sharp like movement of the TB).

out, and the system is in a new equilibrium (Sahlan *et al.*, 2018). While the initial short-term deterioration of TB as a response to the devaluation is referred to in the literature as the *J*-curve (Sahlan *et al.*, 2018; Kurtovic *et al.*, 2016; Bahmani-Oskooee and Kantipong, 2001; Rose and Yellen, 1989; Magee, 1973). The name stems from the pattern of the TB caused by contracts outstanding during the exchange rate change. The *J*-curve occurs because of the sticky domestic currency prices of exports, which are subject to medium-term contracts. Therefore, the export prices in foreign currency fall, while at the same time the import prices in terms of domestic output increase. After a certain time lagged, export and import volumes adjust to the new prices, and the TB starts improving. In other words, the *J*-curve represents a possible transition path from the old equilibrium level to the new equilibrium level.

Several other theories have been used in analysing the impact of exchange rate movements on nations' TB, which include the standard theory of international trade, the structuralists' (elasticity theory), the Keynesian (absorption theory), and the monetary theory, as earlier explained in the literature survey chapter (section 2.4). Among all the theories, the *J*-curve theory has had the most attention. The *J*-curve theory occupied the most recent empirical literature due to its ability to incorporate other older approaches indirectly and provide a novel approach to the issue by itself (Dhakar *et al.*, 2015). For instance, as stated by the Marshall-Lerner condition (MLC),⁹⁰ for currency depreciation to have a positive effect on the TB, the elasticities of demand for imports and exports must, in absolute terms, exceed unity. A long-term improvement of TB under the *J*-curve analysis can show that the condition is met (Bahmani-Oskooee and Wang, 2008).

Another approach is the Elasticity approach by Bickerdike-Robinson-Metzler, which states that for an exchange rate depreciation to improve the TB, the ultimate impact is determined by the interaction of the value and volume effects on the trade flow (Dhakar *et al.*, 2015; Hooy and Chan, 2008).⁹¹ In the short-term, the value effect is fast by changing the traded goods' prices. Due to currency depreciation, the value of imports increases when paid in domestic currency, while the volume of exports remains the same. Thus, the net exports decrease, causing the trade balance to worsen. But, in the long-term, the value effect itself leads to the improvement of TB via changing the volume of trade. The simultaneous combination of two effects causes this: firstly, the domestic market begins compensating for the relatively high price of imported products via the consumption of domestic production. Secondly, exports start improving due to the price competitive advantage of domestic products in the international markets. From the

⁹⁰ The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

⁹¹ The *J*-curve is also understood from the same perspective.

above-mentioned reasons, in this chapter we will examine the relationship between the CFA franc and the TB of CEMAC nations by investigating for the presence of the *J*-curve.

4.3 THE *J*-CURVE EFFECT

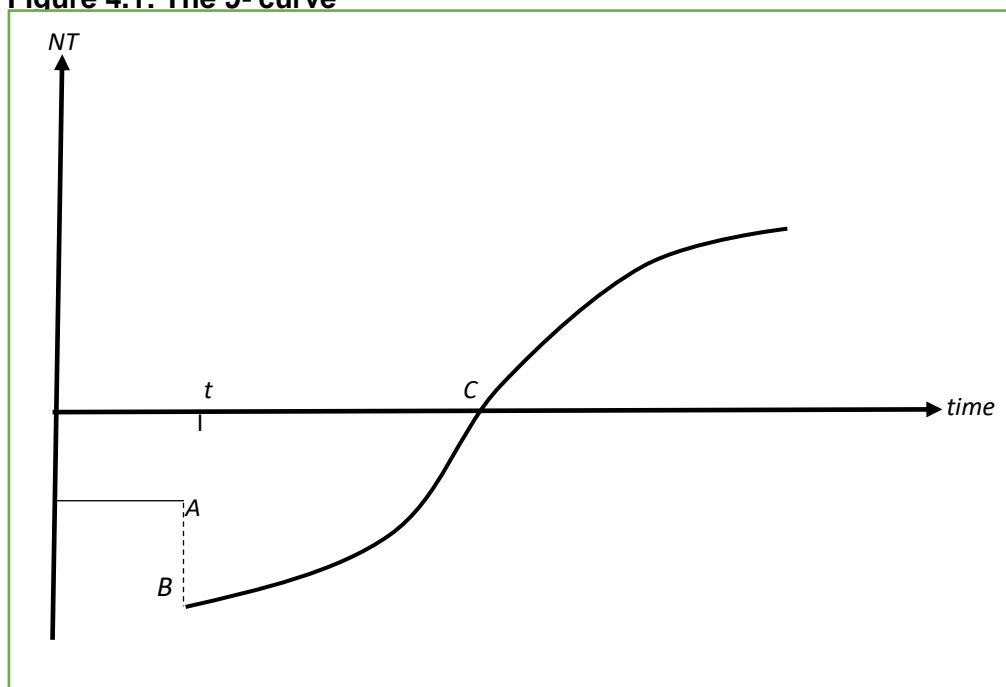
The *J*-curve theory is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC)⁹² holds, it is likely that following a devaluation, an initial drop in TB occurs before an improvement follows (Ziramba and Chifamba, 2014; Baek *et al.*, 2006). The response of the TB over time looks like a tilted *J* shape. The *J*-curve effect is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). For example, in case there is a devaluation of a domestic currency, then the increase in the domestic price competitiveness could result in the exportation of more and the importation of less. By so doing, it improves the TB, known as the volume effect. At the same time, the devaluation increases the import unit value, resulting in the deterioration of the TB, known as the price (value) effect. The price effect dominates in the short term, while the volume effect prevails in the long term, thereby causing the time path of the TB depicted by the *J*-curve phenomenon (Ziramba and Chifamba, 2014; Abd-El-Kader, 2013; Bahmani-Oskooee and Mitra, 2009; Baek *et al.*, 2006).

The *J*-curve assumption suggests that because of price rigidities in the short term, the devaluation of a domestic currency deteriorates the TB but improves it in the long term (Koray and McMillin, 1998). To explain the *J*-curve, we assume that a nation begins with a negative TB⁹³, and devalues its currency at time “*t*” when the TB is negative - point “A” as seen in (figure 4.1). As per the *J*-curve, the short-term response will be negative (i.e., the TB will decline more from point “A” to “B”). However, with time, the TB will improve such that it gets to point “C” and even get positive. Point “C” is when the TB is zero (i.e., there is neither trade deficit nor trade surplus). After point “C,” the nation begins to experience a trade surplus. The existence of the *J*-curve is very different across nations and vital to a nation’s policymakers (Stucka, 2003).

⁹² The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

⁹³ It is necessary to begin with the assumption that a nation’s TB is negative, because if it is not negative, then there will be no need for the authorities to devalue its currency with goal of improving the TB.

Figure 4.1: The J- curve



Source: Ziramba and Chifamba (2014).

It is believed that REER devaluation produces an improvement in TB in the long term after a short-term deterioration (Ziramba and Chifamba, 2014). The perverse short-term effect is thought to have a duration of about a year (Stucka, 2003; Krugman and Baldwin, 1987; Dornbusch and Krugman, 19976). It is the REER effect on the TB that is regarded as the *J*-curve. The cause of the *J*-curve is attributed to three adjustment periods: i) the currency contract period – which is point “A,” ii) the pass-through period – point “B,” and iii) the sluggish response (quantity-adjustment) period - point “C” (Magee, 1973).

Currency contract period - prior to signing a contract, economic agents take into cognizance their expectations concerning a future currency appreciation or devaluation to avoid a capital loss or make a capital gain. An exporter will desire payments in currencies expected to strengthen, while an importer will desire to make payments in currencies expected to weaken. The currency-contract period is a brief period immediately following a devaluation in which contracts negotiated before the change falls due. An example is a situation where domestic contracts are denominated in domestic currency, and domestic import contracts are denominated in foreign currency. In such a situation, a domestic currency devaluation increases the exchange rate and immediately deteriorates TB in the currency-contract period before any volume or price changes.

Pass-through period - the period after a devaluation in which the prices can change, but the quantities of exports and imports stay unchanged. This is the price (value) effect. The pass-through effect depends on the demand and supply elasticities of exports and imports. Because

quantity adjustments often take longer, in the short term, a successful pass-through signifies a worsening of TB (Ziramba and Chifamba, 2014). The constancy of quantities could be due to bottlenecks on either side: supply could be perfectly inelastic for a while because exporters cannot instantaneously change their output or sales abroad (for example is agriculture products - despite any changes, a cocoa tree will always have a set time period to produce cocoa beans). Similarly, demand may also be perfectly inelastic because importers need time to substitute between commodities and change their flow of orders. Considering a situation in which both domestic and foreign demand for imports is inelastic in the short term. As a result of a devaluation, the import price measured in domestic currency increases, but the demand stays the same, thereby leading to an increase in the value of imports (i.e., full pass-through). On the other side, the export price in foreign currency decreases by the same proportion of the exchange rate variation (full pass-through), and the export price in domestic currency remains unchanged. This helps in deteriorating the TB before any trade volume changes. In combining both the currency contract and the pass-through effects, the TB in local currency is expected to decrease following a J-curve pattern.

Sluggish response period – Also known as the quantity-adjustment period, it is the period in which quantities begin to adjust in response to changes in prices (this is known as the volume effect). In this circumstance, both the export and import elasticities increase, and the domestic volume of exports (imports) increases (decreases) in response to the increase (drop) in foreign (domestic) currency. Thus, the TB eventually improves as long as the ML condition is satisfied. Hence, Magee (1973) suggests that an increase in domestic activity or increases in domestic real income relative to activity abroad may swamp any favourable effects that the devaluation may generate. Initially, contracts already in force in specified currencies dominate the determinants of the current account. But, with time, new contracts done after the devaluation starts to dominate. During this brief period of pass-through, the TB may decrease because of the supply lags. Nevertheless, buying patterns do not change overnight due to changes in prices, and the TB could get worse during the early periods of the sluggish response because the price effects surpass the volume effect. The trend reverses in the long term when the TB improves, giving rise to a J-curve.

Though the J-curve effect improved the understanding of the impact of movements in the exchange rate on TB, it has undergone several stages of improvement. There exist three different approaches to investigating the presence of J-curve in a nation's TB, which include:

- i) Aggregate Trade Data Approach by Magee (1973).
- ii) Bilateral Aggregate Trade Data Approach by Rose and Yellen (1989).
- iii) Bilateral Disaggregate Trade Data approach by Doroodian *et al.* (1999).

The early studies of the *J*-curve used the aggregate trade data, which was the trade data of a nation with all its trading partners, to evaluate the overall relationship between the nation's TB and currency devaluation. The early researchers of this approach are Magee (1973) and Himarios (1985). Magee (1973) tested the impact of currency depreciation on TB in a study that introduced the *J*-curve as a novel approach (Dhakir *et al.*, 2015). The study analyzed the three periods following a currency devaluation: the currency-contract, the pass-through, and the quantity-adjustment periods. The study discussed the possibility of different effects of devaluation in the short term and long term. Though in a successful devaluation, the TB worsens in the short-term and improves in the long-term, the study "argues that there could also not be a *J*-curve because the TB can change in either direction in each period" (Dhakir *et al.*, 2015; Magee, 1973). However, findings based on the aggregate trade data approach are mixed and ambiguous, such that the significance of the *J*-curve could be poorly defined (Dhakir *et al.*, 2015).

Rose and Yellen (1989) argued that using the aggregate data in *J*-curve analysis creates an "aggregate bias," and they initiated the second approach, the "Bilateral Aggregate trade Data" approach. This approach tries to reduce the possible effect of "aggregation bias" and the measurement problems by selecting specific pairs of nations. The presence of an aggregate bias problem, which is a drawback of the aggregate approach by Magee (1973), may be due to the different nature of trade in each pair of nations. It could be possible for the *J*-curve to exist between a nation and one of its trading partners while there is no significant liaison between currency devaluation and TB with the nation's other trading partners. Taking this view into cognizance, an insignificant relationship between the exchange rate and the TB with a nation could offset a significant relationship with another trade partner.

Just like in the aggregate trade data approach, it is assumed that the bilateral aggregate trade data approach is inconsistent and is expected to suffer from aggregation bias because it uses aggregate trade data rather than commodity or sectorial trade data. Thus, the next approach looks at the analysis of the relationship between the exchange rate depreciation and the TB from a bilateral disaggregated trade data approach. This third and most recent approach focuses on the analysis of sectoral or commodity trade data, with the aim to further reduce the aggregation bias. There is absolutely no way or reason for each bilateral sector of trade to respond in a similar manner to currency depreciation. As stated by Doroodian *et al.* (1999), payments for agricultural products are made upon delivery; hence, the delivery lag is often longer than that of manufactured products⁹⁴. Bahmani-Oskooee and Hegerty (2010) pointed out that "aggregate or bilateral usually arrive at conflicting or ambiguous outcomes or at time

⁹⁴ They are of the opinion that "it is plausible testing the hypothesis that, the *J*-curve effect is more pronounced in agriculture products than in manufactured products".

no results at all.” As such, some researchers disapproved of the use of the two approaches because they could hide important information.⁹⁵ For this reason, disaggregating the trade data into sectors or industries is used to aid in revealing the significant results undetected at the higher levels of aggregations. Many studies have been done using this approach, such as Bahmani-Oskooee and Zhang (2013), Bahmani-Oskooee and Wang (2008), Doroodian *et al.* (1999).

The bilateral disaggregated trade data approach has also come under some criticism due to the blurry meaning of the term “commodity-level.” In some studies, it is referred to as a single commodity, i.e., *tomatoes*, as done by Alias *et al.* (2012). In other studies, it is looked at as a group of commodities rather than a single commodity (i.e., *soap, cleaning and polishing paper*) regarded as a single commodity by Bahmani-Oskooee and Wang (2008). In some other research, the term is more appropriately regarded as “industry level” (Ardalani and Bahmani-Oskooee, 2007). Nonetheless, in some studies, both groups of commodities and industrial level are used interchangeably (Bahmani-Oskooee and Hosny, 2013).⁹⁶ Thus, in this chapter we will use both the bilateral aggregate trade data approach by Rose and Yellen (1989) and the Aggregate Trade Data Approach by Magee (1973) to investigate for the presence of *J*-curve in the TB of CEMAC nations.

4.4 EMPIRICAL MODEL

Here, we specify the empirical model used to estimate the nature of the relationship between the REER and the TB of the individual CEMAC nations. These nations are small open economies and are price takers, implying that prices in the international market are settled by external institutions, and the CEMAC nations cannot influence the process. Thus, exports depend on the foreign income of the main destinations of CEMAC nations' exports and the REER of the CFA Franc (Dongfack and Ouyang, 2019).⁹⁷ However, China, Nepal, the Korean Republic, India, and the United States of America are among the main contributors to CEMAC nations' export revenue and are the most affected by the exchange rate fluctuations as the

⁹⁵ For example, a bilateral flow from imports could show a positive response to currency depreciation, while the export could show the opposite. Combining the two results as done in the aggregate approach, the responses could cancel each other out, as such causing a single unimportant effect.

⁹⁶ The reason for all the mingling could be attributed to the data sources. The two mainly used sources of commodity trade data are “the Standard International Trade Classification (SITC) and the Harmonized Commodity Description and Coding System (HS)” (Dhakir *et al.*, 2015). Though both sources are recognized as commodity classification systems, each of the nomenclature follows a distinct definition of sectors and commodities. This implies that when applied, it could eventually yield different results, which could be confusing and misleading. Above all, some nations, especially developing nations, might not have such systems or data, making the analysis of the nations' using this approach difficult.

⁹⁷ Ross and Yellen (1989) researched the bilateral *J*-curve between the USA and its trade partners following the Marshallian demand analysis, whereby the demand for imports by a home (foreign) nation is determined by the domestic (foreign) income and the relative price of imported goods.

CFA franc is not pegged to them. On the other hand, France, the Netherlands, the Republic of Ireland (Ireland), and Spain use the Euro to which the CFA franc is pegged.

We start by defining the model, which follows the standard "two-country" imperfect substitute model (i.e., the bilateral aggregate data approach) developed by Rose and Yellen (R&Y) (1989).⁹⁸ The key assumptions of the models are that neither exports nor imports are perfect substitutes for domestic goods, such that finite elasticities for demand and supply could be estimated for traded goods. The volume of imported goods demanded by domestic (foreign) residents positively depends on real domestic (foreign) income and negatively on the relative price of imported goods. The functional forms of the demand for exports and the demand for imports are:

$$X_t = f(REER_t, FI_t) + u_i \quad (4.1)$$

$$M_t = f(REER_t, DI_t) + v_i \quad (4.2)$$

Whereby, X_t = CEMAC nations real exports of goods and services.

M_t = CEMAC nations real imports of goods and services.

$REER_t$ = CEMAC nations real effective exchange rate.

DI_t = Domestic income, proxy by CEMAC individual nation's GDPs.

FI_t = Foreign income, proxy by main trading partners' GDP

u_i and v_i are the disturbing terms.

The functional and explicit forms of the model is:

$$TB_t = f(REER_t, DI_t, FI_t) + \varepsilon_i \quad (4.3)$$

$$TB_t = \alpha + \beta_1 REER_t + \beta_2 DI_t + \beta_3 FI_t + \varepsilon_i \quad (4.4)$$

The goal of this section is to analyse if REER devaluation remedies the trade deficit faced by the individual CEMAC nations or not. The REER may have a significant effect on the exports (X_t) and imports (M_t) used to evaluate the TB_t . The net exports, also known as the net trade

⁹⁸ The bilateral aggregate approach is used instead of the aggregate trade data approach or bilateral disaggregated trade data approach. This is because, firstly, analysing using this approach will identify the trade partner with a J-curve. This helps policymakers to legislate policies that will encourage trade with such individual trade partners and, by so doing, improve the nations' entire trade balance, BoP, and economic growth. As such, achieving the initial goal of the 1994 CFA franc devaluation was to improve the BoP and economic growth. Secondly, if the analysis is done from an aggregate or macro perspective, there might be the presence of an aggregate bias problem, or we might not be able to have a vivid inside look at the individual relationship between each of the CEMAC nations and their individual trading partners as mentioned above. Thirdly, analysing from the industrial or sectorial level (bilateral disaggregated trade data approach) might not give a clear picture of the entire impact of the devaluation since we might not be able to capture all the industries or sectors of a nation. This is because CEMAC nations are developing nations, and data on some sectors might be hard to come by or not available. Above all, one of the objectives of the research is to establish if the 1994 CFA devaluation improved the individual CEMAC nations' trade balance from a holistic perspective and not from a sectorial or industrial level.

balance, are a common means of evaluating the state of the trade balance: positive value ($X_t - M_t > 0$) is a trade surplus, while negative net exports ($X_t - M_t < 0$) imply a trade deficit. Because the net exports of the CEMAC nations have numerous occurrences of negative values from 1980s to 2018, this does not allow TB to be expressed in logarithm form (Ln). For the TB to be expressed in log form, it must be measured in ratio of exports to imports.⁹⁹ This formula describes the state of the TB wherein the equilibrium value switches from 0 to 1. Values greater than 1 ($X_t/M_t > 1$) imply a trade surplus, while values less than 1 ($X_t/M_t < 1$) imply a trade deficit. The natural logarithm function of the trade balance [$Ln(TB_t) = Ln(X_t/M_t) = Ln(X_t) - Ln(M_t)$] has the advantage of making the estimated coefficients directly interpretable as a percentage change and a measure of elasticity, thereby letting us check if the Marshall-Lerner condition (MLC) is fulfilled or not (Dongfack and Ouyang, 2019; Onafowora, 2003).¹⁰⁰ Also, it eliminates the need of explaining the dependent variable (TB) in real terms with the appropriate price index.

4.4.1 TYPES AND SOURCE OF DATA

This section deals with the variables used to investigate the presence of the *J*-curve between each of the CEMAC nations and their main trading partners. The data used are secondary annual data within the period 1980 to 2018. Data within this period were available for Cameroon, CAR, and Gabon, which will be used to represent the CEMAC nations. We will not use Equatorial Guinea, Chad, and Congo due to insufficient data. Though Equatorial Guinea's data for REER is within the period 1985 to 2018, its data for TB is from the year 2005 to 2018. This gives a sum of 14 observations, which is insufficient for analytical purposes. As for Congo and Chad, though their data for TB is from the year 1980 to 2018, their data for REER is between the periods 2004 to 2018. This gives a sum of 15 observations, which are also insufficient for analytical purposes. Cameroon's main trade partners are China, France, India, the Netherlands, and Spain. CAR's main trading partners are Cameroon, China, France, India, and Nepal. Gabon's main trading partners are China, Ireland, the Korea Republic, the

⁹⁹ This ratio has been used by Bahmani-Oskooee and Alse (1994), Bahmani-Oskooee (1991), Haynes and Stone (1982). The use of ratio has the following advantages: Firstly, it is invariant to units of measuring exports to imports, that is, whether they are in real or nominal terms or in foreign or domestic currency. Secondly, the regression equation could be expressed in log-linear form or constant elasticity form.

¹⁰⁰ There have been situations whereby the MLC was satisfied, yet there was still trade balance deterioration (Bahmani-Oskooee and Niroomand, 1998; Rose, 1990; Bahmani-Oskooee, 1985). This has warranted a further approach to be looked at, thus necessitating the test for the *J*-curve.

Netherlands, and the United States of America (USA).¹⁰¹ Thus, these three CEMAC nations will be used to represent the CEMAC zone.

The variables used are in their log form, with log trade balance (LNTB) being the dependent variable. The independent variables used are log real effective exchange rate (LNREER), log domestic income (LNDI), which is a proxy for each of the CEMAC nations' gross domestic production (GDP), and log foreign income (FI) for the individual trade partners' gross domestic production (GDP). The variables are better explained below.

Trade Balance (TB) – is the exports to imports ratio of each of the CEMAC nations. That is, $TB = \text{Exports of goods and services (current US\$)} / \text{Imports of goods and services (current US\$)}$. Exports deal with all the goods and services sold to foreign nations expressed in current US\$. While imports are all the foreign goods and services entering the nation within the set timeframe expressed in the current US\$ (World Bank, 2020). This formula describes the state of the TB wherein the equilibrium value switches from 0 to 1. Values greater than 1 ($X_t/M_t > 1$) imply a trade surplus, while values less than 1 ($X_t/M_t < 1$) imply a trade deficit. The data is from the World banks - World Development Indicators (WDI) database updated on 18/03/2020.

Real Effective Exchange Rate (REER) index - is the measure of the value of a nation's currency against a weighted average of foreign trade partners' currencies divided by a price deflator or index of costs. An increase in the REER implies that the exports of the nation have become more expensive, and imports have become cheaper. This increase indicates a loss in the domestic nation's trade competitiveness. The reverse is true when the REER experiences a decrease. The REER movements based on different years can be interpreted differently. The primary criterion for a base year is that both internal and external equilibrium should be simultaneously met in the specific year. That is, the REER is assumed to be at both internal and external equilibrium when it has an index value of 100. If the value is above 100, the exchange rate is assumed to be overvalued, and if it is less than 100, it is assumed to be devalued. International financial organisations like the World Bank and IMF often publish the REER every ten years. The REER used in this research is the real effective exchange rate index for the base year of 2010 = 100, with the data collected from the World Bank Development Indicator (WDI).

In this research, the REER "is the nominal index adjusted for relative changes in consumer prices. That is, the REER is the nominal effective exchange rate (NEER) index adjusted for relative movements in the national price or cost indicators of the home country, selected

¹⁰¹ The source of the trade partners is from the World Integrated Trade Solution -WITS Data (Worldbank.org, 2020).

countries, and the euro area (expressed on the base year 2010 = 100) (World Bank, 2020)". An increase in the REER above the base year '100' represents an appreciation of the local currency, while a decrease represents a depreciation of the local currency. The data were collected from the World Bank - World Development Indicators (WDI) database, last updated on 18/03/2020.

Domestic income (DI) - is proxy by each of the CEMAC nations' gross domestic production (GDP). "The GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. Data are in current US dollars. Dollar figures for GDP are converted from domestic currencies using single-year official exchange rates" (World Bank, 2020). The data is from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. A rise in domestic income levels would make foreign goods to be more desirable to domestic consumers. Thus, an increase in import demand, which in turn worsens the trade balance and vice versa.

Foreign income (FI) - is proxy by the main trading partners' GDP (i.e., Cameroon, China, France, India, Korean Republic, Ireland, Nepal, Netherlands, Spain, USA). The GDP of the trading partners is calculated the same way as that of DI. The data is from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. A rise in foreign income levels would make locally produced goods to be more desirable to foreign consumers. Hence, an increase in exports could, in turn, improve the trade balance.

4.5 ECONOMETRIC APPROACH

Following Bahmani-Oskooee and Brooks (1999) and Bahmani-Oskooee and Goswami (2003) the bilateral trade balance model takes the following form:

$$LnTB_t = \alpha + \beta_1 LnREER_t + \beta_2 LnDI_t + \beta_3 LnFI_t + \varepsilon_t \quad (4.5)$$

Whereby

$LnTB_t$ is the CEMAC individual nation's trade balance with its trade partner (i.e., it is the ratio of exports to import at time t).

$LnDI_t$ is the GDP of the individual CEMAC nations (the domestic nation),

$LnFI_t$ is the trading partner's real GDP.

ε_t is the disturbance term,

Ln stands for the natural logarithm.

$LnREER_t$ is the real effective exchange rate. Here, the REER is defined in such a way that an increase represents a real devaluation of the CFA franc and a decrease represents an appreciation of the CFA franc.

As far as the sign expectations in the above equation is concerned, it is expected that an estimate of β_2 would be negative on the assumption that an increase in the CEMAC nations' income will raise the demand for imports. Similarly, an increase in the partner's income raises the exports, thereby yielding a positive estimate for β_3 . Meanwhile, the primary focus of this chapter is the coefficient for the exchange rate (β_1). If real devaluation of the CFA (an increase in REER) improves the trade balance, an estimate of β_1 should be positive. That is, we expect its long-term version to be positive ($\beta_1 > 0$) because, in theory, exchange rate depreciation (which is represented by an increase in REER) will lead to an improvement in the trade balance in the long-term. In the short-term, the estimate of β_1 must be negative (i.e., $\beta_1 < 0$) since the TB must diminish due to a dominating price effect, which will in turn engineer the *J*-curve dynamic. Thus, we need a method that demonstrates both the long-term and short-term behaviour of the TB in response to exchange rate innovations.

In this chapter, we used the Autoregressive Distributed Lag (ARDL) of Pesaran *et al.* (2001). This approach is used due to the following advantages it possesses: i) The short- and long-terms parameters are estimated simultaneously. ii) It can be applied irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$) or integrated of order one (i.e., the variables become stationary at first difference - $I(1)$). iii) It has a better small sample property vis-à-vis multivariate cointegration test (i.e., it is more useful when sample size is small between 30 to 80 observations) (Mndaka *et al.*, 2022). iv) The ARDL bounds testing approach to cointegration is free from any problem faced by traditional techniques such as Engle-Granger (1987), Philips and Hansen (1990), Johansen and Juselius (1990), Johansen (1991) and Johansen (1992) maximum likelihood ratio in economic literature. The error correction method integrates the short-term dynamics with the long-term equilibrium, without losing long-term information. The estimation procedure for the ARDL approach entails the following steps:¹⁰²

The steps to estimate ARDL Model using EViews 12 are as follows:

1. Perform some Diagnostic Test.
2. Determine the optimal lag length (p) using the information criterion.
3. Test for Stationarity (Unit Root).
 - a) If Unit Root stationary at level $I(0)$, we can use Simple regression.
 - b) If Unit Root stationary at first difference $I(1)$, we can apply cointegration.
 - c) If Unit Root stationary at level $I(0)$ and first difference $I(1)$ not second difference $I(2)$, we apply ARDL model.
4. Perform ARDL test

¹⁰² This is done after the data are imported from Microsoft excel to EViews12 econometric software application.

- a) Test for cointegration and long-run form (Short-run and Long-run estimation).
- b) Test for Bound Test (F-statistics).
- 5. If there is cointegration, we apply Error Correction Model (ECM).
- 6. If there is no cointegration, we apply VAR model.
- 7. Ensure the model is stable by applying (CUSUM and CUSUMQ graph).

4.5.1 DIAGNOSTIC TESTS

To assess the reliability of the results, several diagnostic tests will be performed. The three main tests done are: VEC residual normality test, VEC residual heteroscedasticity test, VEC residual serial correlation (Autocorrelation) test. These tests will be performed on EViews 12, and the normality test result is composed of the results for Skewness, Kurtosis, and Jarque-Bera. We are interested in the Jarque-Bera test because it factors in both the Skewness, and Kurtosis in its computation. If the p -value > 0.05 , it implies that the residuals are normally distributed, and vice versa if the p -value < 0.05 . The p -value of both the heteroscedasticity test and the serial correlation test must also be greater than 5% for the model to be good.

Normality Test: The normality test allows us to determine if the data is normal or not. The normality test is a test for the normality of data (i.e., it is a specific statistical distribution called a normal distribution or Gaussian distribution or bell-shaped curve). The normal distribution is a symmetrical continuous distribution defined by the mean and standard deviation of the data. The normality test is not whether the data is exactly consistent with a normal distribution, rather if the data is close enough to normal that one could use statistical tools without concern. The normality test is a hypothesis test; whereby:

The null hypothesis (H_0): the data is not different from a normal distribution and the p -value > 0.05 (i.e., the residual of the components is normally distributed).

The alternative hypothesis (H_1): the data is different from a normal distribution and the p -value < 0.05 (i.e., the residual of the components is not normally distributed).

Using EViews 12, the normality test result is composed of the results for Skewness, Kurtosis, and Jarque-Bera. We are interested in the Jarque-Bera (JB) test because it factors in both the Skewness, and Kurtosis in its computation.¹⁰³ If the p -value > 0.05 , it implies that the residuals are normally distributed, and vice versa if the p -value < 0.05 .

¹⁰³ In statistics, the Jarque-Bera (JB) is a goodness-of-fit test of whether a sample data has a skewness and kurtosis matching a normal distribution. This test is always non-negative, far from zero and it signals that the data do not have a normal distribution (Jarque and Bera, 1987). The JB test statistic is defined as:

$$JB = \frac{n}{6} \left(S^2 + \frac{1}{4} (K - 3)^2 \right)$$

Serial Correlation Test: Also known as autocorrelation test, is a test to measure the relationship between a variable's present value and any past values. In other words, it is a test to ensure that the past values of a time series do not influence the present value. Autocorrelation is an ideal method for uncovering trends and patterns in times series data that would have otherwise gone undiscovered. As such, this might cause our analysis to be biased since the time series is not independent as errors in one period depends on error in previous period(s). Autocorrelation could often be removed by adding additional explanatory (independent) variables and/or changing functional form.

The null hypothesis (H_0): there is no autocorrelation in the data and the p -value > 0.05 .

The alternative hypothesis (H_1): there is autocorrelation in the data and the p -value < 0.05 .

In this research, the Breusch-Godfrey serial correlation Lagrange multiplier (LM) test will be used in EViews 12 to investigate the presence of autocorrelation in the time series.¹⁰⁴ This is

Whereby

n is the number of observations (degree of freedom in general),

S is the sample skewness

K is the sample kurtosis:

$$S = \frac{\hat{u}_3}{\hat{\sigma}^3} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^3}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \right)^{3/2}},$$

$$K = \frac{\hat{u}_4}{\hat{\sigma}^4} = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^4}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \right)^2},$$

Whereby, \hat{u}_3 and \hat{u}_4 are the estimates of third and fourth central moments, respectively.

\bar{x} is the sample mean, and $\hat{\sigma}^2$ is the estimate of the second central moment, the variance. In case the data is from a normal distribution, the JB statistic asymptotically has a chi-squared distribution with two degree of freedom. The statistic could be used to test the hypothesis that the data are from a normal distribution. The null hypothesis is a joint hypothesis of the skewness being zero and the excess kurtosis being zero. Thus, samples from a normal distribution have an expected skewness of 0 and an expected excess kurtosis of 0 (which is same as a kurtosis of 3). As stated by JB definition, any deviation from this increases the JB statistic.

¹⁰⁴ The Breusch-Godfrey (BG) test is often used to test for the presence of serial correlation that has not been included in a proposed model structure, which if present could imply that incorrect conclusions could be drawn from other tests or that sub-optimal estimates of model parameters could be obtained.

We consider the linear regression:

$$Y_t = \beta_1 + \beta_2 X_{t,1} + \beta_3 X_{t,2} + \mu_t$$

Where the errors might follow an $AR(p)$ autoregressive scheme, as follows:

$$\mu_t = \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \dots + \rho_p \mu_{t-p} + \varepsilon_t.$$

The simple regression model is first fitted by ordinary least squares to obtain a set of sample residuals $\hat{\mu}_t$.

If the following auxiliary regression model is fitted:

$$\hat{\mu}_t = \alpha_0 + \alpha_1 X_{t,1} + \alpha_2 X_{t,2} + \rho_1 \hat{\mu}_{t-1} + \rho_2 \hat{\mu}_{t-2} + \dots + \rho_p \hat{\mu}_{t-p} + \varepsilon_t$$

and if the usual R^2 statistic is calculated for the model, with the following asymptotic approximation could be used for the distribution of the test statistic

$$nR^2 \sim \chi_p^2,$$

a chi-squared test: if the test statistic has a p -value > 0.05 (observed R^2), the model is said to have no autocorrelation and vice versa.

Heteroscedasticity Test: The opposite, being homoscedasticity – is used in statistics, especially in the context of linear regression or for time series analysis, to describe the case where the variance of errors or the model is not the same for all observations. One of the basic assumptions in modelling is that the variances are homogeneous and that the errors of the model are identically distributed. In linear regression analysis, the fact that the error of the model (also named residuals) is not homoscedastic has the consequence that the model coefficients estimated using ordinary least square (OLS) are neither unbiased nor those with minimum variance. The estimation of their variance is not reliable. If suspected that the variances are not homogeneous (a representation of the residuals against the explanatory variables may reveal heteroscedasticity). As such, it is imperative to perform a test for heteroscedasticity, with the following null and alternative hypothesis:

The null hypothesis (H_0): there is no heteroscedasticity (residuals are homoscedastic) and the p -value > 0.05 .

The alternative hypothesis (H_1): there is heteroscedasticity in the data and the p -value < 0.05 .

In statistic, the Breusch-Pagan is used to test for heteroskedasticity in a linear regression model. It tests if the variance of the errors from a regression is dependent on the values of independent variables. ¹⁰⁵

4.5.2 TEST FOR STATIONARITY (UNIT ROOT TEST)

Stationarity of a series (i.e., a variable) implies that its mean, variance, and covariance are constant over time. This means that the series is *time invariant*. However, if this is not the case, it means that the series is non-stationary. A non-stationary variable has a definite positive or negative trend over time and is said to have a unit root. To see why, consider a

when the null hypothesis $H_0 : \{\rho_i = 0 \text{ for all } i\}$ holds (i.e., there is no serial correlation of any order up to ρ). Thus, n is the number of data-points available for the second regression, that for $\hat{\mu}_t$,

$n = T - \rho$,

whereby T is the number of observations in the basic series. The value of n depends on the number of lags of the error term (ρ).

¹⁰⁵ We can fit a three-variable multiple linear regression with formula $\hat{y}_i = \hat{\beta}_0 x_{1i} + \hat{\beta}_2 x_{2i}$ we obtain regression residuals \hat{e}_i with formula $\hat{e}_i = y_i - \hat{y}_i$ are the estimated differences between actual y_i and fitted \hat{y}_i values.

The Breusch-Pagan test auxiliary regression with formula $\hat{e}_i^2 = \hat{\gamma}_0 + \hat{\gamma}_1 x_{1i} + \hat{\gamma}_2 x_{2i}$

The *chi-square test* with joint null hypothesis that independent variables coefficients are equal to zero with formula $H_0: \hat{\gamma}_1 = \hat{\gamma}_2 = 0$. If joint null hypothesis is rejected, then regression errors are assumed heteroskedastic.

variable whose time series is represented by a first-order, autoregressive scheme, AR (1) for short, i.e.

$$Y_t = \alpha Y_{t-1} + \varepsilon_t \quad (4.6)$$

where ε_t is a standard normal variable.

If α is less than one, then the time path is stationary, i.e., although it will fluctuate the value of Y_t will tend to keep coming back to its mean value. Graphically the time path of Y_t will have no upward or downward trend, and the fluctuations around the constant mean value will be contained within constant bounds.

However, if α is equal to one, the time path of Y_t is non-stationary, and it will have an upward trend. As α is known as the root of the process, non-stationarity implies having a unit root. A time series is a level series if it does not have unit root (stationary or no random walk). A non-stationarity variable could be made stationary by differencing. This removes the trend in the series taking the first difference:

$$\Delta Y_t = Y_t - Y_{t-1}.$$

Annual data's (such as exchange rate) first difference are always stationary and are said to be integrated of order 1 to make it stationary and is written as $I(1)$. In case it is still not stationary after the first difference, it will be differenced the second time (twice) to make it stationary, (i.e., Y_t and ΔY_t are non-stationary, but $\Delta^2 Y_t$ is stationary). In this case, Y_t is said to be integrated of order 2, written $I(2)$.

There exist different ways of testing for stationarity.

- a) Informal testing (time plot): Plotting of the series on a graph to visualise its nature. If the graph shows trends, it could mean that the series has unit root and vice versa.
- b) Formal test: to examine the existence of unit root, we shall apply the following test:
 - The Augmented Dickey-Fuller '*ADF*' test.
 - Philips-Perron '*PP*' test.

Perform an ADF Test

To test a variable Y_t for a unit root the following regression equation is estimated:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \alpha_2 Y_{t-1} + \log \Delta Y_t + \varepsilon_t \quad (4.7)$$

The first difference of Y_t is regressed against a constant, a time trend ($t = 1, 2, \dots, T$), the first lag of Y_t , and, if necessary, lags of ΔY_t . Sufficient lags of ΔY_t must be included to ensure no autocorrelation in the error term. One lag (or even no lags) is usually sufficient with annual data. The test for a unit root (i.e., non-stationarity), is based on the *t*-statistic on the coefficient of the lagged dependent variable, Y_{t-1} .

Both the null and alternative hypotheses are express as:

Null Hypothesis (H_0): series has unit root, (i.e., if the p -value > 0.05).

Alternative Hypothesis (H_1): series does not have unit root, (i.e., if p -value < 0.05).

The null hypothesis is rejected (i.e., the series does not have unit root) if the absolute value of the computed *ADF* and/or *PP* test statistic is greater than the test critical values.¹⁰⁶ That is, when the probability value is less than 0.05 (p -value < 0.05), the model is stationary and as such, the null hypothesis is rejected (while the alternative hypothesis is accepted). However, if the *ADF* and/or *PP* are less than the test critical value, (i.e., if the p -value > 0.05), it means that the model has unit root, and the null hypothesis is not rejected. The series must be difference to remove the unit root.

4.5.3 DETERMINE OPTIMAL LAG LENGTH

In economics, the dependence of a variable Y on another variable X is rarely instantaneous. That is, most often the dependant variable Y response to the independent variable X with a lapse of time. Such lapse of time is referred to as a lag. This means that Y does not response to X immediately. Thus, there is a lag between the response time. We need to be careful on the number of lags we put in our model because too many lags often lead to loss of degree of freedom. It could also cause multicollinearity among the regressors, it could lead to serial correlation in the error terms, and misspecification error. On the other hand, too few lags could result in specification errors.

Hence, the question on the number of lags to be use in a model is empirical. Most often, the number of lags for annual data is typically small (1 or 2), for quarterly data (1 to 8 lags is appropriate), and for monthly data (6, 12, or 24 lags if there are sufficient data points). The optimal lags can be chosen using the following information criterion: Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), Hannan-Quinn information criterion (HQ). The asterisk (*) on the values indicate the lag order selected by the information criterion, and the criterion with the lowest * value's lag length is chosen as the optimal lag length.

4.5.4 COINTEGRATION TEST

In this chapter, we use the Autoregressive Distributed Lag (ARDL) of Pesaran *et al.* (2001) to investigate the presence of cointegration in the models. It allows us to determine the number of long-run equilibrium relationships between integrated variables irrespective of whether the

¹⁰⁶ The *PP* test is a modification of the *ADF* test, where it includes the deterministic time trend term which accounts for a potential linear trend in the dataset. Here the null hypothesis states that the series has unit root, while the alternative statistic states the absence of unit root.

variables are integrated of order zero (i.e., the variables are stationary at level form - **I(0)**) or integrated of order one (i.e., the variables become stationary at first difference - **I(1)**).

The ARDL (or the bounds testing approach) is formulated as follows:¹⁰⁷

$$\Delta \ln TB_t = \alpha_0 + \sum_{i=1}^m \beta_0 \Delta \ln TB_{t-i} + \sum_{i=0}^m \beta_1 \Delta \ln REER_{t-i} + \sum_{i=0}^m \beta_2 \Delta \ln DI_{t-i} + \sum_{i=0}^m \beta_3 \Delta \ln FI_{t-i} + \beta_4 \ln TB_{t-i} + \beta_5 \ln REER_{t-i} + \beta_6 \ln DI_{t-i} + \beta_7 \ln FI_{t-i} + \varepsilon_t \quad (4.8)$$

Whereby m stands for the lag length. The Pesaran *et al.* (2001) cointegration procedure is briefly outlined as follows. The bounds testing procedure is based on the F or Wald-statistics and is the first stage of the ARDL cointegration method. The long-term effect of real depreciation is inferred by the size and significance of β_5 that is normalized by β_4 . The null of no cointegration hypothesis, ($H_0: \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$) is tested against the alternative hypothesis, ($H_1: \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$). The F test used for this procedure has a non-standard distribution. Thus, Pesaran *et al.* (2001) compute two sets of critical values for a given significance level. One set assumes that all variables are **I(0)** and the other set assumes they are all **I(1)**. If the computed F-statistic exceeds the upper critical bounds value, then the H_0 is rejected. If the F-statistic is below the lower critical bounds value, it implies no cointegration. Lastly, if the F-statistic falls into the bounds, then the test becomes inconclusive. In such situation, one could look at the error-correction term in the ARDL's short-term representation (Kremers *et al.*, 1992). If the error-correction term is negative and statistically significant, it means that the variables are quick on approaching their long-term stabilizing condition and can be used to establish cointegration.

A general error correction model (ECM) of the above equation is formulated as follows:

$$\Delta \ln TB_t = \alpha_0 + \sum_{i=1}^m \beta_0 \Delta \ln TB_{t-i} + \sum_{i=0}^m \beta_1 \Delta \ln REER_{t-i} + \sum_{i=0}^m \beta_2 \Delta \ln DI_{t-i} + \sum_{i=0}^m \beta_3 \Delta \ln FI_{t-i} + \lambda EC_{t-1} + \varepsilon_t \quad (4.9)$$

Where λ is the speed of adjustment parameter and EC or error term is the residuals that are obtained by estimates normalized coefficient in model of equation (5.7).

4.5.5 STABILITY TEST

We check if the estimated regression equations are stable throughout the sample period of the study. Parameter stability tests play a vital role in ensuring reliability of policy simulation based on the model. To test for stability following Bahmani-Oskooee and Goswami (2003), we apply the cumulative

¹⁰⁷ From the equation below, both the long-run and short-run equation of the model are as seen below:

Long-Run Equation

$$\ln TB_t = \alpha_0 + \beta_4 \ln TB_{t-i} + \beta_5 \ln REER_{t-i} + \beta_6 \ln DI_{t-i} + \beta_7 \ln FI_{t-i} + \varepsilon_t$$

Short-Run Equation

$$\Delta \ln TB_t = \alpha_0 + \sum_{i=1}^m \beta_0 \Delta \ln TB_{t-i} + \sum_{i=0}^m \beta_1 \Delta \ln REER_{t-i} + \sum_{i=0}^m \beta_2 \Delta \ln DI_{t-i} + \sum_{i=0}^m \beta_3 \Delta \ln FI_{t-i} + \varepsilon_t$$

sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The advantage of this approach is that it selects the break points recursively rather than arbitrarily. According to the CUSUM test the recursive residuals are plotted against the break points while the CUSUMSQ plots the squared recursive residuals against the break points. As a graphical illustration, these two statistics are then plotted with two straight lines which are bounded by 5% significance level. If any point lay beyond the 5% significance level, the null hypothesis of stable parameters is rejected.¹⁰⁸

4.6 BILATERAL AGGREGATE TRADE EMPIRICAL ANALYSIS

The bilateral aggregate trade data approach focuses on the trade relation between each of the CEMAC nations and their individual trade partners. This approach tries to reduce the possible effect of “aggregation bias” and the measurement problems by selecting specific pairs of nations. The presence of aggregate bias problem, which is a drawback of the aggregate trade data approach by Magee (1973), may be due to the different nature of trade in each pair of nations. It could be possible for the J-curve to exist between a nation and one of its trading partners, while there is no significant liaison between currency devaluation and TB with the nation’s other trading partners. Taking this view into consideration, an insignificant relationship between the exchange rate and the TB with a nation could offset a significant relationship with other trade partners (Dhakir *et al.*, 2015).

Also, analysing from industrial or sectorial level (bilateral disaggregate trade data approach) might not give a clear picture of the entire impact of the devaluation, since we might not be able to capture all the industries or sectors of a nation. This is largely because CEMAC nations are developing nations, and data on some sectors might be hard to come by or not available. Using such approach with insufficient data could give incomplete and misleading results. As

¹⁰⁸ The CUSUM charts are constructed by calculating and plotting a cumulative sum based on the data. Let X_1, X_2, \dots, X_n represent n^{th} data points. From this, the sums S_0, S_1, \dots, S_n are calculated. The n data points lead to $n + 1$ (0 through n) sums. The cumulative sums are calculated as follows: Calculate the average:

$$\bar{X} = \frac{X_1 + X_2 + \dots + X_n}{n}$$

Start the cumulative sum at zero by setting $S_0 = 0$.

Calculate the other cumulative sums by adding the difference between the current value and the average to the previous sum, i.e.:

$$S_i = S_{i-1} + (X_i - \bar{X})$$

For $i = 1, 2, \dots, n$.

The cumulative sum is not the cumulative sum of the values. Rather, it is the cumulative sum differences between the value and the average. Because the average is subtracted from each value, the cumulative sum also ends at zero ($S_{24} = 0$). The CUSUM chart will then be interpreted as follows: the section on the CUSUM chart with an upward slope indicates the period the value is above average and vice versa.

such, to get a better inside the bilateral approach is used. We begin the analysis with the diagnostic test.

4.6.1 DIAGNOSTIC TEST RESULTS

To assess that the data used in this section are good, the following diagnostic tests were performed; normality test, serial correlation (autocorrelation) test, and heteroskedasticity test. The normality test is a test to see if the data are normally distributed as earlier explained. The normality test result (Jarque-Bera test) is said to be normally distributed when its p -value > 0.05 , implying that the residuals are normally distributed, and vice versa if the p -value < 0.05 . The autocorrelation test (Breusch-Godfrey test) is to test that past value of a time series do not influence the present value. The null hypothesis states that the model is not having serial correlation (meaning that error in one period does not depend on error in previous periods), and this is confirmed when the p -value > 0.05 and vice versa.

Heteroscedasticity test (Breusch-Pagan test) is a test to ensure that the variances of the model are homogeneous and that the error of the model are identically distributed. This is confirmed when the p -value > 0.05 and vice versa. The diagnostic test for the three nations is summarize in the table below.

Table 4.1: Diagnostic Test Results

Cameroon						
Component	Diagnostic Test	China	France	India	Netherlands	Spain
		p -value	p -value	p -value	p -value	p -value
1	Normality Test	0.245	0.335	0.176	0.905	0.979
2	Autocorrelation	0.519	0.579	0.663	0.573	0.597
3	Heteroscedasticity	0.536	0.365	0.671	0.662	0.629
CAR						
Component	Variable	Cameroon	China	France	India	Nepal
		p -value	p -value	p -value	p -value	p -value
1	Normality Test	0.002	0.005	0.203	0.111	0.254
2	Autocorrelation	0.30	0.896	0.738	0.369	0.634
3	Heteroscedasticity	0.935	0.845	0.578	0.244	0.913
Gabon						
Component	Variable	China	Ireland	Korea	Netherlands	USA
		p -value	p -value	p -value	p -value	p -value
1	Normality Test	0.03	0.201	0.001	0.065	0.000
2	Autocorrelation	0.931	0.769	0.387	0.832	0.786
3	Heteroscedasticity	0.132	0.221	0.543	0.134	0.249

Source: Computation from time-series data using EViews 12.

Cameroon

From the above table, all the diagnostic test results (normality, autocorrelation, and heteroscedasticity test) of Cameroon's models' have p -values > 0.05 . This implies that the models are good and reliable to be used in this thesis.

CAR

For the CAR results, all the models' tests are good, but the normality test results for Cameroon and China models. The normality test result for Cameroon and China models' p -value < 0.05 , meaning it is not normally distributed. However, the models are good from a holistic perspective as the autocorrelation and heteroscedasticity results are good and could be used in the research.

Gabon

For Gabon's results, in all the models, the autocorrelation and heteroscedasticity p -value > 0.05 , meaning that they are good. While for the normality results, China, Korea, and USA models p -value < 0.05 , meaning that they are not normally distributed. However, the models are good from a holistic perspective and will be used in the research. Thus, the models used in this research question are good and can be used for the various tests, beginning with the unit root test as seen below.

4.6.2 UNIT ROOT TEST

An analysis for the presence of unit root is performed using the *Augmented Dickey-Fuller* (ADF) and *Philips-Perron* (PP) test for the variables of the three CEMAC nations and their trade partners. The test results are summarised on table 4.2 in the appendix B, whereby the variables are tested using two options (i.e., with constant, and with Trend and Interception).¹⁰⁹ The result indicates the non-existence of the $I(2)$ variable in our study. From the table on both the ADF and PP test, the absolute values of most variables are stationary after their first difference, but for LNTB for Cameroon, LNTB for Gabon, and LNUSAFI – Gabon trade partner that were stationary at level. This justifies the use of ARDL approach to cointegration.¹¹⁰

4.6.3 OPTIMAL LAG LENGTH

The optimal lag length, as discussed in the previous chapter, is used to obtain the lag length to be used.¹¹¹ The Vector Autoregression Estimate shows the Akaike information criterion (AIC)¹¹² as having the lowest, as such, will be used to obtain the optimal lag. The optimal lag

¹⁰⁹ A variable is stationary when the absolute value of the t -statistic of both the ADF and PP test is greater than the 5% critical value. Alternatively, when the t -statistic value is less than the 5% critical value, the variable has unit root (non-stationary). Stationarity is obtained via differencing the variable.

¹¹⁰ If Unit Root stationary at level $I(0)$ and first difference $I(1)$ not second difference $I(2)$, we apply ARDL model.

¹¹¹ It is the time lapse of the response of the dependent variable to the independent variable. Using the wrong lag length could result to serial correlation in the error terms and misspecification error.

¹¹² AIC is a measure of the goodness of fit of a model, taking into consideration the complexity and likelihood function. The lower the value of AIC, the better the good fit of the model.

length of the three CEMAC nations with each of their trade partners ranges between one, two and three lag length as seen in the table below.

Table 4.3: Optimal Lag Length Results.

Cameroon		
Trade Partners	Optimal lag value	Optimal Lag length
China	-9.075250*	2
France	-8.833568*	2
India	-9.174129*	3
Netherlands	-8.576575*	3
Spain	-8.556360*	3
CAR		
Trade Partners	Optimal lag value	Optimal Lag length
Cameroon	-6.710466*	2
China	-7.278557*	2
France	-8.215906*	1
India	-8.511299*	1
Nepal	-7.027192*	3
Gabon		
Trade Partners	Optimal lag value	Optimal Lag length
China	-6.775574*	2
Ireland	-5.936532*	1
Korea	-5.571777*	1
Netherlands	-6.013452*	1
USA	-9.046906*	1

Source: Computation from time-series data using EViews 12

4.6.4 COINTEGRATION TEST

Cointegration test is a test to verify that variables used in a model have a long-run and short-run relationship among themselves. The Pesaran *et al.* (2001) cointegration procedure (ARDL cointegration method) is used to test for cointegration among the variables in the models. The bounds testing procedure is based on the F -statistics and is the first stage of the ARDL cointegration method. The long-term effect of real devaluation is inferred by the size and significance of coefficient of LNREER that is normalized by the coefficient of LNTB. The null hypothesis of no cointegration is tested against the alternative hypothesis of cointegration.¹¹³

¹¹³ The F test used for this procedure has a non-standard distribution. Thus, Pesaran *et al.* (2001) compute two sets of critical values for a given significance level. One set assumes that all variables are $I(0)$ and the other set assumes they are all $I(1)$. If the computed F -statistic exceeds the upper critical bounds value, then the H_0 is rejected. If the F -statistic is below the lower critical bounds value, it implies no cointegration. Lastly, if the F -statistic falls between the bounds, then the test becomes inconclusive. In such situation, one could look at the error-correction term in the ARDL's short-term representation (Kremers *et al.*, 1992). If the error-correction term is negative and statistically significant, it means that the variables are quick on approaching their long-term stabilizing condition and can be used to establish cointegration.

The results of F -statistic (bound test) among the variables for the various CEMAC nations and their individual trade partners are displayed in the table below.

Table 4.4: The Bound Test Results

Cameroon				
Trading Partner	F-statistics	95%		Outcome
		I(0)	I(1)	
China	6.166	2.79	3.67	Cointegration
France	14.398	3.23	4.35	Cointegration
India	12.969	3.23	4.35	Cointegration
Netherland	7.532	3.23	4.35	Cointegration
Spain	8.000	3.23	4.35	Cointegration
CAR				
Trading Partner	F-statistics	95%		Outcome
		I(0)	I(1)	
Cameroon	7.714	3.23	4.35	Cointegration
China	10.248	3.23	4.35	Cointegration
France	6.194	3.23	4.25	Cointegration
India	8.906	3.23	4.35	Cointegration
Nepal	7.828	3.23	4.25	Cointegration
Gabon				
Trading Partner	F-statistics	95%		Outcome
		I(0)	I(1)	
China	4.924	3.23	4.35	Cointegration
Ireland	5.104	2.79	3.67	Cointegration
Korea	3.118	3.23	4.35	No-Cointegration
Netherland	7.310	3.23	4.35	Cointegration
USA	4.528	3.23	4.35	Cointegration

Source: Computation from time-series data using EViews 12

Note: with LNTB being the dependent variable, a model is cointegrated once the computed F -statistic exceeds the upper critical bounds value.

The cointegration test results show that there exists cointegration among the variables in all the models but for Gabon-Korea model. However, this does not imply that the cointegration is between LNTB and LNREER. (i.e., the cointegration could be among the other variables used in the model). However, our focus in this chapter is to look for the presence of the J -curve, which is a function of the relationship between LNTB and LNREER.

The presence of the J -curve is justified when the coefficient of LNREER is positive and statistically significant in the long run, while the short run coefficient of LNREER is negative and statistically significant (i.e., the t -statistics $\geq |2|$). This is achieved when the coefficient of the error correction term (ECT) of the model is negative (with LNTB being the target variable) and statistically significant (with the t -stat $\geq |2|$, and the p -value < 0.05).¹¹⁴ This will mean that a shock in the LNREER will cause LNTB to deviate in the short-term before recovering and/or

¹¹⁴ The ECT is the speed at which a dependent variable returns to equilibrium after a change in other variables. If ECT has a negative sign and is statistically significant, it implies that any shock happening in the short-term will be corrected in the long-term.

moving to the opposite direction in the long-term. Thus, necessitating a check of both the long-run and short-run relationship.

4.6.5 LONG-RUN AND SHORT-RUN RELATIONSHIP BETWEEN LNTB AND LNREER

We use the ARDL model results of the relationship between CEMAC nations with their trade partners to investigate the presence of the *J*-curve as presented on table 4.5 below. The table is segmented into the three CEMAC nations, showing the relationship among the variables in each trade relationship (i.e., between each of the CEMAC nations and their individual trade partners). The individual models show both the long-run and the short-run relationship among the variables. A panoramic view of the results shows the presence of a long-term relationship between the dependent variable (LNTB) and the independent variable(s) for some of the models.¹¹⁵ Nevertheless, this does not necessarily imply that the long-term relationship is between LNTB and LNREER. The long-term relationship could as well be between LNTB and any of the other independent variables (LNDI, LNFI). The *J*-curve is attained only when the coefficient of LNREER is negative in the short-term and then positive in the long-term, and statistically significant (with the *t*-stat $\geq |2|$, and the *p*-value < 0.05). This means that after a shock in LNREER (devaluation), the value of the LNTB is negative in the short run. However, it will recover or converge back to the equilibrium before getting positive in the long-term to reflect the presence of a *J*-curve.¹¹⁶ The aim of this chapter is to investigate the presence of the *J*-curve in the trade relationship between the CEMAC nations and their individual trade partners. As such, our focus will be on the relationship between LNTB and LNREER as shown below and analysed beginning with Cameroon:

Table 4.5: ARDL Result (Long-Run and Short-Run Relationship)

<u>Cameroon</u>				
Partner China				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable $\Delta LNTB_t$				
Long-run elasticities				
C	-1.246	6.622	-0.188	0.852
LNREER	2.067	0.258	7.995	0.000
LNDI	-3.949	0.848	-4.656	0.000
LNCHINAFI	0.925	1.257	0.735	0.467
Short-run elasticities				
C	0.729	0.096	7.571	0.000
$\Delta LNREER$	-0.379	0.194	-2.961	0.039

¹¹⁵ This is justified by the ECT being negative and statistically significant, with the *t*-statistic greater than $|2|$.

¹¹⁶ As earlier stated, the presence of the *J*-curve implies that a currency devaluation will help improve the nation's trade balance in the long-term, though in the short-term there will be a negative impact. Though the *J*-curve is a short-term phenomenon, its objective is often to ensure that the trade balance converges to its equilibrium and/or positive in the long-term (trade surplus).

ΔLNDI	0.013	0.121	0.104	0.918
ΔLNDI_{t-1}	-0.341	0.107	-3.178	0.004
$\Delta \text{LNCHINAFI}$	0.192	0.160	1.198	0.241
ECM_{t-1}	-0.868	0.112	-7.768	0.000
Partner France				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	0.203	1.284	0.157	0.876
LNREER	0.439	0.114	3.868	0.001
LNDI	-0.219	0.064	-3.423	0.002
LNFRANCEFI	0.099	0.075	1.316	0.199
Short-run elasticities				
C	0.203	0.029	6.997	0.000
ΔLNREER	-0.266	0.175	-1.523	0.139
$\Delta \text{LNREER}_{t-1}$	-0.638	0.156	-4.099	0.000
ΔLNDI	0.101	0.136	0.742	0.464
$\Delta \text{LNFRANCEFI}_{t-1}$	-0.216	0.123	-1.753	0.091
ECM_{t-1}	-0.848	0.106	-7.985	0.000
Partner India				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	1.532	0.894	1.715	0.097
LNREER	0.278	0.204	2.364	0.013
LNDI	-0.130	0.185	-0.703	0.487
LNINDIAFI	-0.01	0.132	-0.076	0.940
Short-run elasticities				
C	1.746	0.213	8.187	0.000
ΔLNREER	-0.481	0.169	-2.835	0.008
$\Delta \text{LNREER}_{t-1}$	-0.597	0.148	-4.027	0.000
ΔLNDI	0.030	0.126	0.239	0.813
$\Delta \text{LNINDIFI}_{t-1}$	-0.302	0.138	-2.180	0.038
ECM_{t-1}	-0.797	0.098	-8.138	0.000
Partner Netherlands				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	0.528	1.263	0.417	0.679
LNREER	0.362	0.114	3.169	0.004
LNDI	-0.203	0.059	-3.444	0.002
LNNETHERLANDFI	0.091	0.066	1.367	0.184
Short-run elasticities				
C	0.527	0.093	5.681	0.000
ΔLNTB	0.198	0.132	1.504	0.145
ΔLNTB_{t-1}	0.253	0.111	2.278	0.032

ΔLNREER	-0.491	0.179	-2.727	0.012
$\Delta \text{LNREER}_{t-1}$	-0.259	0.194	-1.337	0.193
ΔLNDI	-0.055	0.133	-0.417	0.68
ΔLNDI_{t-1}	-0.220	0.128	-1.711	0.099
ECM_{t-1}	-0.902	0.1552	-5.808	0.000
Partner Spain				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	0.962	1.062	0.907	0.373
LNREER	0.340	0.098	3.476	0.002
LNDI	-0.204	0.051	-4.025	0.001
LNSPAINFI	0.0766	0.046	1.680	0.105
Short-run elasticities				
C	0.962	0.162	5.931	0.000
ΔLNTB	0.192	0.129	1.49	0.149
ΔLNTB_{t-1}	0.244	0.108	2.248	0.034
ΔLNREER	-0.491	0.177	-2.775	0.010
$\Delta \text{LNREER}_{t-1}$	-0.259	0.191	-1.34	0.186
ΔLNDI	-0.056	0.131	-0.430	0.671
ΔLNDI_{t-1}	-0.221	0.126	-1.747	0.093
ECM_{t-1}	-0.908	0.152	-5.987	0.000
CAR				
Partner Cameroon				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	10.906	2.294	4.755	0.000
LNREER	-0.480	0.079	-6.102	0.000
LNDI	0.070	0.165	0.425	0.67
LNCAMEROONFI	-0.503	0.123	-4.091	0.000
Short-run elasticities				
C	10.906	1.865	5.847	0.000
ΔLNTB	0.256	0.141	1.821	0.080
ΔLNREER	-0.718	0.238	-3.007	0.006
$\Delta \text{LNREER}_{t-1}$	-0.476	0.225	-2.111	0.044
ΔLNDI_{t-1}	-0.306	0.141	-2.175	0.039
$\Delta \text{LNCAMEROONFI}$	0.173	0.186	0.933	0.359
ECM_{t-1}	-0.901	0.154	-5.866	0.000
Partner China				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C				
LNREER	-0.739	0.068	-10.915	0.000

LNDI	-0.120	0.071	-1.682	0.104
LNCHINAFI	-0.175	0.022	-7.996	0.000
Short-run elasticities				
C	12.615	1.875	6.728	0.000
Δ LNTB	0.523	0.141	3.699	0.000
Δ LNREER	-0.262	0.198	-1.317	0.198
Δ LNDI	-0.364	0.130	-2.792	0.001
Δ LNDI _{t-1}	0.405	0.117	3.474	0.002
ECM _{t-1}	-1.205	0.179	-6.737	0.000
Partner France				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable Δ LNTB _t				
Long-run elasticities				
C	13.968	3.070	4.549	0.000
LNREER	-1.359	0.352	-3.865	0.000
LNDI	0.465	0.363	1.282	0.209
LNFRANCEFI	-1.006	0.337	-2.984	0.006
Short-run elasticities				
C	13.967	2.679	5.213	0.000
Δ LNDI	-0.173	0.145	-1.189	0.243
Δ LNINDIFI _{t-1}	-0.0386	0.198	-0.195	0.847
ECM _{t-1}	-0.571	0.109	-5.213	0.000
Partner India				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable Δ LNTB _t				
Long-run elasticities				
C	9.675	1.871	5.172	0.000
LNREER	-0.619	0.096	-6.388	0.000
LNDI	-0.054	0.112	-0.484	0.631
LNINDIAFI	-0.291	0.053	-5.529	0.000
Short-run elasticities				
C	9.675	1.554	6.227	0.000
ECM _{t-1}	-0.840	0.135	-6.234	0.000
Partner Nepal				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable Δ LNTB _t				
Long-run elasticities				
C	12.014	2.449	4.905	0.000
LNREER	-0.612	0.069	-8.78	0.000
LNDI	*0.084	0.089	-0.937	0.356
LNNEPALFI	-0.289	0.043	-6.652	0.000
Short-run elasticities				
C	12.014	2.043	5.879	0.000
Δ LNTB _{t-1}	0.524	0.156	3.360	0.002
Δ LNREER	-0.266	0.214	-1.242	0.224
Δ LNDI	-0.361	0.141	-2.567	0.016

ΔLNDI_{t-1}	0.367	0.125	2.949	0.001
ECM_{t-1}	-1.128	0.192	-5.887	0.000
<u>Gabon</u>				
Partner China				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	-0.492	1.975	-0.249	0.805
LNREER	-0.852	0.285	-2.994	0.005
LNDI	0.549	0.303	1.817	0.078
LNCHINAFI	-0.254	0.159	-1.593	0.121
Short-run elasticities				
C	-0.492	0.105	-4.706	0.000
ΔLNDI	0.811	0.184	4.417	0.000
ECM_{t-1}	-0.601	0.129	-4.641	0.000
Partner Ireland				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	1.885	3.639	0.517	0.608
LNREER	-0.437	0.341	-1.279	0.210
LNDI	-0.105	0.247	-0.424	0.674
LNIRELANDFI	0.124	0.221	0.561	0.579
Short-run elasticities				
C				
ΔLNDI	0.842	0.193	4.365	0.000
$\Delta \text{LNFRANCEFI}_{t-1}$	-0.878	0.255	-3.447	0.001
ECM_{t-1}	-0.594	0.111	-5.368	0.000
Partner Korea				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	-0.064	2.713	-0.0236	0.981
LNREER	-0.622	0.586	-1.061	0.297
LNDI	0.072	0.317	0.228	0.821
LNKOREAFI	0.067	0.339	0.200	0.843
Short-run elasticities				
C	-0.064	0.031	-2.084	0.045
ΔLNDI	0.416	0.195	2.1135	0.041
$\Delta \text{LNINDIFI}_{t-1}$	0.634	0.228	2.774	0.009
ECM_{t-1}	-0.381	0.1031	-3.698	0.001
Partner Netherlands				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				

C	-1.223	3.784	-0.323	0.749
LNREER	-0.305	0.356	-0.859	0.397
LNDI	-0.088	0.248	-0.354	0.725
LNNETHERLANDFI	0.225	0.359	0.636	0.536
Short-run elasticities				
C	-1.222	0.216	-5.664	0.000
Δ LNDI	0.966	0.195	4.953	0.000
Δ LNNETHERLANDFI	-0.945	0.274	-3.452	0.002
ECM _{t-1}	-0.584	0.103	-5.663	0.000
Partner USA				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable Δ LNTB _t				
Long-run elasticities				
C	6.110	5.832	1.047	0.303
LNREER	-0.890	0.372	-2.395	0.023
LNDI	0.317	0.223	1.429	0.163
LNUSAFI	-0.426	0.373	-1.145	0.261
Short-run elasticities				
C	6.110	1.378	4.434	0.000
Δ LNDI	0.793	0.186	4.259	0.000
ECM _{t-1}	-0.597	0.134	-4.451	0.000

Source: Computing from time-series data using EViews 12.

Cameroon

The result of Cameroon shows that the coefficient of ECT for all the trade partners are negative and statistically significant (with their ECT coefficient being -0.868, -0.848, -0.797, -0.902 and -0.908, with statistical significance of [7.768], [7.985], [8.138], [5.808] and [5.987] respectively for China, France, India, Netherland, and Spain). This means there is a long-run relationship between the target variable (LNTB) and the independent variables. From a holistic perspective, the result shows the presence of the *J*-curve in all the models as the LNREER is negative and statistically significant in the short-run (-0.379, of [2.961]; -0.638, of [4.099]; -0.597, of [4.027]; -0.491, of [2.727]; -0.491, of [2.775], respectively for China, France, India, Netherland, and Spain). While the long-run, LNREER is positive and statistically significant (2.067, of [7.995]; 0.439 of [3.868]; 0.278 of [2.364]; 0.362 of [3.169]; 0.340 of [3.476], respectively for China, France, India, Netherland, and Spain). The negative short-term and positive long-term of LNREER shows the presence of the *J*-curve in all the models.

Beginning with the results of the trade relationship between Cameroon and China; it shows that in the long-run a 1% devaluation of the CFA franc leads to a 2.067% improvement in the trade balance. While in the short-run, it results in a (-0.379%) deterioration of the trade balance, thereby representing a *J*-like shape. This means that currency devaluation results in

trade improvement in the long-run. A 1% increase in domestic income leads to (-3.949%) worsening in the trade balance in the long-run. In the short run, a 1% increase in domestic income leads to a (-0.341%) worsening of the trade balance. This means that an increase in domestic income worsens the trade balance in both the short run and the long run. This is obviously because an increase in domestic income will incentivise domestic consumers to import foreign finished/ manufactured products, which are mostly not produced in Cameroon, and by so doing, worsen the trade balance. Thus, policymakers should encourage the consumption of domestically produced goods and services by creating/ improving an enabling environment for the production of domestic products and services. Cameroon needs to improve its manufacturing sector to reduce the purchase of finished foreign products (like cars, electronic gadgets, etc). There should also be a diversification in the production of semi-finished and finished products. The result further shows that there is neither long-run nor short-run relationship between foreign income (LNCHINAFI) and trade balance because the coefficient of the *t*-statistic is insignificant (i.e., 0.735 for long-run and 1.198 for short-run which are less than |2|). Thus, an increase in Chinese income (foreign income) does not impact trade balance. This implies that Chinese might not be incentivised to buy more Cameroon products in spite an increase in their income level. Could this be due to the type, quality or price of products imported from Cameroon?

The results of Cameroon and the other four trading partners are like that between Cameroon and China. The trade relationship between Cameroon with France, India, Netherlands, and Spain shows the presence of the *J*-curve. In the long-run, a 1% devaluation will cause improvements in the trade balance (i.e., 0.439%, 0.278%, 0.362%, and 0.340% for France, India, Netherlands, and Spain, respectively) and statistically significant (i.e., *t*-statistic of 3.868, 2.364, 3.169, and 3.476 respectively, which are greater than |2|). The ECTs are negative (i.e., -0.848, -0.797, -0.902, and -0.908 respectively), and statistically significant (i.e., *t*-statistic of |7.985|, |8.138|, |5.808|, and |5.987| respectively, which is greater than |2|). In the short run, on average, a 1% devaluation of the CFA franc leads to a (-0.638%, -0.481%, -0.491%, and -0.491% for France, India, Netherlands, and Spain, respectively) worsening of the trade balance. The *J*-curve, therefore, holds in these models because in the short run, the trade balance is worsening or negative (i.e., LNREER is negative and statistically significant with *t*-statistic greater than |2|). In the long-run, the trade balance improves or is positive (with LNREER being positive and statistically significant). Thus, there is the presence of the *J*-curve in the trade balance between Cameroon and all her 5 main trade partners.

Cameroon's exports are dominated by oil export, which accounts for about 60% of the exports. A devaluation shock will lead to an increase in demand for oil, and producers adjust by increasing production. Eventually, there is an improvement in the trade balance. These results

are in line with the results obtained by Rose and Yellen (1989), Marwah and Klein (1996), Bahmani-Oskooee and Brooks (1999), Dhasmana (2012), Laetitia and Hongbing (2019), stating that currency devaluation improves a nation's trade balance in the long-term though there will be a short-term deterioration of the trade balance. Hence, currency devaluation is a valuable tool to be used by Cameroon policymakers to improve their trade balance, which could eventually lead to the improvement of Cameroon's economic growth.

CAR

The result of CAR shows that the coefficient of ECT for all the trade partners are negative and statistically significant (with their ECT coefficient being -0.901, -1.205, -0.571, -0.840 and -1.128, with statistical significance of [5.866], [6.737], [5.213], [6.234] and [5.887] respectively for Cameroon, China, France, India, and Nepal). This means that there exist long-run relationships in the models. The presence of the *J*-curve is justified when the relationship is with LNREER. In the long-run, their LNREER are negative (-0.480, -0.739, -1.359, -0.619 and -0.612, respectively), instead of being positive, and are statistically significant (with *t*-statistics of [6.102], [10.915], [3.865], [6.388], and [8.78] which is $> |2|$).

However, in the short run, the results show that LNREER does not have an impact on trade balance as LNREER are statistically insignificant (with *t*-statistics of [1.317], and [1.242], which is less than $|2|$) for China and Nepal. The result also shows that there is no short-run relationship between LNTB and LNREER in CAR trade relationship with both France and India. While there is a negative short-run relationship between LNTB and LNREER in CAR trade relationship with Cameroon, which is statistically significant (with value of -0.718 and *t*-stat of [3.007]). The result of CAR shows that there is a negative long-term relationship between LNTB and LNREER in the trading relationship between CAR and its trading nations, and as such, there is no *J*-curve phenomenon. These results are in line with the results obtained by Miles (1979), Bahmani-Oskooee (1994), Rose (1990), and Bahmani-Oskooee and Brooks (1999) that there was no evidence that currency devaluation had an impact on a nation's trade balance in the long-term. As such, a currency devaluation will not help to improve the nation's economic growth via the TB channel. Thus, it would be better if CAR government could use other policies to improve the nation's TB and economic growth instead of using currency devaluation.

Gabon

The results of Gabon, just as those of Cameroon and CAR, shows the presence of long-term relationship in the TB models of Gabon. This is justified by the ECTs being negative and statistically significant (-0.601, -0.594, -0.381, -0.584, and -0.597 with *t*-stat of [2.994], [5.368], [3.698], [5.663], and [4.451] respectively for China, Ireland, Korea, Netherlands, and USA).

However, the long-term relationship between LNTB and LNREER is only in China and USA models. The result shows the presence of a negative relationship between LNTN and LNREER instead of a positive relationship (i.e., the coefficient of LNREER -0.852 and -0.89 and statistically significant with t -stat of $|2.994|$ and $|2.395| > |2|$). This means that currency devaluation worsens the trade relationship with these nations, and there is no *J*-curve in these models. Because there is no short-term relationship in these models, the results do not exhibit the presence of an “*S-curve*”.¹¹⁷

The results further show that the long-term relationship between LNTN and LNREER is negative and statistically insignificant in the Ireland, Korea, and Netherlands models. While there is no short-term relationship in the models. This means that there is no *J*-curve in the TB relationship between Gabon and its trading partners. As such, a currency devaluation will not help to improve the nation’s economic growth via the TB channel. It could worsen the nation’s economic growth because every effective currency devaluation is backed by an increase in the foreign reserve that yields a low interest rate. This reserve is money that could be invested to receive higher returns – opportunity cost. Thus, the government could use other policies to improve the nation’s TB and economic growth. We shall proceed with the impulse response function (IRF) to see how LNTB responds to shock in LNREER for Cameroon.

4.6.6 IMPULSE RESPONSE FUNCTION (IRF)

To quantify the trade balance response to an unexpected shock on the real effective exchange rate several periods later, residuals were analysed, and the results illustrated by the impulse response function (IRF).¹¹⁸ Because the objective of this chapter is to investigate the presence of *J*-curve, we focus on the response of LNTB to a one standard deviation shock to LNREER. We look at all of Cameroon results as seen on figure 4.2 below. Because the above results showed that there was negative long-term relationship between LNTB and LNREER for CAR and Gabon models, we will look at them as seen in figure 4.3 and figure 4.4 below.¹¹⁹ The IRF further justifies the above results that there is a *J*-curve only in Cameroon models as seen below.

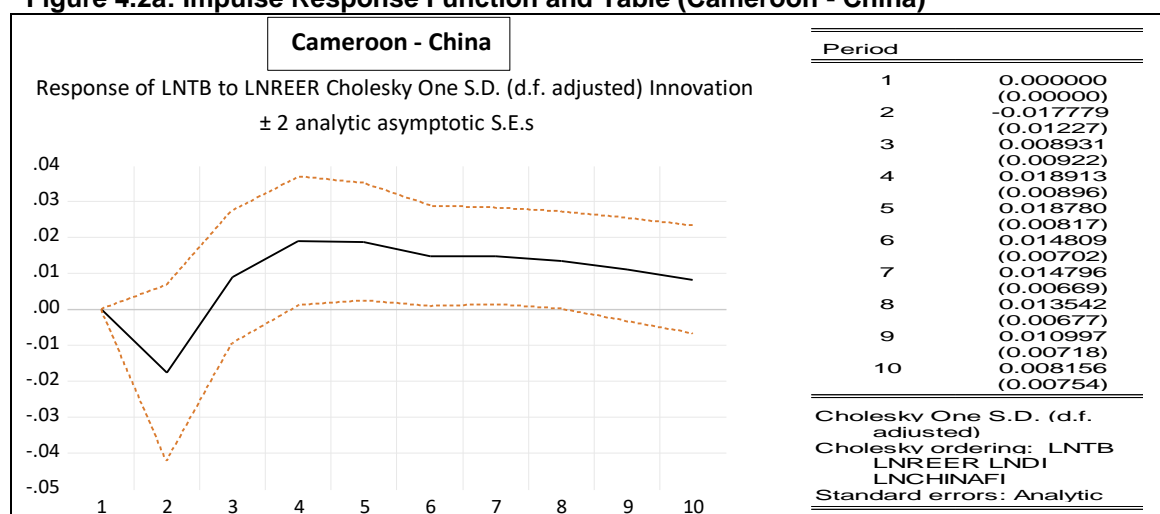
¹¹⁷ An *S-curve* occurs when the REER has a positive impact on TB in the short-term and a negative impact in the long-term. Because the REER does not impact TB in the short-term, there is no *S-curve* in these relationships.

¹¹⁸ An impulse response is the reaction of any dynamic system in reaction to some external change. As a time-series model can be written as an indefinitely lagged moving average model, equilibrium values from the original vector autoregressive (VAR) results can be used to evaluate the impact of shocks as stated by Brandt and William (2006). In this case, the residuals from the estimated VECM constitutes a shock or random external change to the equation and will be used to analyse the IRF in order to assess how changes in one variable affect other ones over time. Hence, the IRF can be described as the effect on TB of a unit innovation in REER that has occurred (k) period ago.

¹¹⁹ The results of Gabon with their trading partners focuses on the models with long-term relationship, though not having the presence of *J*-curve. We look at Gabon with China, and Gabon with USA IRF graphs.

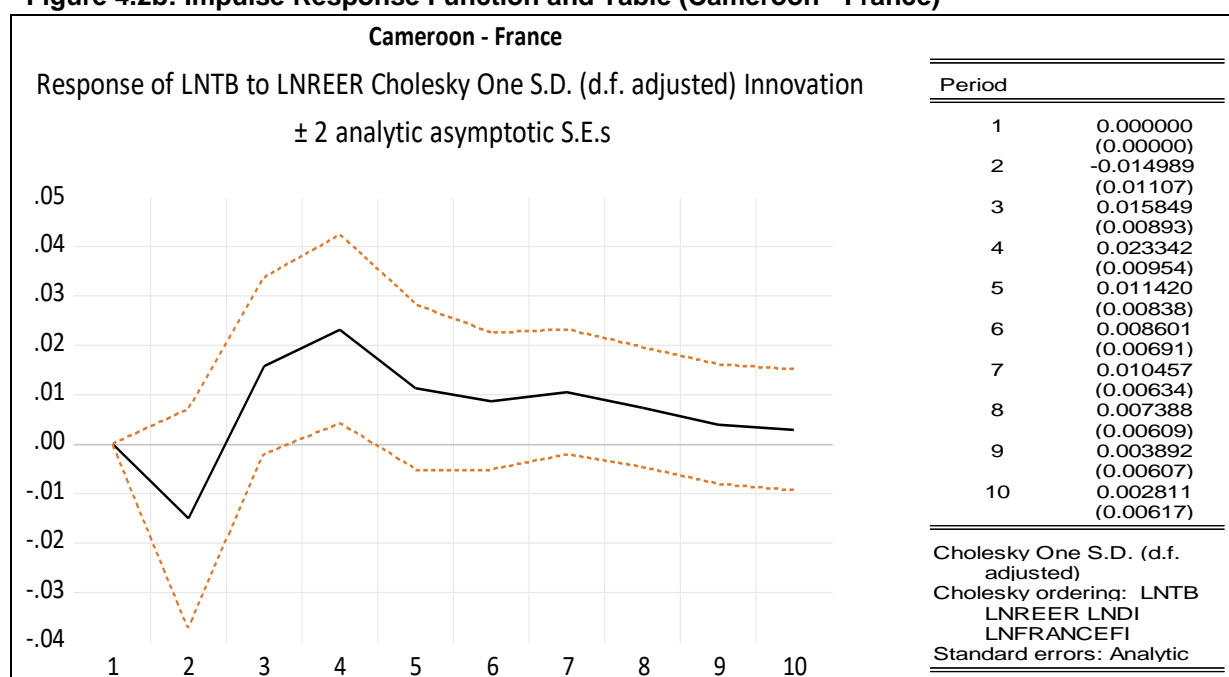
Figures 4.2: Cameroon and Trade Partners IRF

Figure 4.2a: Impulse Response Function and Table (Cameroon - China)



Source: Computation from time-series data using EViews 12

Figure 4.2b: Impulse Response Function and Table (Cameroon - France)



Source: Computation from time-series data using EViews 12

Figure 4.2c: Impulse Response Function and Table (Cameroon - India)

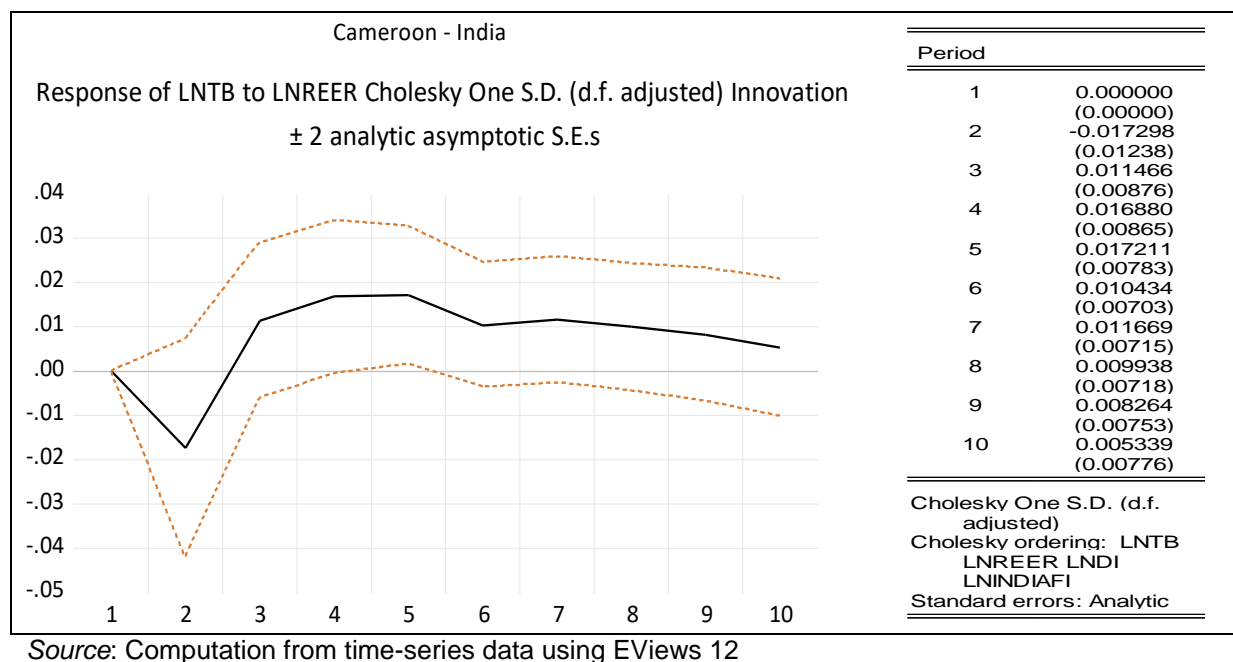


Figure 4.2d: Impulse Response Function and Table (Cameroon - Netherlands)

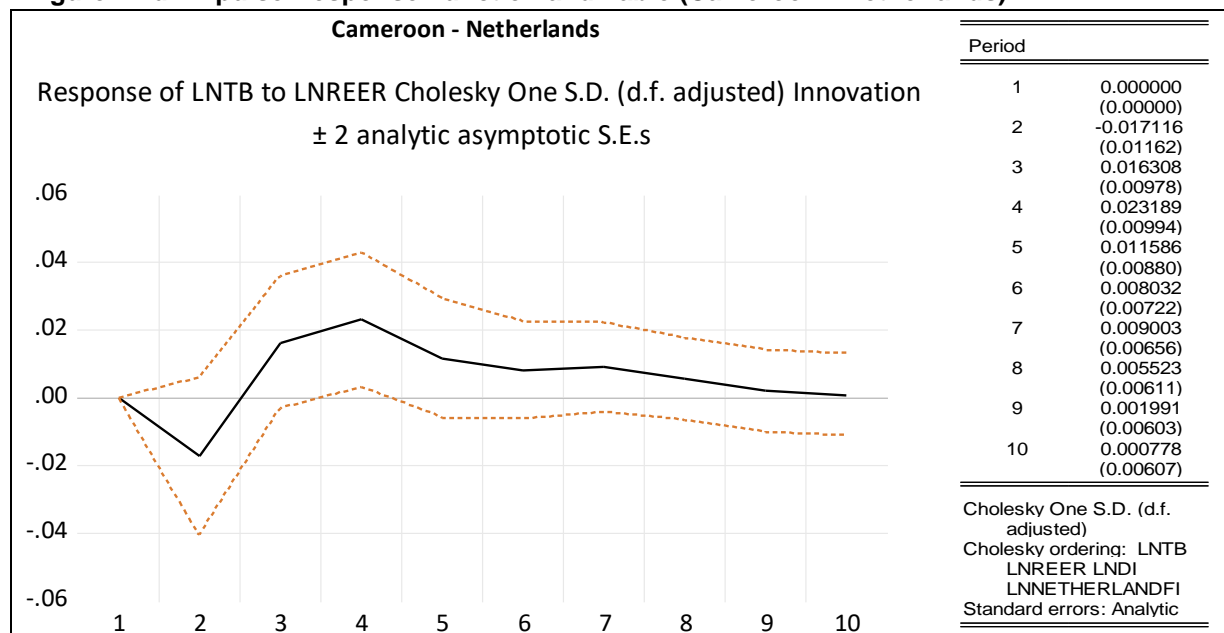
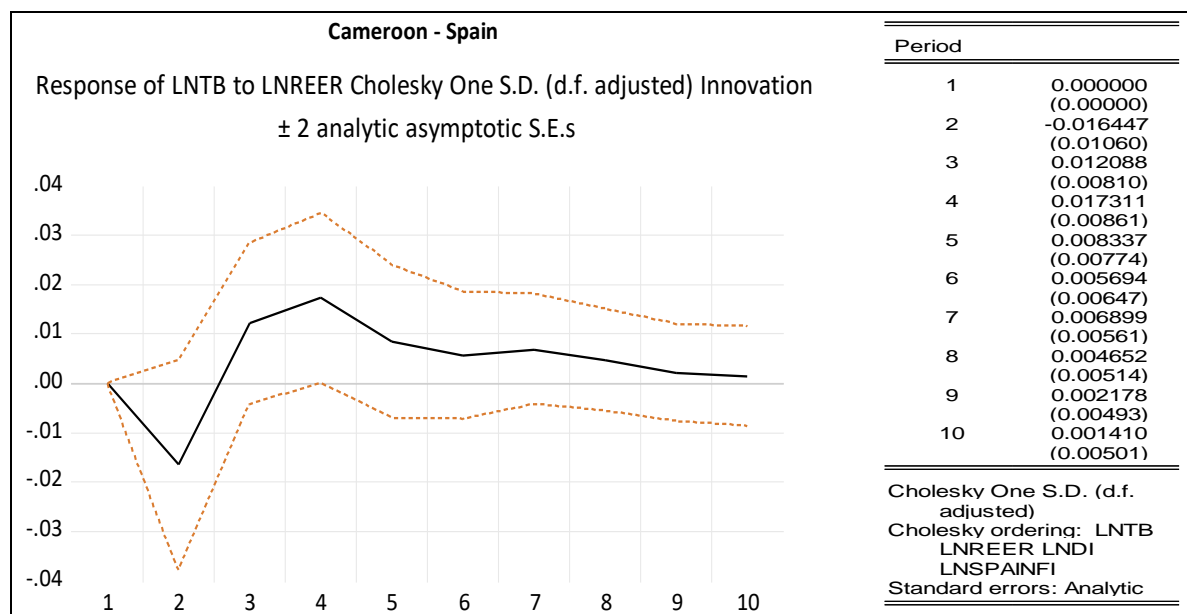


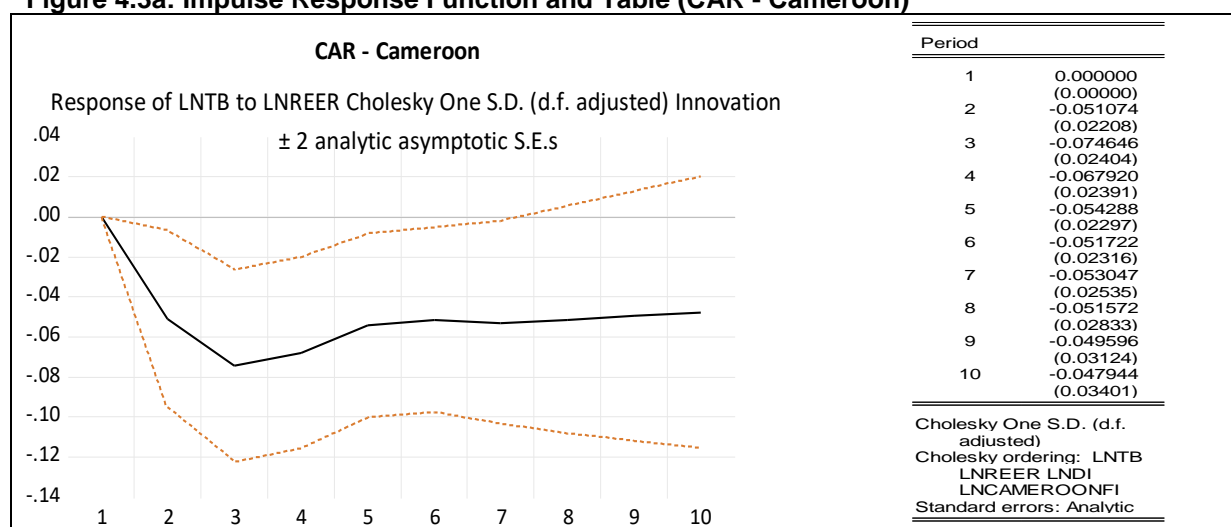
Figure 4.2e: Impulse Response Function and Table (Cameroon - Spain)



Source: Computation from time-series data using EViews 12

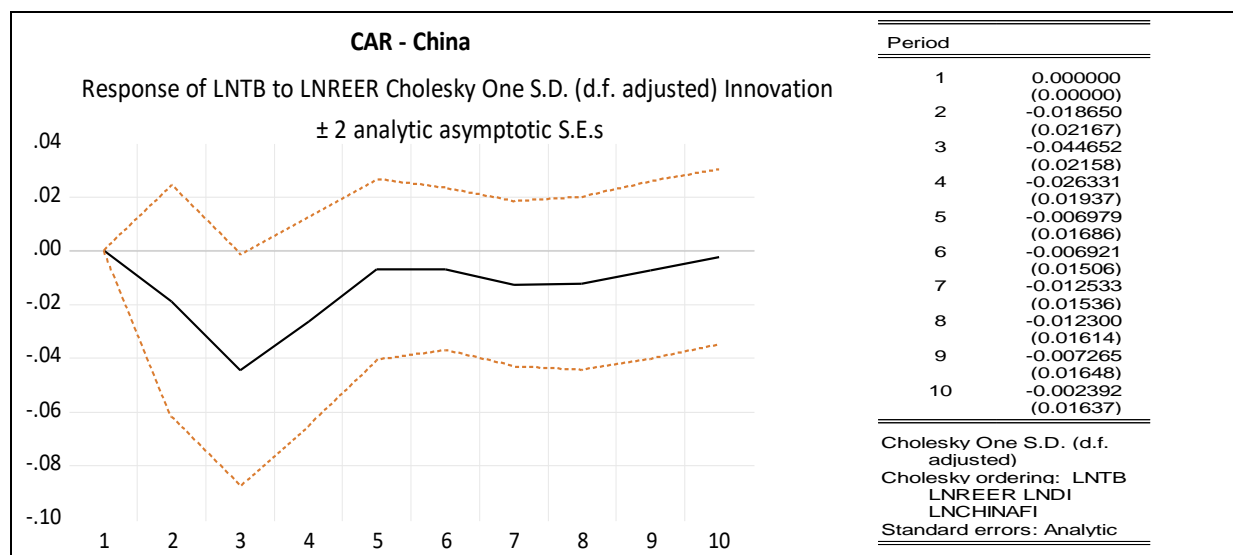
Figures 4.3: CAR and Trade Partners IRF

Figure 4.3a: Impulse Response Function and Table (CAR - Cameroon)



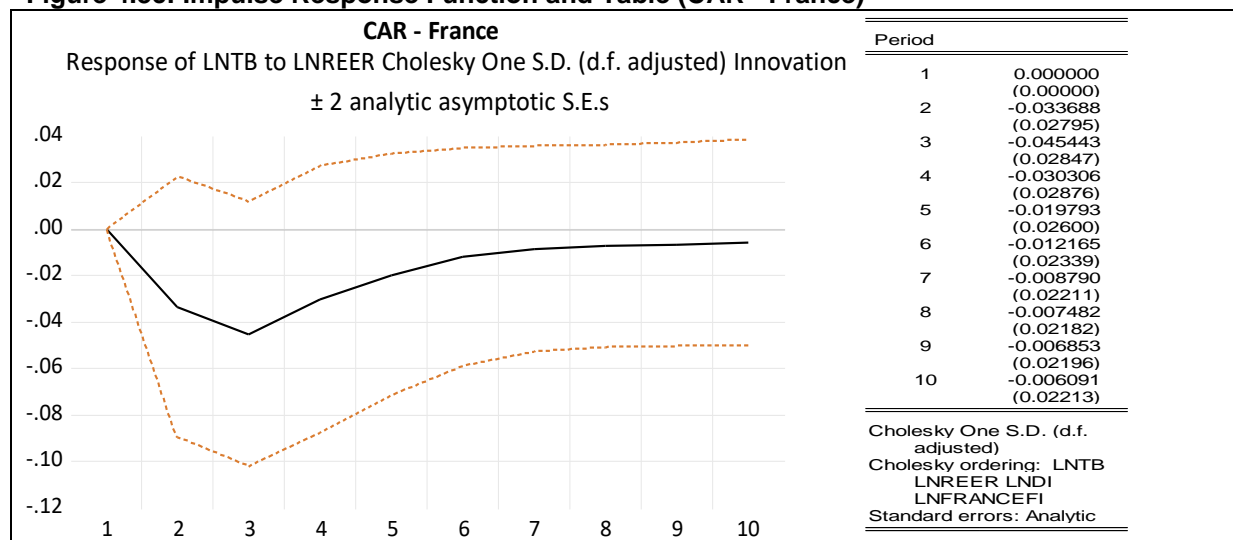
Source: Computation from time-series data using EViews 12

Figure 4.3b: Impulse Response Function and Table (CAR - China)



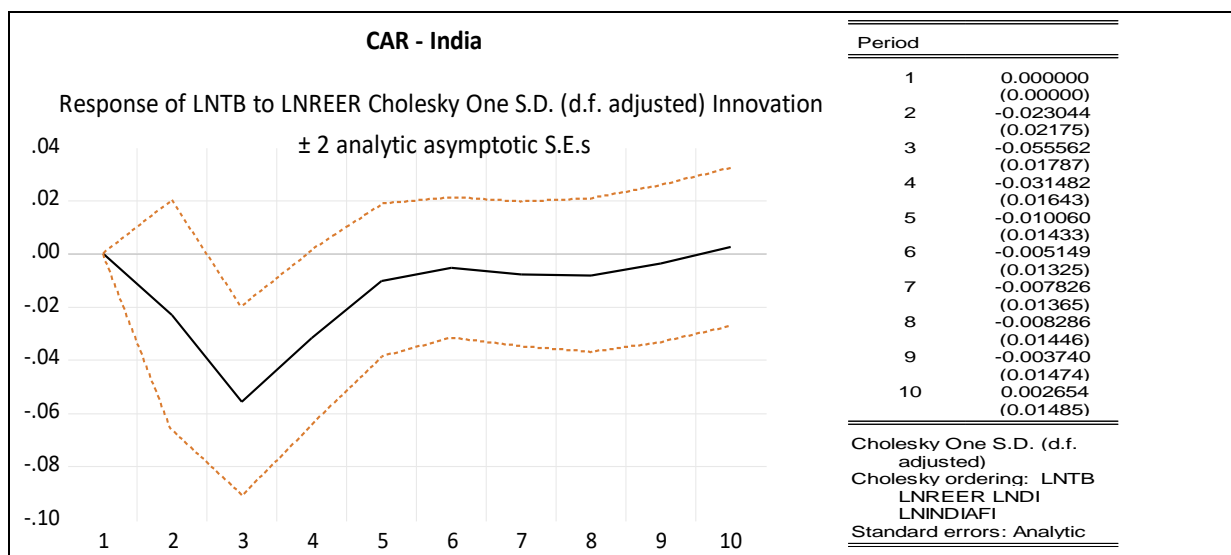
Source: Computation from time-series data using EViews 12

Figure 4.3c: Impulse Response Function and Table (CAR - France)



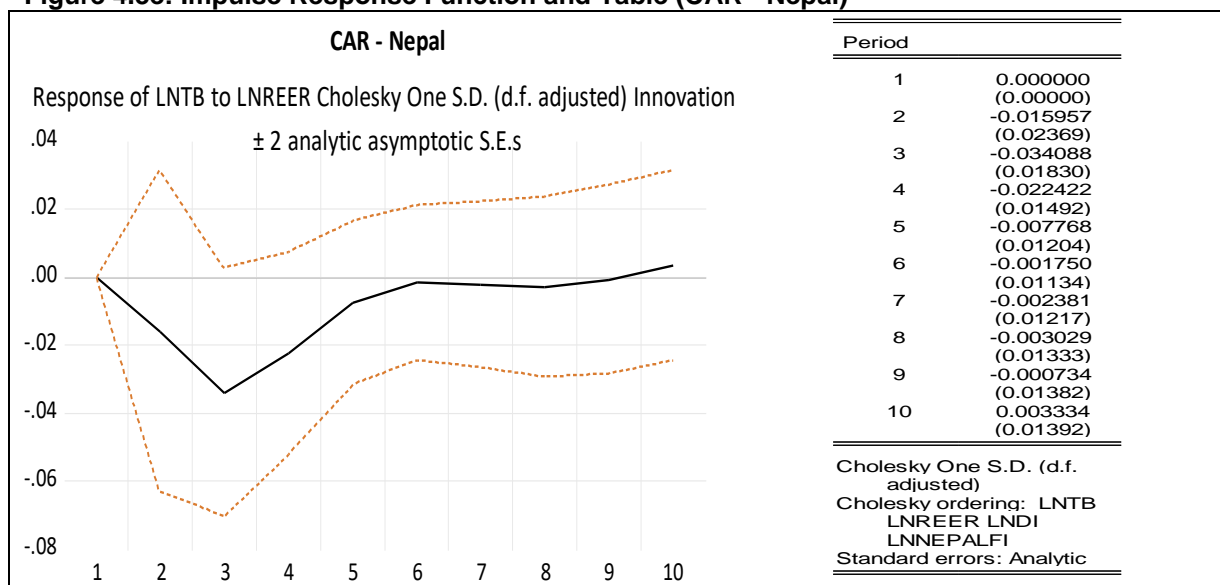
Source: Computation from time-series data using EViews 12

Figure 4.3d: Impulse Response Function and Table (CAR - India)



Source: Computation from time-series data using EViews 12

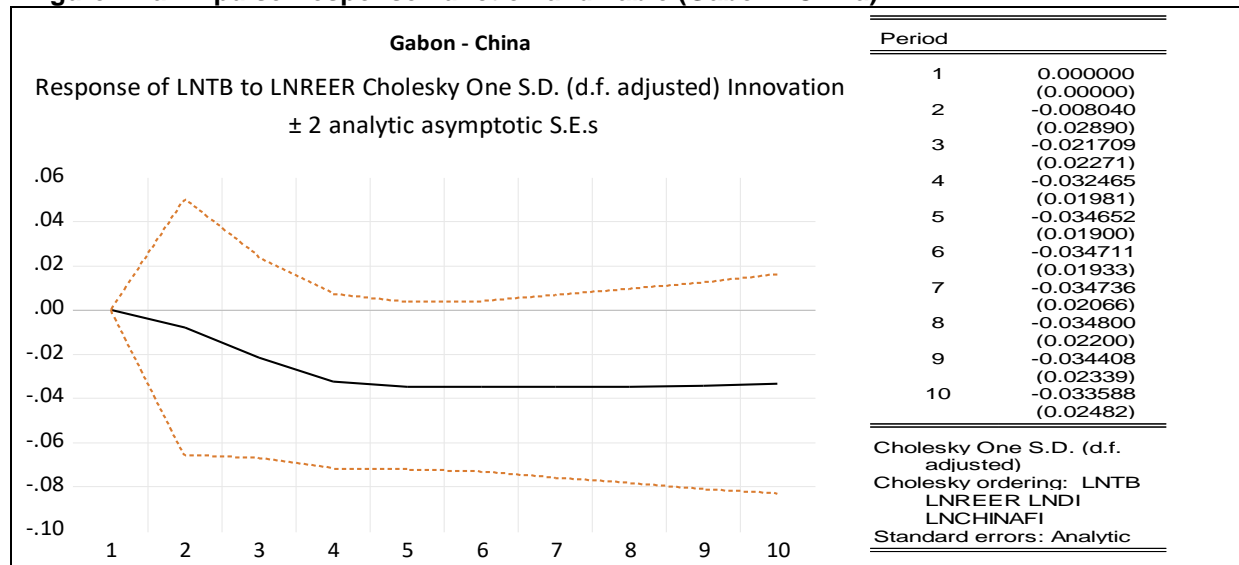
Figure 4.3e: Impulse Response Function and Table (CAR - Nepal)



Source: Computation from time-series data using EViews 12

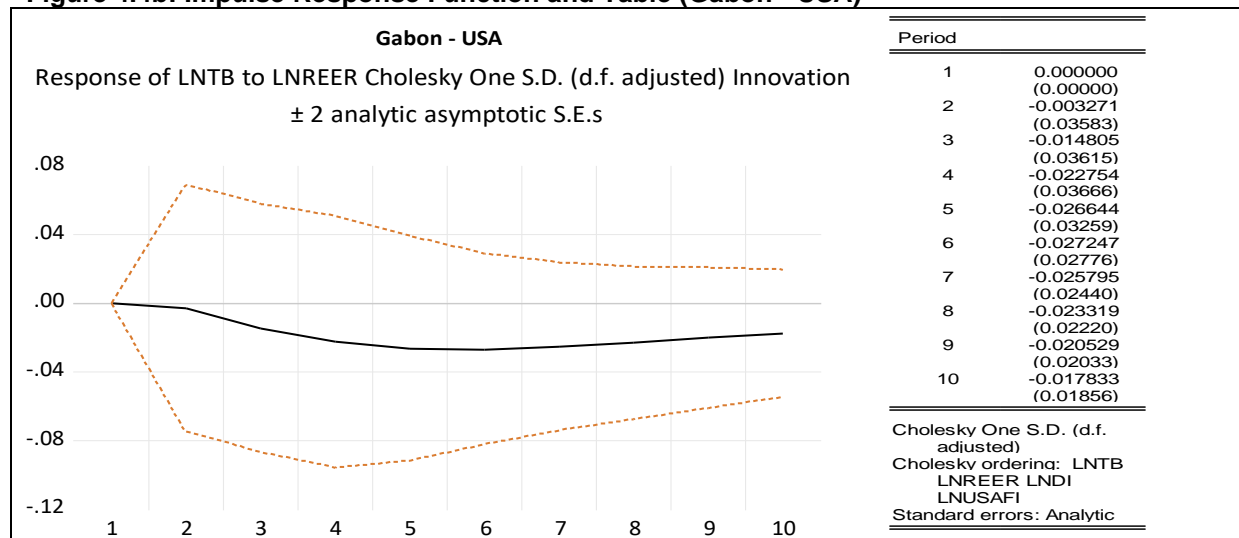
Figures 4.4: Gabon and Trade Partners IRF

Figure 4.4a: Impulse Response Function and Table (Gabon - China)



Source: Computation from time-series data using EViews 12

Figure 4.4b: Impulse Response Function and Table (Gabon - USA)



Source: Computation from time-series data using EViews 12

The IRF results also show that there is the presence of the *J*-curve in the TB relationship between Cameroon and all its five main trade partners (i.e., LNREER got negative before

getting positive). The curve moves from value (0) in period 1 to negative value (-0.018), (-0.015), (-0.017), (-0.017), and (-0.016) for China, France, India, Netherlands, and Spain respectively. This means that after the devaluation, the TB with France was least affected, second by Spain, third by India and Netherlands, and last by China, as seen by the values representing the extent of the drop in the TB one period after the devaluation. After the negative TB effect at period 2, the TB gets positive, confirming the presence of the *J*-curve. The IRF graph and table show that the TB of France and Netherlands recovered the fastest by (0.016), followed by Spain with (0.012%), India with (0.011), and finally by China with (0.009). In the long-term, the devaluation causes TB to improve, showing the presence of *J*-curve with all the trade partners. These results are in line with that of Dhasmana (2012), who analysed the bilateral trade of India with its 15 major trade partners. He concluded that though the direction of the relationship between the real exchange rate and trade balance might differ in the short-term, in the long-term, devaluation improves the trade balance. Šimakova (2013) investigated the impact of depreciation on the Hungary TB with its major trading partners. He applied the Johansen cointegration test, using quarterly data between the period 1997 to 2012. The outcome of the research showed the presence of the *J*-curve in the bilateral trade with

The response of the TB over time looks like a tilted *J* shape (*J*-curve effect) attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973; Junz and Rhomberg, 1973). The CFA franc devaluation causes an increase in the domestic price competitiveness, resulting in the exportation of more and the importation of less. By so doing, it improves TB, known as the volume effect. At the same time, the devaluation increases the import unit value, resulting in the deterioration of the TB, known as the price (value) effect. The price effect dominates in the short-term, while the volume effect prevails in the long-term, thereby causing the time path of the TB depicted by the *J*-curve (Ziramba and Chifamba, 2014; Abd-El-Kader, 2013;).

From the above IRF results of Cameroon, it is seen that the *J*-curve is present in the relationship between Cameroon and its five main trade partners. This means that the 12th January 1994 devaluation will improve the TB between Cameroon and the trade partners. Hence, it will be recommended for policymakers to continue to maintain their trade and trade policies that will improve their trading relationship with the partners. Thus, the bilateral aggregate trade data approach by Rose and Yellen (1989) has helped to investigate the presence of the *J*-curve in the trading relationship between Cameroon and each of its five main trading partners. The presence of the *J*-curve implies that a currency devaluation will help improve the nation's TB in the long-term, though in the short-term there will be a negative impact. However, the results of both CAR and Gabon show that there is no *J*-curve in their trade balance relationship with their main five trade partners. It is therefore recommended that

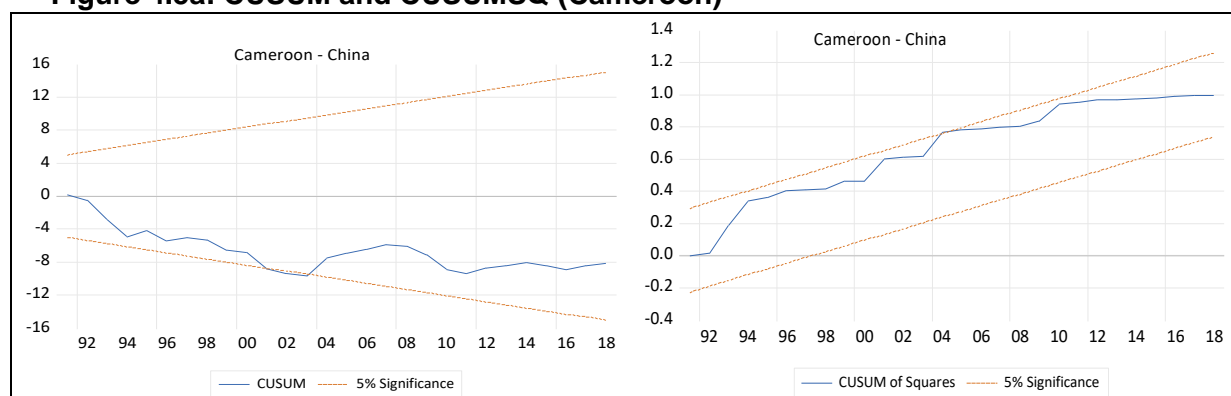
their governments use different policies to improve their trade balance because the CFA franc devaluation does not improve their trade balance, because all the CEMAC nations have their unique characteristics. Currency devaluation will help improve Cameroon's trade balance but will not improve that of CAR and Gabon.

4.6.7 STABILITY TEST

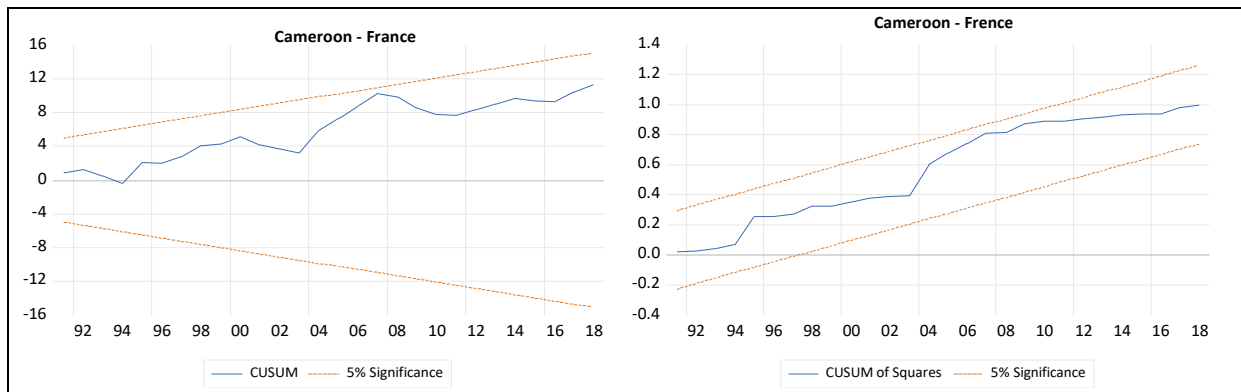
We check if the estimated regression equations are stable throughout the sample period of the study. Parameter stability tests play a vital role in ensuring the reliability of policy simulation based on the model. To test for stability following Bahmani-Oskooee and Goswami (2003), we apply the cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The advantage of this approach is that it selects the break points recursively rather than arbitrarily. According to the CUSUM test, the recursive residuals are plotted against the break points while the CUSUMSQ plots the squared recursive residuals against the break points. As a graphical illustration, these two statistics are then plotted with two straight lines, which are bounded by 5% significance level. If any point lies beyond the 5% significance level, the null hypothesis of stable parameters is rejected. The stability test results of the three CEMAC nations are graphically presented in figures 4.5 below.

Figures 4.5: CUSUM and CUSUMSQ

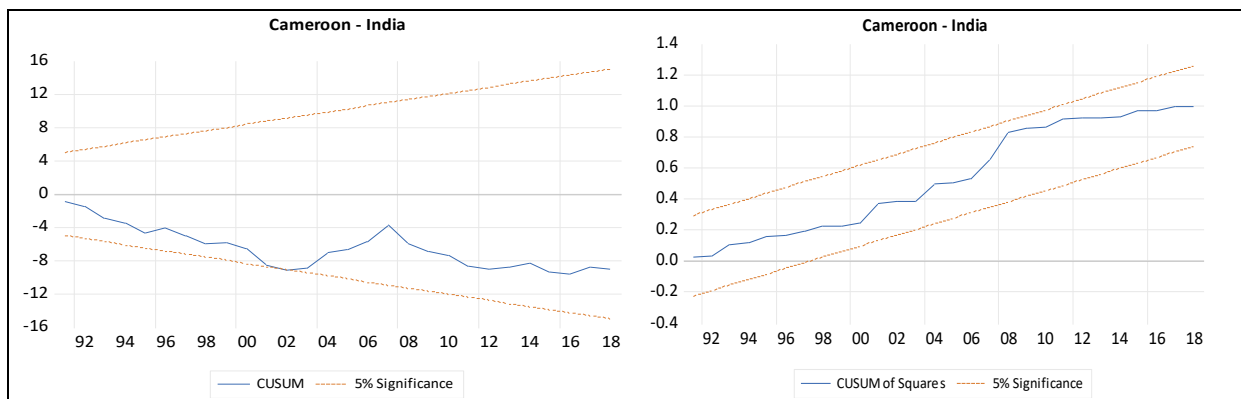
Figure 4.5a: CUSUM and CUSUMSQ (Cameroon)



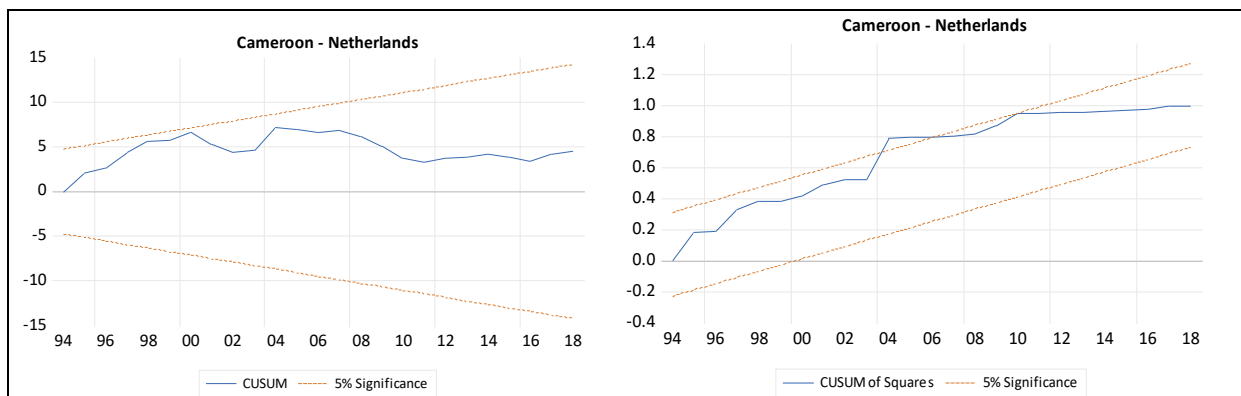
Source: Computation from time-series data using EViews 12



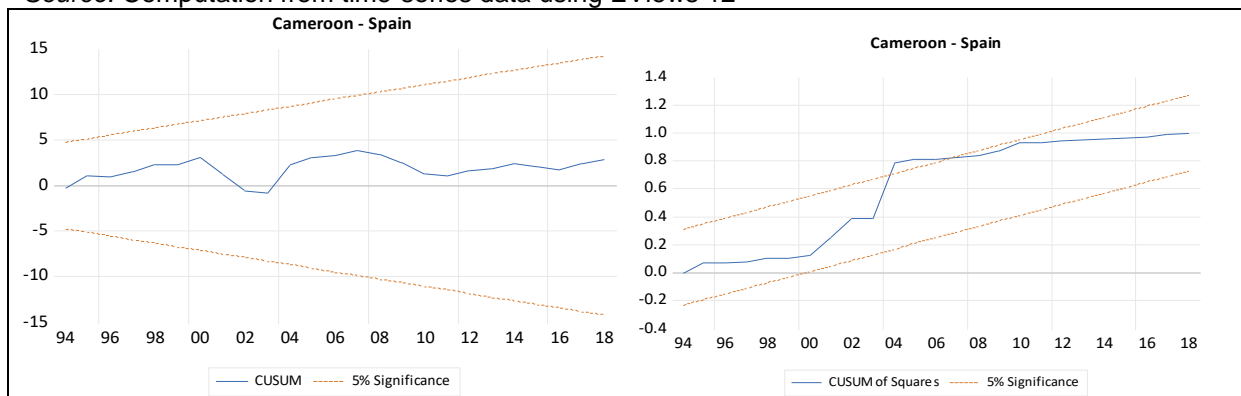
Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12

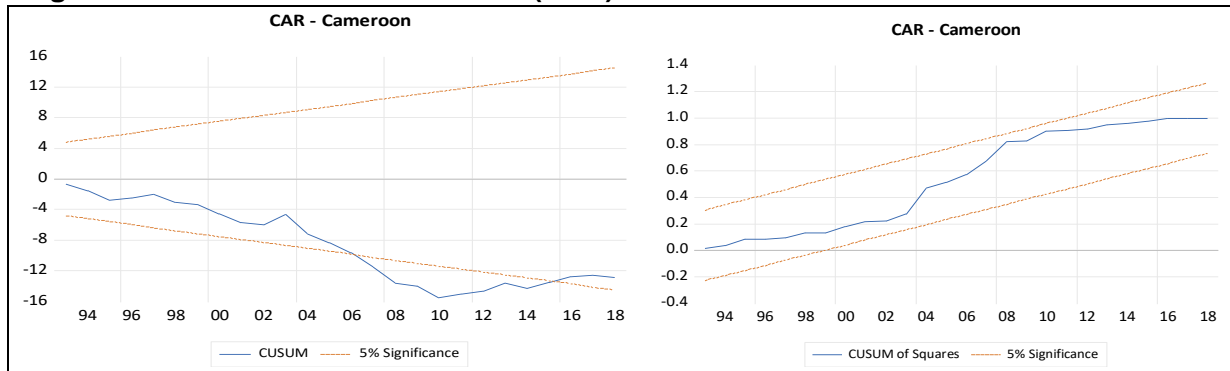


Source: Computation from time-series data using EViews 12

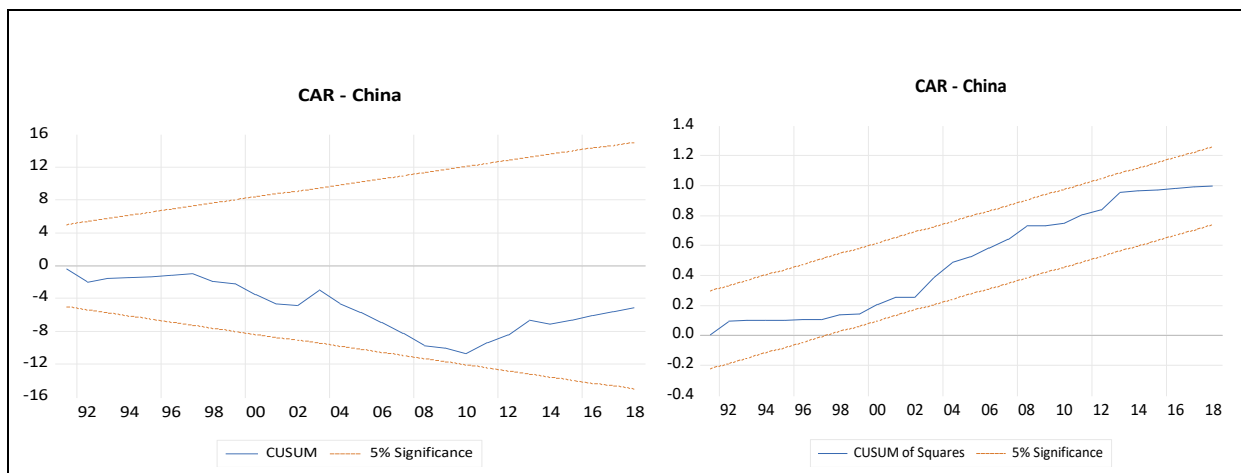


Source: Computation from time-series data using EViews 12

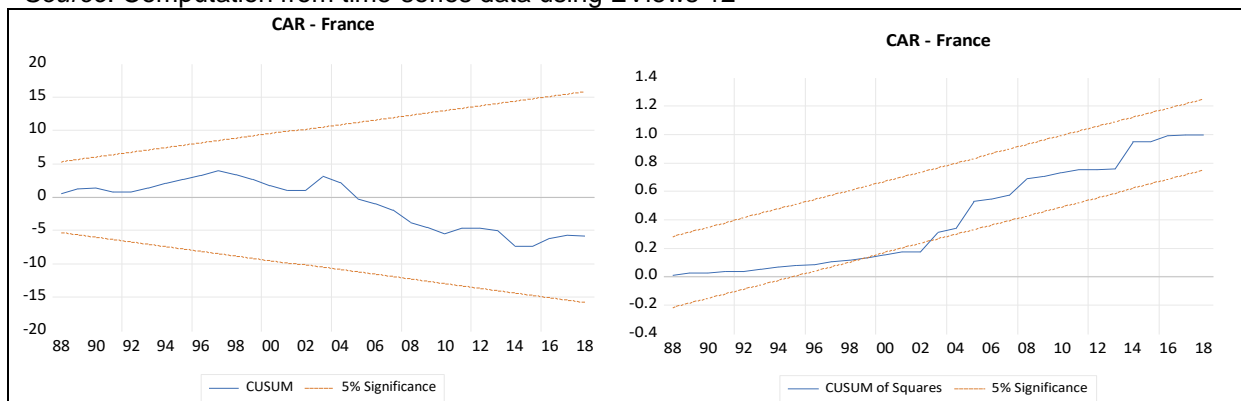
Figure 4.5b: CUSUM and CUSUMSQ (CAR)



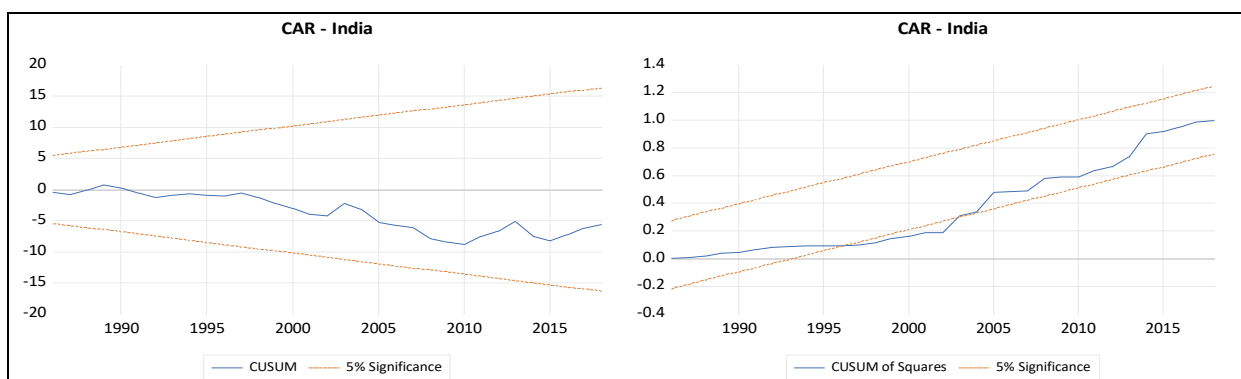
Source: Computation from time-series data using EViews 12



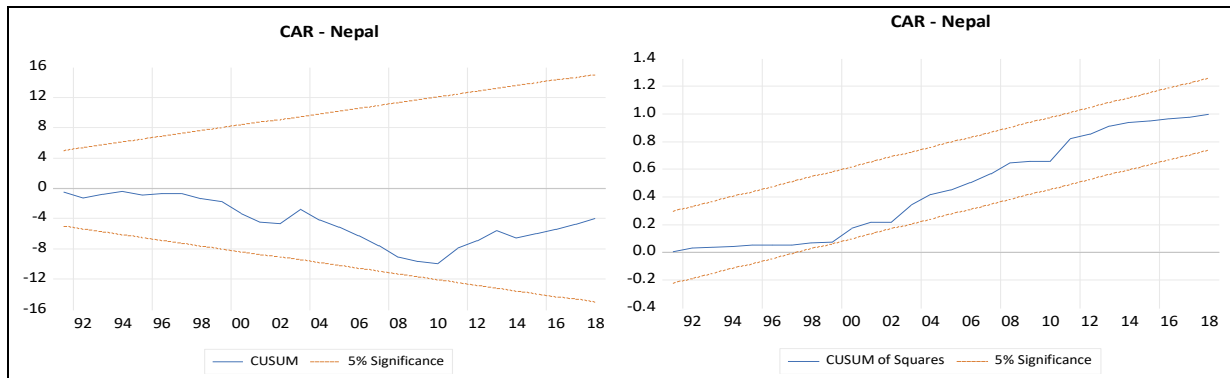
Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12

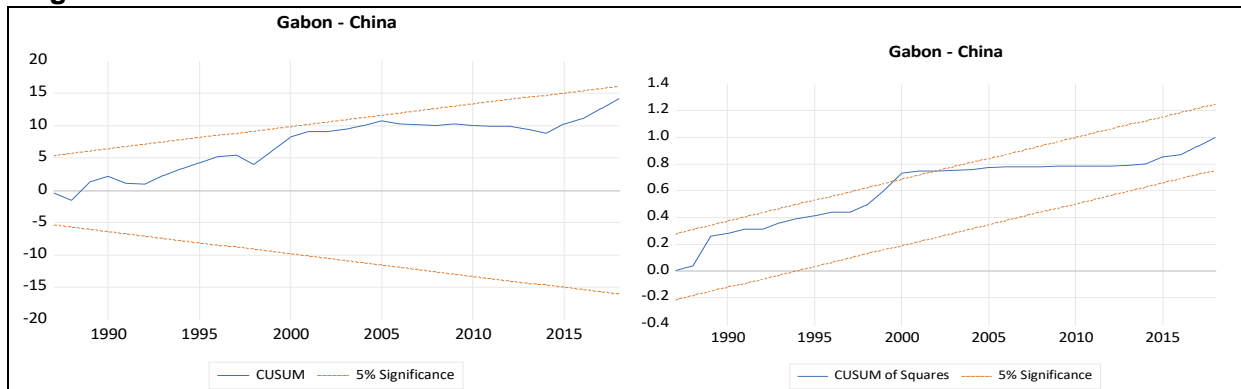


Source: Computation from time-series data using EViews 12

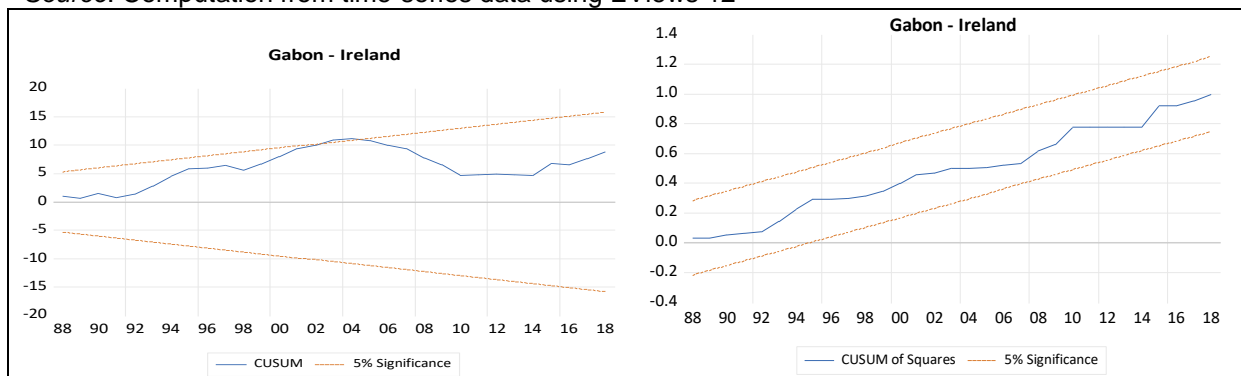


Source: Computation from time-series data using EViews 12

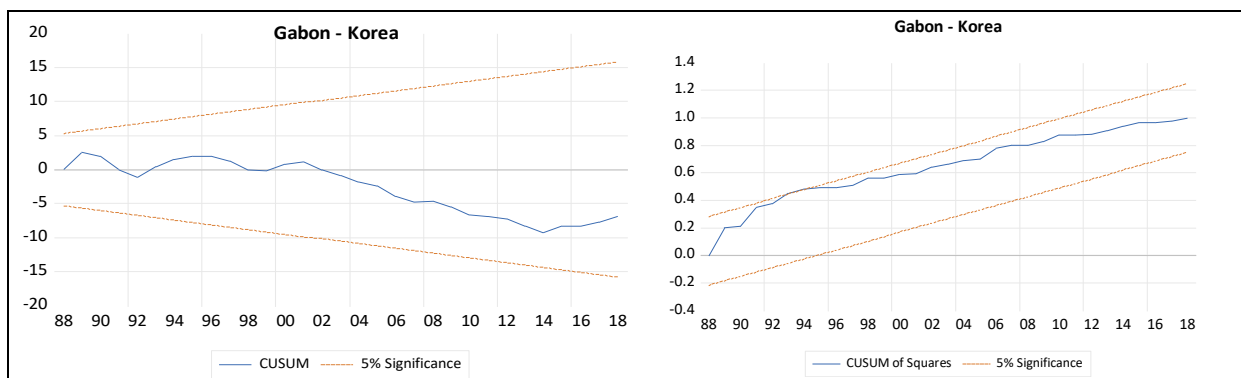
Figure 4.5c: CUSUM and CUSUMSQ for Gabon



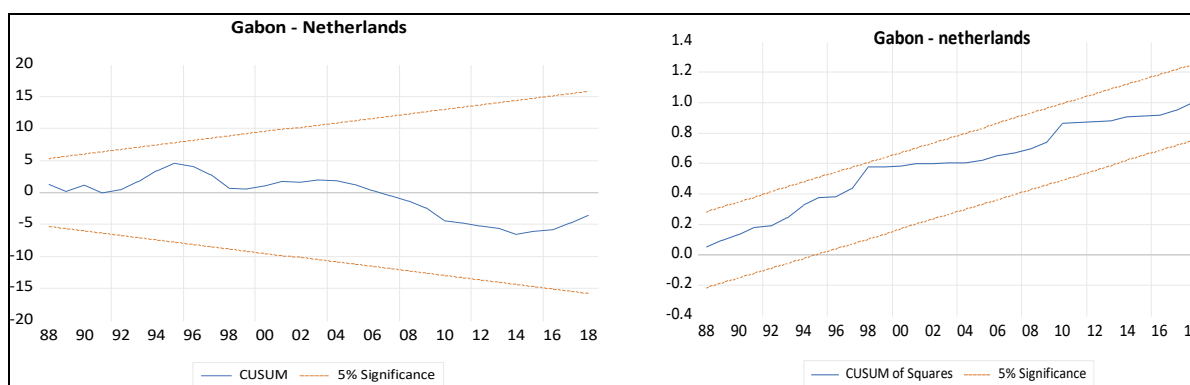
Source: Computation from time-series data using EViews 12



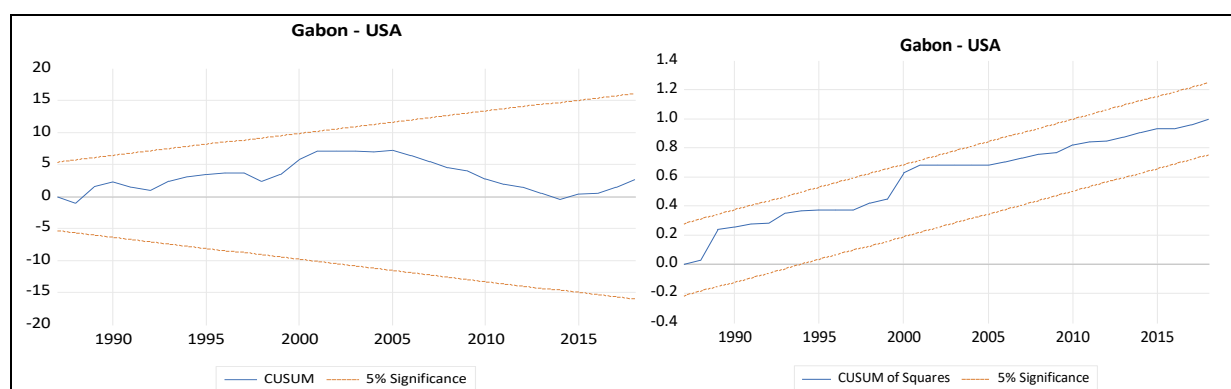
Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12

The stability test results of the three CEMAC nations with their trade partners are good, as the plots of both CUSUM and CUSUMSQ statistics fall within the 5% critical values. The stability test result is summarised below.

Table 4.6: Stability Test Results Based on CUSUM and CUSUMSQ Test

Cameroon			CAR			Gabon		
Partner	CUSUM	CUSUMSQ	Partner	CUSUM	CUSUMSQ	Partner	CUSUM	CUSUMSQ
China	Stable	Stable	Cameroon	Unstable	stable	China	Stable	unstable
France	Stable	Stable	China	Stable	stable	Ireland	Stable	stable
India	Stable	Stable	France	Stable	Unstable	Korea	Stable	stable
Netherland	Stable	Unstable	India	Stable	Unstable	Netherland	Stable	stable
Spain	Stable	Unstable	Nepal	Stable	Stable	USA	Stable	stable

Source: Extracted from EViews 12

The result above reveals that the CUSUM statistic provides stable results for all three CEMAC nations but for CAR – Cameroon trade. While the CUSUMSQ statistics provides stable result for all the nations but for Cameroon – Netherlands, Cameroon – Spain, CAR – India, CAR – Nepal, and Gabon – China. Thus, the models for the three CEMAC nations are good.

After dealing with the bilateral aggregate trade data approach by Rose and Yellen (1989), we then proceed to the next approach - the aggregate trade data approach by Magee (1973), to

investigate the presence of the *J*-curve. This gives a holistic perspective of the trade relationship between each CEMAC nation and all their trade partners. We follow the same procedures as done with the bilateral trade data approach. However, instead of using the individual trade partners, we sum all the trade partners as one. Thus, the data used will be the same as above but for LNFI. We will be using the log trade partners' foreign income (LNPARTNERSFI), which is a proxy for the sum of all the main five trading partners' gross domestic production.

4.7 AGGREGATE TRADE DATA EMPIRICAL ANALYSIS

In this section, we examine if the CFA franc devaluation has an impact on the individual CEMAC nations' TB.¹²⁰ This gives us an understanding on the state of each CEMAC nation's TB (i.e., if currency devaluation helps improve the nation's TB or not). As such, we use the aggregate trade data approach by Magee (1973) to investigate for the presence of the *J*-curve in their TB, instead of using the bilateral aggregate or bilateral disaggregated trade data approach. This is because the aggregate trade data approach gives us an overview of a nation's TB (i.e., it tells us if currency devaluation improves the nation's TB or not). As earlier mentioned, one of aim of currency devaluation is to improve a nation's TB and the aggregate trade data approach help us analyse if this is achieved. This helps inform policymakers if currency devaluation improves the nation's TB or not, and for them to make informed decisions.¹²¹

Analysing from industrial or sectorial level (bilateral disaggregate trade data approach) might not give a clear picture of the entire impact of the devaluation since we might not be able to capture all the industries or sectors of a nation. This is largely because CEMAC nations are developing nations, and data on some sectors might be hard to come by or not available. Hence, using such approach with insufficient data could give incomplete and misleading results. However, to ascertain if the objective of the devaluation is achieved (which is to see if the CFA franc devaluation could improve the individual CEMAC nation's trade balance), we ought to investigate from an aggregate perspective. This necessitates the use of the aggregate trade data approach, which helps to look at the trading relationship between each of the CEMAC nations and all their main trading partners as one.

¹²⁰ Here, rather than only examining the trade relationship between each of the CEMAC nations and their individual trade partners as done in the previous section of this chapter, we examine the relationship between each of the CEMAC nations and all its main trade partners put together.

¹²¹ We used the bilateral aggregate approach by Rose and Yellen (1989) in the previous section to investigate for the presence of the *J*-curve in the TB between each of the three CEMAC nations and their individual main trade partners. The bilateral aggregate trade data approach could aid the authorities of the individual CEMAC nations to improve their TB via the improvement of the individual trading relationship with each of the trading partners having a *J*-curve in the trading relationship.

The dataset analyzed in this section is secondary, sourced from the World Bank – World Development Indicators. They are annual observations covering the period 1980 to 2018. The variables used are in their log form, with the log trade balance (LNTB) being the dependent variable. The independent variables used are log real effective exchange rate (LNREER); log domestic income (LNDI), which is a proxy for each of the CEMAC nations' gross domestic production (GDP); and log trade partners' foreign income (LNPARTNERSFI), which is a proxy for the sum of all the main five trading partners' gross domestic production. The main trading partners used are the same as in the previous section.¹²² The ARDL approach is also used in this section, beginning the analysis with the diagnostic test, as seen below.

4.7.1 DIAGNOSTIC TEST RESULTS

Assess that the data used in this section are good; the following diagnostic (residual) tests were performed: normality test, serial correlation (autocorrelation) test, and heteroscedasticity test, as done in the previous section above. The diagnostic test results for the three nations are summarised in table 4.7 below.

Table 4.7: Diagnostic Test Results

Trade Partners	Cameroon	CAR	Gabon
Normality Test <i>P</i> -value	0.952	0.008	0.001
Autocorrelation <i>P</i> -value	0.899	0.864	0.884
Heteroscedasticity <i>P</i> -value	0.397	0.894	0.213

Source: Computation from time-series data using EVIEWS 12

From the above diagnostic test, the result of Cameroon shows that the *p*-value of the three tests conducted are greater than 0.05. This means that the model is good to be used in this research. The results of CAR and Gabon show that the *p*-value of the normality test is less than 0.05, which is not good. While the *p*-value of the other two tests is greater than 0.05 (i.e., the autocorrelation test and heteroscedasticity test). Thus, the models used in this section are good and can be used for various tests, beginning with the unit root test, as seen below.

4.7.2 UNIT ROOT TEST

An analysis for the presence of unit root is performed using the *Augmented Dickey-Fuller* (ADF) and *Philips-Perron* (PP) tests for the variables of the three CEMAC nations and their trade partners. The test results are summarised in the last part of table 4.2 in the appendix B, whereby the variables are tested using two options (i.e., with constant and with Trend and

¹²² Cameroon's main trade partners are China, France, India, Netherlands, and Spain (joined together as one). CAR main trading partners are Cameroon, China, France, India, and Nepal (joined together as one). While Gabon's main trade partners are China, Ireland, the Korean Republic, the Netherlands, and the United States of America (USA) (joint together as one). Thus, these three CEMAC nations will be used to represent the CEMAC zone.

Interception).¹²³ The result indicates the non-existence of the $I(2)$ variable in our study. From the table on both the *ADF* and *PP* test, the absolute values of most variables are stationary after their first difference, but for LNTB for Cameroon and LNTB for Gabon, they were stationary at level. This justifies the use of ARDL approach to cointegration.¹²⁴

4.7.3 OPTIMAL LAG LENGTH

Applying the wrong lag (too many lags) in an analysis could result in loss of degree of freedom, cause multicollinearity among the regressors, serial correlation in the error terms, and misspecification error. On the other hand, too few lags could result in specification errors. As such, the right lag must be applied as seen below, with the optimal lag length of Cameroon being 3, CAR being 2, and Gabon being 1, as shown in the table below.

Table 4.8: Optimal Lag Length Results.

CEMAC Nations	Optimal lag value (AIC)	Optimal Lag length
Cameroon	-9.370037*	3
CAR	-7.562079*	2
Gabon	-9.105653*	1

Source: Computation from time-series data using EViews 12

4.7.4 COINTEGRATION TEST

The cointegration test is a test to verify that variables used in a model have a long-run and short-run relationship among themselves. The Pesaran *et al.* (2001) cointegration procedure (ARDL cointegration method) is also used to test for cointegration among the variables in the models. The bound testing procedure is based on the *F*-statistics and is the first stage of the ARDL cointegration method. The long-term effect of real depreciation is inferred by the size and significance of coefficient of LNREER that is normalized by the coefficient of LNTB. The null hypothesis of no cointegration is tested against the alternative hypothesis of cointegration as mentioned in the previous section on the bilateral trade approach. The results of *F*-statistic (bound test) among the variables for the three CEMAC nations and their joint trade partners are displayed in the table below.

Table 4.9: The Bound Test Results

CEMAC Nations	F-statistics	95%		Outcome
		I(0)	I(1)	
Cameroon	7.893	3.23	4.35	Cointegration
CAR	8.625	3.23	4.35	Cointegration
Gabon	4.618	3.23	4.35	Cointegration

Source: Computation from time-series data using EViews 12

¹²³ A variable is stationary when the absolute value of the *t*-statistic of both the *ADF* and *PP* test is greater than the 5% critical value. Alternatively, when the *t*-statistic value is less than the 5% critical value, the variable has unit root (non-stationary). Stationarity is obtained via differencing the variable.

¹²⁴ If Unit Root stationary at level $I(0)$ and first difference $I(1)$ not second difference $I(2)$, we apply ARDL model.

Note: with LNTB being the dependent variable, a model is cointegrated once the computed *F*-statistic exceeds the upper critical bounds value

The cointegration test results show that there exists cointegration among the variables in all three models. However, this does not imply that the cointegration is between LNTB and LNREER. (i.e., the cointegration could be among the other variables used in the model). However, our focus in this section is to look for the presence of the *J*-curve, which is a function of the relationship between LNTB and LNREER.

The presence of the *J*-curve is justified when the coefficient of LNREER is positive and statistically significant in the long-run, while the short run coefficient of LNREER is negative and statistically significant (i.e., the *t*-statistics ≥ 2). This is achieved when the coefficient of the error correction term (ECT) of the model is negative (with LNTB being the target variable) and statistically significant (with the *t*-stat ≥ 2 , and the *p*-value < 0.05).¹²⁵ This will mean that a shock in the LNREER will cause LNTB to deviate in the short-term before recovering and/or moving to the opposite direction in the long-term. Thus, necessitating a check of both the long-run and short-run relationship.

4.7.5 LONG-RUN AND SHORT-RUN RELATIONSHIP BETWEEN LNTB AND LNREER

We used the ARDL model results on the relationship between CEMAC nations with their main trade partners joint together to investigate the presence of the *J*-curve as presented in table 4.10 below.

Table 4.10: Long-Run and Short-Run Relationship

Joint Partner				
Cameroon				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	1.227	1.049	1.169	0.253
LNREER	0.230	0.193	2.754	0.011
LNDI	-0.407	0.169	-2.397	0.024
LNPARTNERFI	0.194	0.121	1.597	0.123
Short-run elasticities				
C	1.227	0.209	5.869	0.000
ΔLNTB_{t-1}	0.203	0.129	1.567	0.129
ΔLNTB_{t-2}	0.246	0.108	2.282	0.031
ΔLNREER	-0.430	0.75	-2.454	0.021
$\Delta\text{LNREER}_{t-1}$	-0.574	0.160	-3.587	0.001
LNDI	-0.024	0.136	-0.177	0.861
LNPARTNERFI	-0.071	0.168	-0.421	0.677

¹²⁵ The ECT is the speed at which a dependent variable returns to equilibrium after a change in other variables. If ECT has a negative sign and is statistically significant, it implies that any shock happening in the short-term will be corrected in the long-term.

ECM _{t-1}	-0.917	0.154	-5.946	0.000
CAR				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	12.539	2.423	5.176	0.000
LNREER	-0.740	0.081	-9.158	0.000
LNDI	-0.003	0.101	-0.032	0.974
LNPARTNERFI	-0.295	0.045	-6.609	0.000
Short-run elasticities				
C	12.539	2.031	6.172	0.000
ΔLNTB_{t-1}	0.464	0.145	3.205	0.003
ΔLNREER	-0.309	0.208	-1.486	0.148
ΔLNDI	-0.291	0.136	-2.143	0.041
ΔLNDI_{t-1}	0.347	0.121	2.881	0.007
ECM _{t-1}	-1.073	0.174	-6.180	0.000
Gabon				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Dependent variable ΔLNTB_t				
Long-run elasticities				
C	4.819	4.267	1.129	0.267
LNREER	-0.883	0.329	-2.685	0.011
LNDI	0.424	0.269	1.574	0.125
LNPARTNERFI	-0.419	0.318	-1.318	0.197
Short-run elasticities				
C	4.819	1.077	4.472	0.000
ΔLNDI	0.817	0.186	4.391	0.000
ECM _{t-1}	-0.624	0.139	-4.495	0.000

Source: Computing from time-series data using EViews 12.

The table is segmented into the three CEMAC nations, showing the relationship among the variables in each trading relationship. The individual models show both the long-term and the short-term relationship among their variables. A panoramic view of the results shows the presence of a long-term relationship between the dependent variable (LNTB) and the independent variable(s) for all the models, as their ECT are negative and statistically significant. However, this does not necessarily imply that the long-term relationship is between LNTB and LNREER. The long-term relationship could be between LNTB and any of the other independent variables (LNDI, LNFI). The *J*-curve is attained only when LNREER is negative in the short-term and then positive in the long-term (with the coefficient of the ECT being negative and statistically significant). This means that after a shock in LNREER (devaluation), the value of the LNTB (trade balance) could get either negative or positive in the short run. However, it will recover or converge back to the equilibrium before getting positive or negative

in the long-term to reflect the presence of either a *J*-curve or *S*-curve.¹²⁶ The aim of this chapter is to investigate the presence of the *J*-curve in the trade relationship between the CEMAC nations and their individual trade partners. As such, our focus will be on the relationship between LNTB and LNREER. The results are analysed below.

Cameroon

Beginning with Cameroon, the results of the trade relationship between Cameroon and her trade partners show that in the long-run, a 1% devaluation of the CFA franc leads to a 0.23% improvement in the nation's trade balance. This means that currency devaluation results in trade improvement in the long-run. Meanwhile, in the short run, a 1% devaluation results in - 0.46% worsening of the trade balance. This shows that in the short-run, the trade balance is negative, and in the long-run, it is positive. Also, the ECT is negative (-0.917) and statistically significant (with a *t*-statistic of |5.946|, which is greater than |2|).¹²⁷ Thus, there is the presence of the *J*-curve in Cameroon trade balance. This result is inline, and a further confirmation of the results obtained in the previous section on the trade relationship between Cameroon and its individual trade partners. The result showed the presence of a long-term relationship in the trade balance models with all the trading partners.

This result is in line with that of Dongfack and Ouyang (2019), which state that the CFA franc devaluation improves Cameroon's trade balance. This means that Cameroon's authority could use the CFA franc devaluation as a tool to improve the nation's trade balance *ceteris paribus*. The result also shows that an increase in domestic income leads to a drop in trade balance. This means that when the citizens have an increase in their income, they will import more foreign products, leading to a drop in their trade balance in the long-run. In the short run, an increase in domestic income leads to an increase in trade balance *ceteris paribus*. This could mean that the nation must improve and diversify the products it produces so as to encourage the nationals to consume local products rather than importing much. Finally, the result shows that there is no relationship between foreign income and trade balance either in the short run or in the long-run.

CAR

¹²⁶ As earlier stated, the presence of the *J*-curve implies that a currency devaluation will help improve the nation's trade balance in the long-term, though in the short-term there will be a negative impact. Though the *J*-curve is a short-term phenomenon, its objective is often to ensure that the trade balance converges to its equilibrium and/or positive in the long-term (trade surplus).

¹²⁷ This is the speed of adjustment, meaning that the short-run deviations are corrected at 91.7%.

Looking at the results of CAR, it shows that the coefficient of ECT for all the trade partners are negative and statistically significant (with their ECT coefficient being -1.073, with statistical significance of [6.180]). In the long-run their 1% devaluation leads to a (-0.74%) deterioration of the trade balance *ceteris paribus*. However, in the short-run, the results show that LNREER does not have an impact on trade balance, as LNREER is statistically insignificant. So, there is no short-term relationship between TB and REER in the trading relationship between CAR and its trading nations put together. As such, there is no *J*-curve phenomenon. Rather, currency devaluation worsens the nation's trade balance. This implies that currency devaluation will not help to improve the nation's economic growth via the TB channel. Thus, the government could use other policies to improve the nation's TB and economic growth instead of using currency devaluation. These results are in line with the result obtained by Ngondo and Khobai (2018) on the impact of the exchange rate on exports in South Africa within the period 1994 to 2016. Their result revealed that the exchange rate had a significant and negative impact on exports in South Africa. This implies that the exchange rate has a negative impact on South Africa's trade balance.

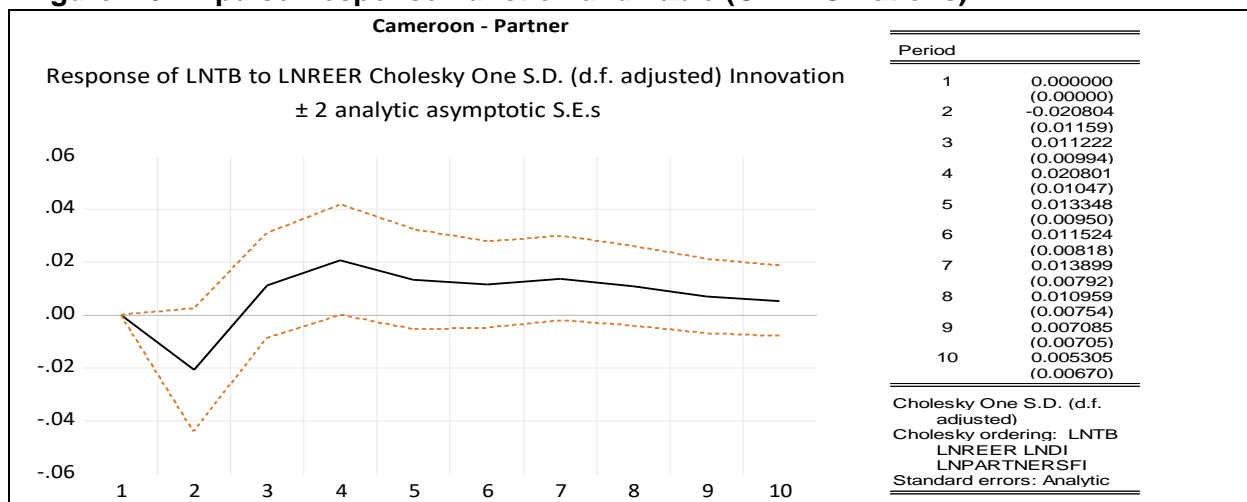
Gabon

Finally, looking at the results of Gabon, just as that of CAR shows that the coefficient of ECT for all the trade partners are negative and statistically significant (with their ECT coefficient being -0.624, with statistical significance of [4.495]). In the long-run their 1% devaluation leads to a (-0.883%) deterioration of the trade balance *ceteris paribus*. However, in the short-run, the results show that LNREER does not have an impact on the trade balance, as there is no short-term relationship between TB and REER in the trading relationship between CAR and its trading nations put together. As such, there is no *J*-curve phenomenon. Rather, currency devaluation worsens the nation's trade balance. This implies that currency devaluation will not help to improve the nation's economic growth via the TB channel. Thus, the government could use other policies to improve the nation's TB and economic growth instead of using currency devaluation. These results are in line with the result obtained by Ngondo and Khobai (2018) on the impact of the exchange rate on exports in South Africa within the period 1994 to 2016. Their result indicated that the exchange rate had a significant and negative impact on exports in South Africa. This implies that the exchange rate has a negative impact on South Africa's trade balance.

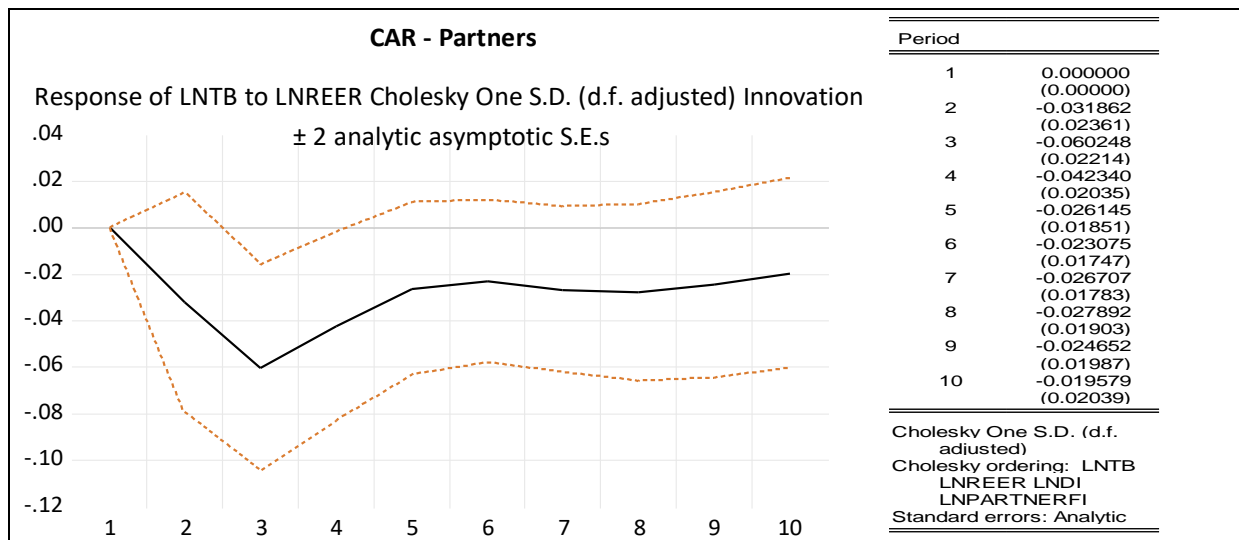
4.7.6 IMPULSE RESPONSE FUNCTION (IRF)

The above ARDL results show that there exists a *J*-curve phenomenon only in the Cameroon model. To affirm the above results, we use the IRF graphs for a better presentation of the results of the three nations, as presented in figures 4.6 below.

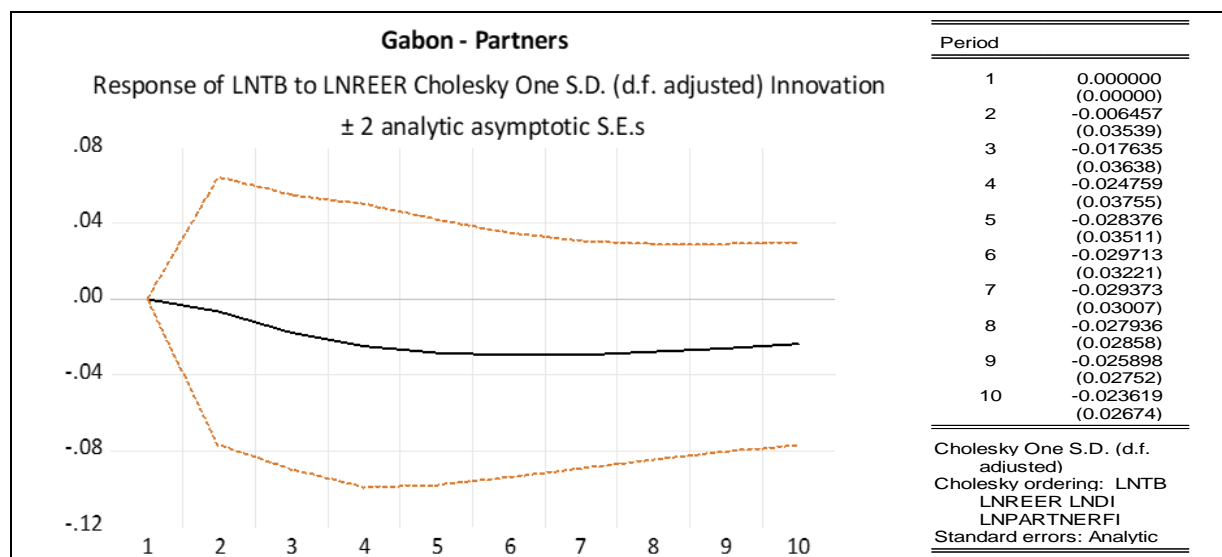
Figure 4.6: Impulse Response Function and Table (CEMAC Nations)



Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12

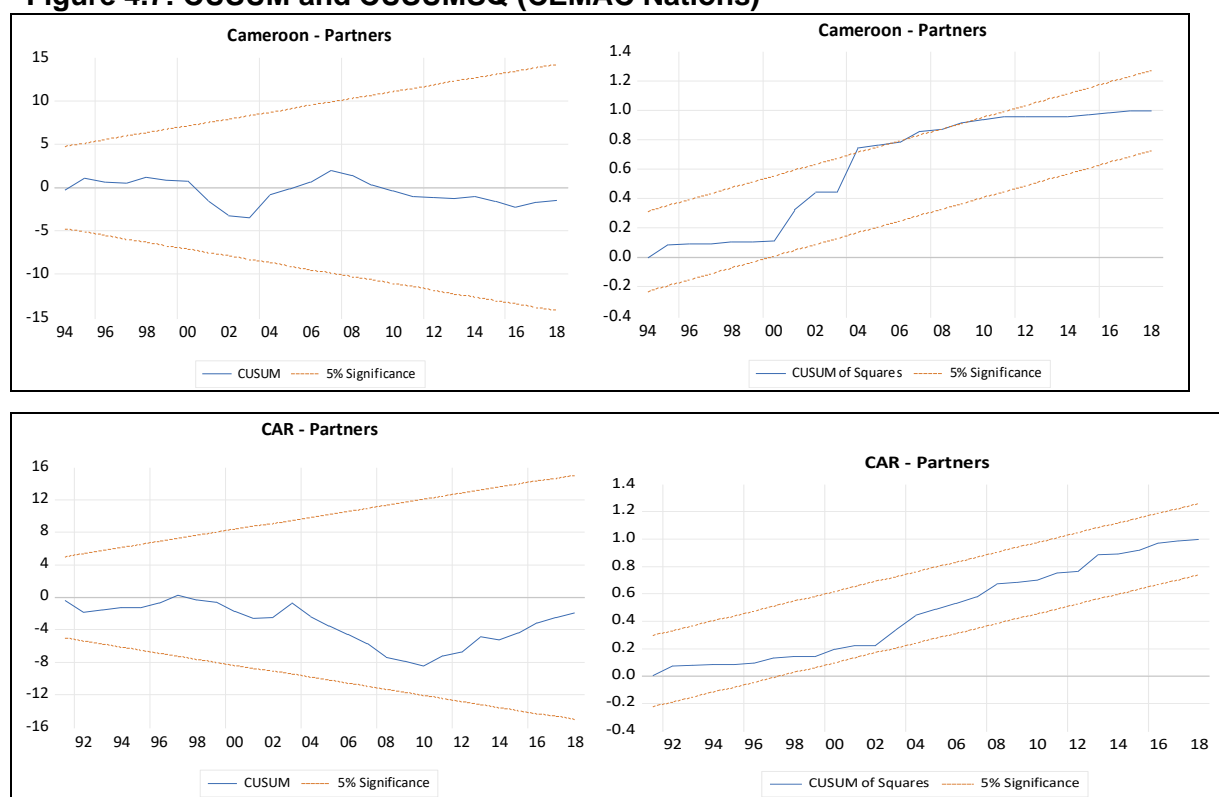
The impulse response function (IRF) graphs and tables of Cameroon show the long-term relationship between LNTB and LNREER. The result shows that there is the presence of the *J*-curve in the LNTB (i.e., LNTB got negative before getting positive). The curve moves from value (0) in period 1 to negative value (-0.021%) in period 2 and gets better or improves to positive in period 3. From the third period onward, the TB got positive (i.e., a surplus of 0.011%), with an average TB surplus of 0.01%. Thus, both the graph and the table show the presence of the *J*-curve in Cameroon TB. Thus, a currency devaluation helps to improve Cameroon's trade balance. While the IRF graph and table of both CAR and Gabon show that there is no *J*-curve in the LNTB (i.e., LNTB got negative and never got positive). The curve moves from value (0) in period 1 to negative value in period 2 (-0.032%, and -0.006% for CAR and Gabon respectively) and never gets positive throughout the periods. This indicates the absence of the *J*-curve. This means that currency devaluation does not help to improve CAR and Gabon's trade balance in the long-run, and the government should use other policies and tools to improve their TB.

4.7.7 STABILITY TEST

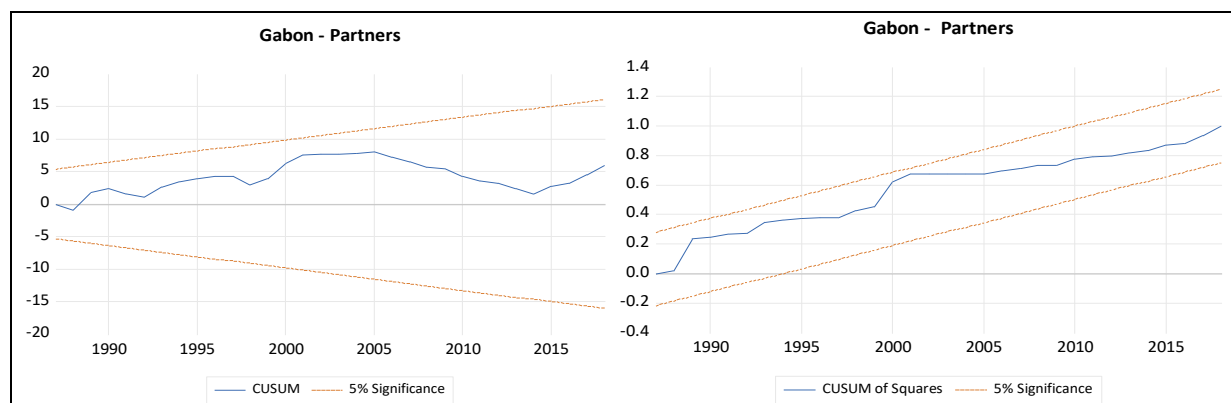
We check if the estimated regression equations are stable throughout the sample period of the study. Parameter stability tests play a vital role in ensuring the reliability of policy simulation based on the model. To test for stability following Bahmani-Oskooee and Goswami (2003), we apply the cumulative sum (CUSUM) and cumulative sum square (CUSUMSQ) tests of Brown *et al.* (1975) to the residuals of the models. The advantage of this approach is that it selects the break points recursively rather than arbitrarily. According to the CUSUM test, the recursive residuals are plotted against the break points while the CUSUMSQ plots the squared recursive residuals against the break points. As a graphical illustration, these two statistics are then plotted with two straight lines, which are bounded by 5% significance level. If any point

lies beyond the 5% significance level, the null hypothesis of stable parameters is rejected. The stability test results of the three CEMAC nations are graphically presented in figures 4.7 below.

Figure 4.7: CUSUM and CUSUMSQ (CEMAC Nations)



Source: Computation from time-series data using EViews 12



Source: Computation from time-series data using EViews 12

The stability test results of the three CEMAC nations and their trade partners are good, as the plots of both CUSUM and CUSUMSQ statistics fall within the 5% critical values. The stability test result is summarised below.

Table 4.11: Stability Test Results Based on CUSUM and CUSUMSQ Test

Country	CUSUM	CUSUMSQ
Cameroon	Stable	Unstable
CAR	Stable	Stable

Gabon	Stable	Stable
-------	--------	--------

Source: Extracted from EViews 12

The stability test results of the three CEMAC nations are good, as the plots of both CUSUM and CUSUMSQ statistics fall within the 5% critical values. The stability test result is summarised in the appendix. The result above reveals that the CUSUM statistic provides stable results for all four nations. While the CUSUMSQ statistics provides stable result for all the nations but for Cameroon. Thus, the models for the four CEMAC nations are good.

4.8 POLICY RECOMMENDATION

The result of this chapter shows that using CFA franc devaluation as a tool to improve the economic growth of the region via the trade balance channel gives different results for the different member nations. This justifies the fact that every nation has its unique characteristics, which should be understood and respected. Using CFA franc devaluation as a “one-size-fits-all approach” is not ideal for the region. Policymakers require a comprehensive approach that will address the various underlying factors relating to individual nations and the entire region.

The objectives of the CEMAC region are primarily to promote economic integration, stability, and development among its member nations. Among others, some of CEMAC’s main objectives are to foster regional cooperation,¹²⁸ and economic integration.¹²⁹ However, we saw that, but for CAR, which had Cameroon as one of its main trading partners, there was no main trading collaboration among the other CEMAC nations. This means that there is a need for an improvement of regional cooperation among CEMAC nations. In spite of the supposed free movement of people, goods, services, and capital within the region, yet trade within the region is not maximised. Thus, CEMAC policymakers need to enforce and promote economic integration and regional cooperation.

Improving the trade balance in the CEMAC region demands a comprehensive approach which addresses both the demand and supply sides of trade, which entails the following recommendations: encourage and support the diversification of export sectors beyond traditional commodities. This could be done by promoting value-added industries like agro-processing, manufacturing, and services. These could generate higher export revenues and reduce the dependence on volatile commodities prices (i.e., they should diversify the economy by reducing their dependence on oil and other primary commodities to sectors like agriculture,

¹²⁸ That is, it seeks to strengthen regional cooperation and collaboration among its member nations. This includes initiatives to promote regional trade, shared development projects, and infrastructure connectivity.

¹²⁹ CEMAC aims to promote economic integration among its member nations, which includes the free movement of people, goods, services, and capital within the region, as well as the harmonisation of economic policies and regulations to facilitate trade and investment across borders.

manufacturing, services, and technology). This could be done by promoting entrepreneurship, encouraging investments, and supporting innovation in these sectors to create sources of employment and growth.

Policymakers should facilitate trade by simplifying trade procedures and shrinking administrative burdens to facilitate cross-border trade. This could be achieved by harmonizing trade regulations with neighboring nations and eliminating non-tariff barriers to ease regional and international trade and cost-effectiveness. This could improve trade within the region.

Also, policymakers could enhance the development of infrastructure via investment in infrastructure projects, which include transportation, telecommunication networks, and energy. This robust infrastructure system helps facilitate trade, attracts private sector investments, reduces transaction costs, and stimulates economic activities across the CEMAC region. Finally, policymakers should create favorable business climates that will address issues like bureaucratic red tape, corruption, and the enforcement of intellectual property rights. These could create a conducive business environment for trade and investment. As seen in section 4.6.5 and 4.6.6 (table 4.5 and figure 4.3a), only CAR has Cameroon as a main trade partner, yet there is no presence of *J*-curve in the TB. This means that there is need to improve the trade relationship within the CEMAC region, and an improvement of the business climate. Statistics indicate that CEMAC region does not have an attractive business environment/ climate. According to the World Bank's Doing Business Report (2020), CEMAC nations' business environment is far from being attractive, as can be seen on Table 5.7 in the appendix C. None of the indicators used reveal a good or positive condition for any of the six CEMAC nations, implying that their business climate is unconducive. Thus, it is imperative for CEMAC nations to collaborate and implement the above recommendations in a synchronized way, taking into consideration each nation's specific needs and circumstances to attain a sustainable improvement in their trade balance.

4.9 CONCLUSION

This chapter investigated the impact of CFA franc devaluation on CEMAC nations' trade balance by looking for the presence of the *J*-curve.¹³⁰ The variables used in the study include log trade balance (LNTB) being the dependent variable, and independent variables are; log real effective exchange rate (LNREER), log domestic income (LNDI) – proxy by each of the CEMAC nations' gross domestic production (GDP), and log foreign income (LNFI) – proxy by

¹³⁰ *The three CEMAC nations used (Cameroon, Central Africa Republic – CAR, and Gabon) and their individual five main trading partners (Cameroon's main trade partners are; China, France, India, Netherlands, and Spain; CAR partners are Cameroon, China, France, India, and Nepal; while Gabon's partners are China, Ireland, Korea, Netherlands, and USA).*

the main trading partners' GDP. The datasets are secondary, within the period 1980 to 2018, and gathered from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. The study showed that stationarity of the variables was achieved at both levels and first differencing, which implies the ARDL model was the appropriate estimation technique needed to estimate the coefficients of the variables.

The aggregate bilateral trade data approach by Rose and Yellen (1989) was used to investigate the presence of the *J*-curve in the trade balance relationship between each of the three CEMAC nations and their individual main trade partners. To have a holistic view of the impact of CFA franc devaluation on the nation's trade balance, we used the aggregate trade data approach by Magee (1973). The presence of the *J*-curve means that the CFA franc devaluation leads to the improvement of the CEMAC nations' trade balance in the long-run and vice versa, *ceteris paribus*. The presence of the *J*-curve is achieved when the coefficient of LNREER is positive and statistically significant (i.e., the *t*-statistics $\geq |2|$) in the long run, while the short run coefficient of LNREER is negative and statistically significant (i.e., the *t*-statistics $\geq |2|$).

The results of the aggregate bilateral trade data approach show the presence of a *J*-curve in the TB between Cameroon and all its five main trade partners. While the results of both CAR and Gabon show the absence of *J*-curve in the TB between them and all their trade partners. From a holistic perspective, the aggregate trade data approach shows the presence of a *J*-curve in the TB between Cameroon and all her main trade partners combined, while there is no *J*-curve in both CAR and Gabon with their major trade partners combined. This research shows that only Cameroon could benefit from the CFA franc devaluation. Thus, the governments of both CAR and Gabon should use different policies to improve their trade balance rather than using currency devaluation.

CHAPTER 5

AN EMPIRICAL EXAMINATION OF THE REAL EFFECTIVE EXCHANGE RATE MOVEMENT AND ECONOMIC GROWTH.

5.1 INTRODUCTION

In this chapter, we will be investigating the relationship between the Real Effective Exchange Rate (REER) and economic growth (i.e., does currency devaluation improve the economic growth of nations). This is done by empirically investigate the relationship between the CFA franc and the economic growth of the CEMAC zone. To estimate the long-run relationship among the variables, we used the panel autoregressive distributed lag (ARDL) model.¹³¹ This approach helps us understand if CFA franc devaluation contributes to the region's economic growth. If there is no long-term relationship between REER and economic growth, policymakers should look for different tools but for currency devaluation to improve their economic growth.

The 'Washington Consensus' by Williamson (1994) acknowledges the vital role of RER in the growth process.¹³² According to it, an appropriate real exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economic growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance. From this vantage point, there is the notion that there exists an equilibrium real exchange rate (ERER) that satisfies both internal and external balances (Nurkse, 1945), and any deviation from it could impede economic growth. A persistently overvalued RER leads to factor misalignment, loss in efficiency, and loss of competitiveness, which hinders growth and slows convergence.¹³³ Also,

¹³¹ *The panel ARDL model is beneficial because, it simultaneously estimates short-run and long-run dynamics. While other cointegration techniques require all of the regress to be integrated of the same order, the ARDL can be applied whether the regressors are of order one or zero, but not of order two.*

¹³² *The Washington consensus refers to a set of broadly free market economic ideas supported by prominent economists and international organisations like the World Bank, the International Monetary Fund (IMF), and European Union (EU) advocates; free trade, free market, and macroeconomic stability through ten principles stated by John Williamson in 1989.*

¹³³ *An overly competitive RER is inappropriate because it would fuel inflation and curb resources (foreign reserves) available for investment (Schroder, 2013; Williamson, 1994).*

an overvalued RER exposes a currency to speculative attacks, which could eventually lead to capital flight as was the case of the Southeast Asia 1997 crisis (Ngian, 2000; Goldstein, 1998).¹³⁴ The above conclusion is unanimously accepted for the RER overvaluation, but the theoretical and analytical equivalent for its alternative – the RER undervaluation being helpful to economic growth – is not.¹³⁵

Contrary to the ‘Washington Consensus’ is the view championed by Rodrik (2008) that RER undervaluation promotes economic growth, and overvaluation harms it. This stance is in part due to the point of view that exchange rate – precisely an undervalued currency could be used in protecting home-based infant industries and the competitiveness of their exports (Nouira and Sekkat, 2015; Grekou, 2015; Levy-Yeyati *et al.*, 2013; Rodrik, 2008). This perspective was recently rekindled due to the success story of the export-led growth in conjunction with apparently undervalued currency in East-Asian nations (Grekou, 2015; Rodrik, 2008; Levy-Yeyati and Sturzenegger, 2007).¹³⁶ Finally, Rodrik (2008) says that due to institutional weakness and market failure,¹³⁷ the manufacturing sector in developing nations is unduly subject to distortions. As such, it is below its optimal size in equilibrium. Because removing

¹³⁴ On 19th May 1997, the Thai Baht was hit by massive speculative attacks because it did not devalue and lacked the foreign reserves to support the USD-Baht currency peg. As such, the Thai government was forced to float the Baht on 2nd July 1997, allowing the value of the Baht to be set by the currency market. This eventually caused a chain reaction of events into a region-wide crisis affecting Indonesia, South Korea, Philippines, Hong Kong, Malaysia, Japan, and Singapore.

¹³⁵ This is because when a currency is devalued, the domestic exporter will benefit from cheaper exports (competitive), thereby increasing their sales and returns. It boosts their product demand and could result in job creation in the export sector of the economy. Also, a high export could improve the nation’s current account deficit, especially if the deficit is due to the absence of competitiveness. Thus, high export and aggregate demand (AD) could result in high economic growth. Contrarily, a currency devaluation could have some setbacks to a nation because it is likely to result in inflation: much money getting into the economy due to the much export sales will increase aggregate demand relative to aggregate supply (AS), resulting in demand-pull inflation. At the same token, a devaluation will cause imports to be much more expensive (imported raw materials and semi-finish goods will increase in price), thereby increasing the cost of production. It eventually results in a cost-push inflation, increasing the cost of living and impoverishing the population. In addition, because it is difficult for developing nations to borrow in their currency from the international market “original sin” – as stated by Eichengreen and Hausmann (1999), they are compelled to borrow in foreign currencies. With a devaluation, the cost of borrowing becomes much more expensive, increasing the cost of production and increasing the dependency on developed nations.

¹³⁶ However, it should be noted that the export-led growth strategy also considers the type and quality of exports (primary, industrial, or tertiary).

¹³⁷ A weak institution depicts a state of decline or powerless government agencies to effectively discharge some of the fundamental responsibilities of the state, such as the maintenance of law and order and the protection of its territorial integrity. Some of the manifestations of institutional weakness are Losing control of territory or the sole power of using physical force therein, crisis of legitimacy in which some part of the state seeks disintegration, and inability to provide essential services to the citizens (Usman *et al.*, 2015). Market failure occurs when there is a state of disequilibrium in the market because of market distortion. It takes place when the quantity of goods and services supplied is not equal to the quantity demanded, and some of the distortions that could affect the free market include price limits, monopoly power, minimum wage requirements, and government regulations. Thus, the causes of market failures are externality, public goods, market control (monopoly, oligopoly, monopsony, oligopsony), and imperfect information in the market.

those distortions appears difficult, an undervalued RER serves as a ‘more practical’ second-best option for optimally re-allocating resources towards the manufacturing sector (Rodrik, 2008).

Some empirical results do not support the conclusion that an undervalued RER contributes to economic growth. Easterly (2005) review of the updated Dollar (1997) measure of currency devaluation concludes that RER devaluation was insignificant as a determinant of economic growth. Acemoglu *et al.* (2003) and the IMF (2005) also reached this conclusion, and that the outcome was even weaker when institutions were introduced in the growth model. Nevertheless, some evidence of the positive effect of RER devaluation has surfaced, with the East-Asian nations (China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Thailand, and Taiwan) being perfect examples. It is believed that their “miraculous” growth between the periods 1965 to 1990 was due to the support of “smart”¹³⁸ in their export-led growth strategy, alongside their manipulation of the exchange rate (Razmi *et al.*, 2012; Rodrik, 2008; World Bank, 1993).

Since the FCFA was devalued with the aim of improving the economic growth of the region, in this chapter we shall be using the Pooled Mean Group (PMG) panel autoregression distributed lag (ARDL) approach to investigate the nature of the relationship between REER and the CEMAC region’s economic growth. This will inform us if the FCFA devaluation improves the CEMAC region’s economic growth or not. The data used are secondary data collected from the World Bank - World Development Indicators (WDI). The data sample is within the period 1980 to 2018 for the following three CEMAC nations (Cameroon, Central Africa Republic - CAR, and Gabon).¹³⁹ We use economic growth proxy by gross domestic product (GDP) per capita growth as the dependent variable, while real effective exchange rate, Government consumption, Trade openness, Foreign Direct Investment, Terms of Trade as independent variables. The analysis is performed using Eviews12 econometric software application. The rest of the chapter is organized as follows: section 5.2 looks at the impact of the REER on economic growth. Section 5.3 deals with the empirical model, section 5.4 deals with the econometric approach, section 5.5 deals with empirical analysis, section 5.6 deals with policy recommendation, and section 5.7 deals with the chapter conclusion.

¹³⁸ SMART is a well-established tool used to plan and achieve goals and is the acronym for Specific, Measurable, Achievable, Relevant, and Time-bound.

¹³⁹ As earlier seen in the previous chapters, due to insufficient data for Equatorial Guinea, Chad, and Cong, we were unable to obtain the optimal lag length for each of these nations. As such, we will not be able to proceed with their analysis. Thus, the rest of the analysis in this chapter will focus on the other three CEMAC nations (Cameroon, CAR, and Gabon).

5.2 IMPACT OF REER ON ECONOMIC GROWTH

As per the orthodox Keynesian open economic theory, internal balance (price stability, full employment, and economic growth) and external balance (current account that is compatible with long-run capital flows) could be sustained via two kinds of policies: the expenditure-reducing and the expenditure-switching policies. While the expenditure-reducing policy aims at controlling aggregate expenditures, the fiscal and monetary policies are the tools used for achieving it. On the other hand, the expenditure-switching policy influences the composition of a nation's expenditure on tradable and non-tradable goods, and the exchange rate is the principal mechanism used for this policy.

The Mundell-Flaming model postulates that currency devaluation is expansionary if the Marshall-Lerner condition (MLC) is fulfilled.¹⁴⁰ Hence, the devaluation of an exchange rate enhances aggregate demand via the encouragement of exports and the creation of substitution from imports to domestic commodities. Until the 1970s, it was believed that currency devaluation only had a positive effect on a nation's economic growth (Lizondo and Montiel, 1988). However, the recessions that occurred in some nations in Latin America through their implementation of the orthodox adjustment programs raised browse on the possibilities of devaluation being contractionary in developing nations. Several theoretical reasons were proposed by the "structuralist" economist, which were contrary to the traditional views on why devaluation could be contractionary, thereby leading to a decline in a nation's economic growth (Diaz-Alejandro, 1963; Cooper, 1971; Lizondo and Montiel, 1988). They emphasised the effects of devaluation ignored by the orthodox, which include the negative income distribution effects, supply-side effects, and the real balance effect (Lizondo and Montiel, 1988). Thus, in the next section, we look at both the contractionary and expansionary devaluation assumptions, as well as the channels through which they could influence a nation's economic growth.

5.2.1 CONTRACTIONARY DEVALUATION

The advocates of the view that currency devaluation is contractionary in developing nations provided the theoretical channel via which this could negatively affect a nation's economic activities (Diaz-Ajandro, 1963; Cooper, 1971; Hanson, 1983). Until the publication of Krugman and Taylor (1978), it was believed that the substitution effects embarked via a RER devaluation would prove sufficiently strong to ensure that the net effect on employment and output would be expansionary despite a countervailing negative real balance effect and

¹⁴⁰ The condition states that devaluation improves the trade balance if the sum of the foreign price elasticity of demand for export (η_x) and domestic price elasticity of demand for imports (η_m) exceeds unity, in absolute value, i.e., if: $|\eta_x + \eta_m| > 1$.

problematic income distribution effects (Lizondo and Montiel, 1988). The Krugman-Taylor paper postulates the channels of contractionary influence, especially in developing nations, and they are split into three groups: effects on the aggregate supply, effects on the aggregate demand, and effects on the balance sheet:

i **The effect on aggregate supply:** In the advent of a devaluation, the domestic cost of production increases in response to the devaluation, especially when the factors of production (inputs – machinery, capital, raw and semi-finished material) are imported (Lizondo and Montiel, 1988). This could be an upward shift of the goods supply curve, with the demand curve sloping down, leading to output reduction and reduced real depreciation than expected. A currency devaluation has an adverse effect on the supply channels of an economy through three main channels: an increase in the cost of working capital, the use of imported input, and an increase in nominal wage (Calvo, 1983; Van Wijnbergen, 1983).

Some authors have emphasised the point that a nominal devaluation could have an adverse (contractionary) impact on domestic output supply through an increase in the cost of working capital (i.e., costs of financing imported input and labour) (Lizondo and Montiel, 1988; Van Wijnbergen, 1983). In the advent of a devaluation, the cost of foreign capital and interest rate will increase, thereby reducing the profit margin, reducing the demand for capital, and reducing the output supplied. Supposing that before the 1994 FCFA devaluation, Cameroon had a foreign debt of 1,000 FCFA; after the devaluation, the amount doubled, and this also had an impact on the interest to be paid. This increases the burden on the country and makes it much poorer than before.

When the inputs used for the production process are mostly imports with little elasticity of substitution by domestic inputs, the imported inputs cost will increase due to the devaluation. This increases the cost of production, and the negative effect could outweigh the positive impact to be enjoyed from the devaluation via price competitiveness. This is so because the domestic price of the outputs will be much more than the foreign price, thereby reducing the aggregate output and making the products less competitive in the international market.

A devaluation might have an adverse effect on nominal wages since it will reduce the real value of the wage due to the high prices of imported products. At the same token, if there is an increment in the nominal wage to compensate for this difference, it could just be money illusion and it could induce a contrary supply effect (Van Wijnbergen, 1986).

ii **The effect on aggregate demand:** Besides affecting supply, as illustrated above, a currency devaluation could also have an adverse effect on the demand for domestically produced products. A currency devaluation could adversely affect a nation's aggregate demand via four main channels: income redistribution effects, real income effects, effect via

imported inputs, and a decrease in investment (Lizondo and Montiel, 1988). A devaluation leads to an increase in the prices of traded commodities, thereby increasing the profit of producers. An increment in the price level results in a drop in real wages, making the marginal propensity to save from wages to be small relative to the marginal propensity to save from profits. This transfers income from the wage earners (employees) to the profit earners (employers), causing a drop in aggregate demand (Lizondo and Montiel, 1988; Krugman and Taylor, 1978; Diaz-Ajandro, 1963).

An increase in the price level of traded commodities relative to non-traded commodities after a devaluation increases the general price level, leading to a drop in the real money balance. This is especially true if a great portion of the income is spent on the consumption of imported goods whose prices have increased due to the devaluation, leading to a drop in the quantity demanded as well as the quality. Though it is believed that it encourages the consumption of local commodities, the prices of the local commodities could also be expensive due to the increased cost of imported inputs, as well as those goods that might not be produced in the nation (manufactured goods – cars, phone, computers) (Hanson, 1983). These limit the choice of consumers and drop in the standard of living of society.

Investment in less developed nations requires the importation of capital goods. Because of the devaluation, capital goods become expensive, especially for new investors. With the advent of modern technology, it becomes exceedingly difficult for new investors in less developed nations to afford the required capital goods. This goes a long way to cause a drop in investment, an increase in inefficiency, a decline in output, and a drop in aggregate demand (Lizondo and Montiel, 1988).

With the devaluation, the value of imported commodities becomes more expensive. If the government imposes many taxes on either imports or exports, the commodities become much more expensive for domestic consumption and expensive in the international market, respectively. At the same token, because the imported inputs are expensive, the exported finished commodities turn out to be expensive. Thereby defeating the purpose of the devaluation unless the exports are subsidised by the government or taxes on exports are reduced. In either case, the government income generated through taxes drops. This ripple effect is felt in the entire economy as the government might not be able to achieve its goal unless it borrows from the nation's central bank or from abroad, which further increases the indebtedness and burden on the nation's taxpayers (Van Winjbergen, 1986; Cooper, 1971). This is a vicious cycle and could be a contributing factor to what less developed nations, especially CFA franc nations, are facing (Adom, 2012).

iii **Balance Sheet Channel:** Despite the theoretical views of contractionary devaluation channels, it was thought that the positive outcome of the increase in exports was going to offset the negative impact of a devaluation. This belief was predominant until the 1990s currency crises. The 1990s devaluations after the financial crises had more negative than positive balance sheet impacts (Frankel *et al.*, 2005; Kamin and Rogers, 1997; Edwards, 1989). Because it is difficult for developing nations to borrow in their currency from the international market “*original sin*” – as stated by Eichengreen and Hausmann (1999), they are compelled to borrow in foreign currencies. This leads to a mismatch of currency in the entire economy because the assets of firms are denominated in local currency, while liabilities in foreign currency. In the advent of a sudden exchange-rate depreciation, the currency imbalance could lead to balance sheet problems (Frankel, 2005; Calvo and Reinhart, 2000).

Also, there is a drop in the net worth of the local firms with respect to foreign currency, and this reduces investment and output. This is so because interest on borrowed foreign capital becomes more expensive than before, making the cost of capital increase, coupled with the increased cost of imported input (Frankel, 2005; Krugman, 1999; Edwards, 1986; Gylfason and Risager, 1984). It is presumed that the 1994 Mexican crisis and 1997 East Asian crises were due to domestic dollarisation liability, coupled with their currency depreciation. This led to the sudden stop and reversal of capital inflow (Calvo *et al.*, 2004; Jeanne and Zettelmeyer, 2002; Bernanke *et al.*, 1999).

There are some empirical studies on the balance sheet effects of depreciation because of the dollarisation of nations’ liabilities. In analysing the devaluation episodes in some developed and middle-income nations, Céspedes (2005) used RER and external debt to capture the balance sheet effects. His evaluation of 82 large devaluation episodes in 1980-2001 showed that the balance sheet effect was negative on output. There was also an expansionary effect of the RER depreciation thanks to the depreciation effect, but because the expansionary effect was less significant within the first year after the devaluation. For nations having huge foreign-dominated external debts, their RER depreciation could generate significant output loss in the short term. Nevertheless, the competitiveness effect starts influencing and significantly determines the growth of output from the second year. As such, in the medium term, the expansionary effect of the RER devaluation dominates the balance sheet effect. This means that in the medium term, there could be a positive impact on output.

5.2.2 EXPANSIONARY DEVALUATION ASSUMPTION

The hypothesis of contractionary devaluation was analogised from the 1990s using the balance-sheet channel, while in the 1960s, it was deliberated via the supply-side and demand-side channels. But the recent successful economic growth experienced by some East-Asian

nations, South Korea, China, and India, have revealed some additional channels via which a real exchange-rate devaluation/depreciation could positively affect the economic growth of a nation (Gluzmann *et al.*, 2012; Rajan and Subramanian, 2011; Rodrik, 2008). The Capital accumulation channel (savings) and the Productivity channel are the two main mechanisms through which a devaluation could positively affect a nation's economic growth.

i. **The capital accumulation channel:** It is also referred to as the saving channel. The IS-LM model stipulates that saving accumulation facilitates investment, with interest rate considered (Copeland, 2005). An increase in investment leads to an output increase and eventually to economic growth. An exchange-rate depreciation increases the saving rate since the depreciation causes a shift from the demand of tradable to non-tradable. This shift from traded to non-traded goods requires an increment in the interest rate to maintain internal balance (Dooley *et al.*, 2005; Bernanke, 2005).¹⁴¹

ii. **The production channel:** This channel in an economy is via the tradable and non-tradable sectors. Because of the externalities of learning by doing, skill and technological spill over are faster in the tradable than the non-tradable sector; the expansion of this sector increases productivity and economic growth. As supposed by Rodrik (2008), less developed nations could obtain higher economic growth through an increment of the tradable sector profitability. He further postulates that the tradeable sector is special since it disproportionately suffers from both market failure and institutional weakness. As such, an undervalued real exchange rate was, therefore, the second-best policy for reducing the distortions, raising the sector's profits, as well as accelerating economic growth (Rodrik, 2008; Hausmann *et al.*, 2007).

As earlier stated, there is little or no systematic evidence supporting Rodrik (2008) views, coupled with the fact that there was no empirical evidence to justify that the tradable sector - especially industries were disproportionately subjected to institutional and market failure in less developed nations (Schroder, 2013; Gluzmann *et al.*, 2012; Vita and Kyaw, 2011). Rather, it was the non-tradable sectors, such as financial sectors, electricity production, telecommunication, infrastructure provision, educational services, and health services, that were seriously affected by the institutional and regulatory quality of a nation (Gluzmann *et*

¹⁴¹ *The rise in interest rate will lead to an increase in savings rate. Because the exchange rate decreases the real wages of workers, transferring income to profit-earners. Because of the marginal propensity to save (MPS) of the profit-earners is higher than that of workers, which leads to an increment in the savings rate (Levy-Yeyati and Sturzenegger, 2007). Contrary to this saving channel was Diaz- Alejandro (1963) view that savings were contractionary because of their negative impact on consumers and decline in domestic demand. Nevertheless, according to Levy-Yeyati and Sturzenegger (2007), the saving channel is expansionary because high savings ease the financial constraint faced by firms with foreign currency liabilities. The devalued real exchange rate, alongside the high savings rate of the fast-growing East-Asian nations, was an eye-opener to this channel.*

al., 2012; Klein and Shambaugh, 2010). Moreover, as argued by Hausmann *et al.* (2007), Baily and Solow (2001), the non-tradable sectors tend to be more skills-intensive than the tradable sectors and, therefore, be more affected and overburdened by institutional quality. In line with Levy-Yeyati and Sturzenegger (2007), it was ascertained that there exists a positive effect of undervaluation on investments, savings, and employment instead of on the export-import substitution effect (Levy-Yeyati *et al.*, 2013; Gluzmann *et al.*, 2012; Klein and Shambaugh, 2010).

A nation's economic growth is determined by an accumulation of its natural endowment of resources, stock of physical capital, skills and education of its labour force, and technology employed in transforming inputs into outputs. Investing in these stocks is vital for stimulating the process of economic growth. The level of investment in a small open economy depends on the tradable sector's attractiveness, which is presumed to be fundamental to economic expansion. A nation's domestic production structure is made of the traded goods sector comprising all the production activities whereof its industries are exposed to international market competition (for example, cars, phones, dresses).¹⁴² A nation's expenditure must be equivalent to its total produced output value, else any deficit due to importation ought to be paid-off through exportation of domestic products to the international market. The expansion of China's tradable sector has been particularly important for its industrialisation and economic growth, with its net exports contributing significantly to output expansion (Godbout and Langcake, 2013).

On the other hand, the non-tradable sector is made of all other goods (for example, public administration, construction, transport, and health services). This sector is essential in attracting foreign investors into an economy. The domestic policy influences are limited to the tradable sector because the international markets exogenously provide the prices of tradable goods. But what attracts footloose investors in an economy is the relatively cheap input cost in the non-tradable sector.¹⁴³ Therefore, for the government to increase the competitiveness of the tradable sector and the entire economy, she ought to improve the quality and supply of the non-tradable inputs to the tradable sector, and endeavour that the prices are comparable and imports substitute quality. With the government ensuring that the footloose investors' firms

¹⁴² *The tradable sector is divided between the manufacturing industry and the natural resource-based industry like the agriculture sector. The distinction between the two industries is because the farmer (agriculture) site is mainly determined by the natural resources' geographical location (McAndrew, 1995). This possesses limitations on the outputs of a nation, a constraint not found in the non-tradable sector.*

¹⁴³ *China is a good example of a nation that has attracted foreign investors due to its cheap labour and energy costs, which are in the non-tradable sector of the economy.*

are competitively supplied by the local markets,¹⁴⁴ the non-tradable sectors' output increases, as well as the real value added to the economy by the foreign firms. The institutional and infrastructure environment of a nation could also be a great determinant for prospective foreign investors.

5.3 EMPIRICAL MODEL

There are several variables used in determining the economic growth of a nation. Sala-i Martin (1997) indicated that over 60 variables are significant in growth regressions. The control variables used in this chapter follows those used by Barro (1991). Some empirical growth studies like Loayza and Ranciere (2006), Levine et al (2000), and Temple (1999), also used similar variables. We use the following conventional growth model, which is a version of Barro (1991):

$$g_{it} = \alpha_0 + \alpha_1 REER_{it} + \alpha_2 OPEN_{it} + \alpha_3 GOVCON_{it} + \alpha_4 FDI_{it} + \alpha_5 TOT_{it} + \varepsilon_{it} \quad (5.1)$$

Whereby:

g = gross domestic product (GDP) per capita growth (annual %) and it is the dependent variable.

REER = real effective exchange rate and is the main control variable of interest.¹⁴⁵

GOVCON = Government consumption,

OPEN = Trade openness,

FDI = Foreign Direct Investment,

TOT = Terms of Trade.

5.3.1 TYPES AND SOURCE OF DATA

Since the FCA franc was devalued with the aim of improving the economic growth of the region, we shall be using the panel autoregression distributed lag (ARDL) approach to investigate the impact of CFA franc on the CEMAC region's economic growth. This incorporates the following three CEMAC nations (Cameroon, Central Africa Republic – CAR, and Gabon). The data used are secondary annual data within the period 1980 to 2018. The data collected were available until the year 2018 because data beyond that period were not yet available. The data for Chad and Congo (REER) are within the period 2004 to 2018, giving

¹⁴⁴ When the locals mostly service the non-tradable sector, it helps retain in the economy money that would have gone out of the nation via payment to expatriates. Thus, retaining savings that could be used to invest in the economy at a cheaper cost than borrowing from abroad. By so doing, the nation depends more on local investors, who will most times plough back their profit in the system, rather than foreign investors who might take the profit abroad.

¹⁴⁵ The REER is assumed to be at both internal and external equilibrium when it has an index value of 100. If the value is above 100, the exchange rate is assumed to be overvalue, and if it is less than 100, it is assumed to be devalue.

just 15 observations, which are insufficient for analytical purposes. The data of the variables and their sources are explained below.

Gross Domestic Product (GDP) Proxy by Gross Domestic Product per capita:

GDP and GDP per capita are two of the measures used to spell the economic state of a nation. Gross Domestic Product (GDP) is the criterion for judging the health of the economy of a nation. It represents the total value of goods and services produced in a nation over a specific period. The GDP is a measure of the size of an economy and represents the growth or economic production of a nation. While GDP per capita is the GDP divided by the total population of the nation, and it is a better indicator of the standard of living of a nation than the GDP.¹⁴⁶

In this research, we use the GDP per capita growth (annual %). “Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by mid-year population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.” However, in this chapter, we will use the acronym “GDPc” to represent “GDP per capita growth (annual %)”. The data were collected from the World Bank - World Development Indicators (WDI) database, last updated on 18/03/2020.

Real Effective Exchange Rate (REER) index:

This is the measure of the value of a nation's currency against a weighted average of foreign trade partners' currencies divided by a price deflator or index of costs. An increase in the REER implies that the exports of the nation have become more expensive, and imports have become cheaper. This increase indicates a loss in the domestic nation's trade competitiveness. The reverse is true when the REER experiences a decrease. The REER movements based on different years can be interpreted differently. The primary criterion for a base year is that both internal and external equilibrium should be simultaneously met in the

¹⁴⁶ *To have a better understanding of why GDP per capita is better, let us look at nations like India and China, which have huge GDP, which is natural considering the population of the two nations. However, one gets a real picture when GDP per capita is calculated because it reflects the true picture of the state of the nation's economy. In terms of GDP, China is the largest economy in the world today, but in terms of GDP per capita, it is not the best. Therefore, though GDP is a good measure of the state of an economy, it does not reflect the standard of living of the population for which GDP per capita is a better indicator. Thus, in this section, we shall be using GDP per capita instead of the gross domestic product (GDP). Though the CFA franc devaluation was to improve the GDP of the zone, it was for the final goal of improving the nationals' standard of living.*

specific year. That is, the REER is assumed to be at both internal and external equilibrium when it has an index value of 100. If the value is above 100, the exchange rate is assumed to be overvalued, and if it is less than 100, it is assumed to be devalued. International financial organisations like the World Bank and IMF often publish the REER every ten years. The REER used in this research is the real effective exchange rate index for the base year of 2010 = 100, with the data collected from the World Bank Development Indicator (WDI).

In this research, the REER “is the nominal index adjusted for relative changes in consumer prices. That is, the REER is the nominal effective exchange rate (NEER) index adjusted for relative movements in the national price or cost indicators of the home country, selected countries, and the euro area (expressed on the base year 2010 = 100) (World Bank, 2020)”. An increase in the REER above the base year ‘100’ represents an appreciation of the local currency, while a decrease represents a depreciation of the local currency. The data for the CEMAC nations were collected from the World Bank - World Development Indicators (WDI) database, last updated on 18/03/2020.

Degree of Openness (OPEN):

OPEN is the measurement of the extent to which a nation depends on trade with other nations. That is, the degree to which non-domestic transactions (imports and exports) take place and affect the growth and size of a nation (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). The OPEN is measured by the actual size of all registered imports and exports within a nation. Thus, it is the ratio of the sum of imports and exports of goods and services to GDP.

The openness index is an economic metric calculated as the ratio of a nation’s trade, the sum of exports plus imports, to the nation’s gross domestic product:

$$OPEN = \frac{Export + Import}{GDP}$$

While trade is considered an important determinant of income and growth, with theoretically well-substantiated channels of welfare transmission through trade, the effects of trade policy are theoretically less known or somewhat ambiguous. Trade integration allows for a more efficient allocation of resources via economies of scale and scope as well as via increased competition. It facilitates the diffusion of knowledge and technology transfer. These affect cost and productivity patterns that foster technological progress and result in greater efficiency. Nonetheless, the theoretical propositions relating to market and coordination failures, including a need for ‘investment coordination’, ‘infant industry argument’, indivisibilities and risks related to investments in (new) technology, technological interdependencies and complementarities, as well as its tacit elements, which hinders its diffusion and knowledge transfer, have all given rise to targeted state intervention predominantly via trade policy and

protection of strategic sectors (Silajdzic and Mehic, 2018). This means that, though trade (especially export-led growth) is commonly viewed as an important determinant of the growth process, trade policies are often subjected to much controversy.

In this research, OPEN is the sum of exports and imports of goods and services as a percentage of GDP. $OPEN = [\text{Exports of goods and services (\% of GDP)} + \text{Imports of goods and services (\% of GDP)}]$. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise and other services as above (World Bank, 2020). The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Government Consumption (GOVCON):

It is the purchase of goods and services, which includes public investment, public consumption, and transfer payments consisting of capital transfers and income transfers. A government spends money towards the supply of goods and services that the private sector does not provide but are important for the nation's welfare. Government spending is done on infrastructure, health, welfare benefits, and national defence. Also, the government subsidises industries that cannot propel their operation with private sector funding, like agriculture or transportation. The total government expenditure is necessary for the economic activity of a nation. It affects the rate of economic growth and the level of production in the private sector. Thus, GOVCON is a ratio of GOVCON as a share of GDP:

$$GOVCON = \frac{GOVK}{GDP}$$

In this research, GOVCON is the general government final consumption expenditure (formerly general government consumption), which includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defence and security but excludes government military expenditures that are part of government capital formation. $GOVCON = [\text{General Government Final Consumption Expenditure (\% of GDP)}]$. The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Terms of Trade (TOT):

TOT is the measurement of how much-imported products a nation could get for a unit of exported products (Reinsdorf, 2009). The TOT is measured as - the ratio of the price of export to the price of import (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). In the real world, where nations export and import large amounts of goods, the TOT is computed as:

$$TOT = \frac{\text{Index of export prices}}{\text{Index of import prices}} \times 100$$

A rise of the TOT above 100 means it is improving, while a fall of the TOT below 100 means it is worsening. The TOT could also be expressed in terms of the number 1, with a figure above 1 indicating an improvement. While a figure below 1 indicates a worsening of the TOT. Improvement in a nation's TOT means that a unit of its exports sold can buy more units of the import products. A rise in the TOT creates benefits for a nation as few of its products chase more foreign products (i.e., an appreciation of the nation's exchange rate). However, a nation could suffer in terms of a fall in its export volume and a worsening of the balance of payments (Coleman, 2008; Elbadawi, 1994; Edwards, 1989). A worsening of the TOT indicates that a nation exports more of its products to import a given quantity of imports.

In this research, the TOT is the ratio of the export and import price index. $TOT = [(\text{Export value index (2000 = 100)} / \text{Import value index (2000 = 100)}) * 100]$. The export values index is the current value of exports converted to U.S. dollars and expressed as a percentage of the average for the base period (2000). Import value indexes are the current value of imports converted to U.S. dollars and expressed as a percentage of the average for the base period (2000) (World Bank, 2020). They are multiplied by 100 such that values greater than 100 means the TOT is improving, while a value below 100 means that it is worsening. The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

Foreign Direct Investment (FDI)

Foreign direct investment (FDI) is the international flow of capital that provides a parent company or multinational companies (MNCs) with control over foreign affiliates (Lily *et al.*, 2013). FDI is recognised as an important instrument for resources to flow across national borders to improve economic performance, industrial and international competitiveness, and export. In the new growth theory, FDI is a key factor which contributes to economic growth through technology transfer efficiency improvement. Thus, FDI is associated with both import and export trade in goods, and the host country can benefit from investment-led export growth.

FDI is an agent for the transformation of both the host and source economics.¹⁴⁷ The initial optimistic view of FDI has slipped off to a mixed feeling of its impact on the host nation's economic growth. It is consensual that the developmental benefits of FDI are not automatic but depend on some conditions in the host nation (Alfaro & Chauvin, 2017; Alfaro *et al.*, 2010).¹⁴⁸

In this research, we will use 'Foreign direct investment, net inflows (% of GDP)'. Foreign direct investments are the net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital, as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors and is divided by GDP. The data is from the World banks - World Development Indicators (WDI) database lastly updated on 18/03/2020.

5.4 ECONOMETRIC APPROACH

To estimate the long-run relationship among the variables, we used the panel autoregressive distributed lag (ARDL) model. The panel ARDL model is beneficial because, it simultaneously estimates short-run and long-run dynamics. While other cointegration techniques require all the regressors to be integrated of the same order, the ARDL can be applied whether the regressors are of order one or zero, but not of order two. This approach helps us understand from a holistic perspective if CFA franc devaluation contributes to the region's economic growth. For this to be done, we begin by performing some diagnostic test. The cross-section dependency test is performed to check if the study does not produce spurious results. This test also examines the presence of serial correlation. The diagnostic tests employed in this

¹⁴⁷ *The improvements in local productivity due to the presence of foreign firms could arise from several channels. From a macro perspective, FDI could spawn new economic sectors, diversify exports, and push an economy's technological frontier. From a micro perspective, it could improve managerial and employee skills, foster technology transfer, and boost investment incentives and productivity in downstream and upstream sectors. Escalating competition due to foreign entry might incentivise local firms to upgrade their productivity and flush out unproductive domestic firms. The factors of production are reallocated to more productive firms, by so doing encouraging the effective and efficient allocation of factors of production in the domestic economy.*

¹⁴⁸ *For example, the ability of FDI to push the knowledge frontier could depend on the host nation's level of economic development and education at introducing new exports and opening up markets on existing trade policies and competitive environments to create spill overs and cultivate links with other sectors, on the strength of the domestic financial markets*

study are, the Breusch-Pagan Chi-Square¹⁴⁹, Pearson LM normal¹⁵⁰, and the Pearson cross-sectional dependence (CD)¹⁵¹ tests.

After performing diagnostic test, we proceed with the unit root test to ensure that the variables used are stationary.¹⁵² For panel data, the Levin, Lin, and Chu (2002), Pesaran and Shin

¹⁴⁹ The Breusch Pagan test for heteroscedasticity is used to describe the case where the variance of errors or the model is not the same for all observations. One of the basic assumptions in modelling is that the variances are homogeneous and that the error of the model are identically distributed. If suspected that the variances are not homogeneous (a representation of the residuals against the explanatory variables may reveal heteroscedasticity). As such, it is imperative to perform a test for heteroscedasticity, with the following null and alternative hypothesis:

The null hypothesis (H_0): there is no heteroscedasticity (residuals are homoscedastic) and the p-value > 0.05 .

The alternative hypothesis (H_1): there is heteroscedasticity in the data and the p-value < 0.05 .

In statistic, the Breusch-Pagan is used to test for heteroskedasticity in a regression model. It tests if the variance of the errors from a regression is dependent on the values of independent variables.

¹⁵⁰ The normal distribution is a symmetrical continuous distribution defined by the mean and standard deviation of the data. The normality test is not whether the data is exactly consistent with a normal distribution, rather if the data is close enough to normal that one could use statistical tools without concern. The normality test is a hypothesis test; whereby:

The null hypothesis (H_0): the data is not different from a normal distribution and the p-value > 0.05 (i.e., the residual of the components is normally distributed). The alternative hypothesis (H_1): the data is different from a normal distribution and the p-value < 0.05 (i.e., the residual of the components is not normally distributed).

¹⁵¹ Panel data models are likely to exhibit substantial cross-sectional dependence in the errors which arise due to the presence of common shocks and unobserved components that ultimately become part of the error term, spatial dependence, and idiosyncratic pairwise dependence in the disturbance with no particular pattern of common components or spatial dependence (De Hoyos and Sarafidis, 2006). A reason for such result could be due to the ever-increasing economic and financial integration of nations and financial entities, which implies strong interdependencies between cross-sectional units. If there is sufficient cross-sectional dependence in the panel data and is ignored in estimation, the decrease in estimation efficiency could become so large that the panel least-squares estimator may provide little gain over the single-equation ordinary least-squares. This result is important because it means that if one decides to pool a population of cross sections that is homogeneous in the slope parameters but ignores cross-sectional dependence, the efficiency gains that one had hoped to achieve, compared with running individual ordinary least-squares regressions for each cross section, may largely diminish. Considering a standard panel-data model;

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it} \quad i = 1, \dots, N \text{ and } t = 1, \dots, T.$$

Where x_{it} is a $k \times 1$ vector of regressors, β is a $K \times 1$ vector of parameters to be estimated, and α_i represents time-invariant individual nuisance parameters. Under the null hypothesis, ε_{it} is assumed to be independent and identically distributed over periods and across-sectional units. Under the alternative, ε_{it} could be correlated across sections, but the assumption of no serial correlation remains. Breusch and Pagan (1980) proposed an LM statistic, which is valid for fixed N as $T \rightarrow \infty$ and is given by:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{P}_{ij}^2$$

Where \hat{P}_{ij} is the sample estimate of the pairwise correlation of the residuals

$$\hat{P}_{ij} = \hat{P}_{ji} = \frac{\sum_{t=1}^T \hat{\varepsilon}_{it} \hat{\varepsilon}_{jt}}{(\sum_{t=1}^T \hat{\varepsilon}_{it}^2)^{1/2} (\sum_{t=1}^T \hat{\varepsilon}_{jt}^2)^{1/2}}$$

¹⁵² Stationarity of a variable implies that its mean, variance and covariance are constant over time.

This means that the series is time invariant. However, if this is not the case, it implies that the series is non-stationary. A non-stationary variable has a definite positive or negative trend over time and is said to have a unit root.

(2003), ADF, and *PP* panel unit root test are performed.¹⁵³ These approaches could be applied irrespective of whether the variables are integrated of order zero (i.e., the variables are stationary at level form - $I(0)$), integrated of order one (i.e., the variables become stationary at first difference - $I(1)$), or mixed (i.e., both stationary at level form and integrated of order one). The variables are not to be integrated of order two (i.e., become stationary at second difference - $I(2)$).¹⁵⁴

The Pooled Mean Group (PMG) panel ARDL approach is used, which assumes that all long-run coefficients are the same across groups, while the short-run coefficients could differ across groups (Pesaran *et al.*, 1997). This estimator is useful when one expects similar long-run relationships between nations, being of a similar nature with regards to economic growth. According to Pesaran *et al.* (1997), an ARDL dynamic heterogeneous panel regression can be written by using ARDL (p, q) approach where ' p ' is the lag of dependent variable and ' q ' is the lags of independent variables. The equation could be written as:

$$g_{it} = \sum_{j=1}^p \lambda_{ij} g_{i,t-j} + \sum_{j=0}^q \delta_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (5.2)$$

whereby:

g is the dependent variable; X_{it} are vector of the explanatory variables; δ_{it} are the coefficient vectors; λ_{ij} are the scalars; μ_i is the cross-section effects; ε_{it} is the error term; $i = 1, 2, 3, \dots, N$ number of cross sectional (Here $i = 3$); $t = 1, 2, 3, \dots, T$ total time period ($T = 39$).

The estimated panel ARDL model is as seen below:

$$\Delta g_{it} = \phi_i (g_{i,t-1} - \theta_t X_{it}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta g_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (5.3)$$

Where:

¹⁵³ There are two types of panel unit root tests. The first-generation unit root tests assume cross-sectional independence and homogeneity across-sections. While the second-generation of panel unit root tests assumes cross-sectional dependence.

¹⁵⁴ To test a variable Y_{it} for a unit root the following regression equation is estimated:

$$\Delta Y_{it} = \alpha_{i0} + \alpha_{i1}t + \alpha_{i2}Y_{it-1} + \text{lags of } \Delta Y_{it} + \varepsilon_{it}$$

i.e. the first difference of Y_{it} is regressed against a constant, a time trend ($t = 1, 2, \dots, T$), the first lag of Y_{it} and, if necessary, lag of ΔY_{it} . Sufficient lags of ΔY_{it} must be included to ensure no autocorrelation in the error term. One lag (or even no lags) is usually sufficient with annual data. The test for a unit root, i.e., non-stationarity, is based on the t-stat on the coefficient of the lagged dependent variable, Y_{it-1} .

In the unit root test, both the null and alternative hypotheses are expressed as:

Null Hypothesis (H_0): series has unit root, (i.e., if the p-value > 0.05).

Alternative Hypothesis (H_1): series does not have unit root, (i.e., if p-value < 0.05).

The null hypothesis is rejected (i.e., the series does not have unit root) if the absolute value of the computed test statistic is greater than the test critical values. That is, when the probability value is less than 0.05 (p-value < 0.05), the model is stationary. As such, the null hypothesis is rejected (while the alternative hypothesis is accepted). However, if the absolute value of the computed test statistic is less than the test critical value, (i.e., if the p-value > 0.05), it means that the model has unit root, and the null hypothesis is not rejected. The series has to be difference in order to remove the unit root.

The ϕ_i is speed of adjustment parameter and it must be non-zero.¹⁵⁵ λ and δ represent the short-run coefficients of dependent and independent variables respectively. The subscripts i and t stand for cross-section and time respectively, θ stands for long-run coefficients while μ stands for fixed effect and ε is the error term.

According to Pesaran and Smith (1995), ARDL with the error correction form is a new cointegration approach, superior to other cointegration techniques such as Johansen (1988), Engle and Granger (1987), and Johansen and Juselius (1990). The ARDL technique estimates the long-run and short-run causality for variables integrated of order 0 and 1. The PMG estimator is valid if the error correction term (ECT) is negative. We will then proceed with the analysis as seen in the next section.

5.5 EMPIRICAL ANALYSIS

In this section, the descriptive statistics show the overall perspective of the dataset. Table 5.1 below shows the Mean, Maximum and Minimum values of all the variables used in the section.

Table 5.1: Descriptive Statistics

Statistical Indicators	GDPc	REER	OPEN	GOVCON	FDI	TOT
Mean	-0.401	124.398	60.952	13.171	1.442	79.412
Maximum	13.564	223.648	119.853	25.783	10.034	165.890
Minimum	-36.557	82.835	26.452	6.367	-5.007	17.651
Std. Dev.	5.7331	37.080	22.064	3.199	2.207	29.363
Observations	117	117	117	117	117	117

Source: Computation from using EViews 12

The result shows that the average annual GDPc growth rate is negative (-0.401), and its minimum and maximum levels are (-36.557) and (13.564), respectively, then the base period of 2010. This implies that, on average, the GDPc is negative in the CEMAC region.¹⁵⁶ The average REER is 24.398% higher than the base period of the period (year 2010). This therefore implies that averagely, the CFA franc was overvalued. Also, the minimum and maximum are 17.165% lower and 123.648% higher, respectively than the base period of 2010.

The OPEN mean of 60.952 implies that, on average, the region is moderately open to international trade. This means that, the value of the region's total trade (exports plus imports)

¹⁵⁵ In case $\phi_i = 0$, then there will be no long-run relationship in the model. This parameter is expected to be negative and statistically significant (i.e., the t-stat $\geq |2|$), under the assumption of bringing back the variables to the long-run equilibrium.

¹⁵⁶ A nation could have a consistent economic growth, but if its population is growing faster than its GDP, its GDP per capita growth will be negative. However, this is not a dilemma for most established economies because a moderate pace of economic growth could outpace their population growth rates. Many nations in Africa have low levels of GDP per capita which could be due to their rapid increase in population with little GDP growth, resulting to a steady erosion of living standards. If a nation's GDP per capita is growing with a stable population level, it could be due to its technological progressions that produces more with the same population level.

relative to its Gross Domestic Product (GDP) is moderate. Thus, the region is engaged in trade activities without being excessively dependent on international trade, and at the same time not being overly protective with trade barriers (tariffs, quotas). So, the region is integrated into the global economy to a substantial level.

The GOVCON mean of 13.171 indicates that on average, the government consumption expenses account for 13.171% of the region's GDP. The government consumption level relative to GDP gives insight into the size of government sector in the economy. A larger level of government consumption relative to GDP could indicate an expansionary fiscal policy, aiming at boosting demand and to support the region's economic growth.

The mean FDI ratio of 1.442 implies that on average, the FDI inflows into the CEMAC region are relatively high compared to their GDP. This signals that foreign investment performs a significant role in the region's economy. Thus, the region benefits from foreign investment like infrastructure development, technological transfer, and job creation, which could contribute to the region's economic growth.

The TOT mean of 79.412 shows that on average, the region exports prices are 79.412% of their import prices. That is the region receive less value for their exports relative to what they pay for imports (i.e., the value of their exports is lower than that of Imports). A lower-than-average TOT (less than 100) could impact the region's economic performance as the region will have to export more volume of goods and services to finance their imports.

We now proceed to analyse the data of the three CEMAC nations to establish if REER devaluation has an impact on their economic growth. We begin by performing some diagnostic tests, as seen below.

5.5.1 DIAGNOSTIC TEST RESULTS

The cross-section dependency test was performed to check if the study did not produce spurious results. The test also examines the presence of serial correlation. The diagnostic tests employed in this section were the Breusch-Pagan Chi-Square, Pearson LM normal, and the Pearson CD test. The results of all the diagnostics tests in the table below show that the model is stable (with no spurious results as the p-value > 0.05). This means that the model is very good to be used in this research. Thus, we could proceed to perform unit root test.

Table 5.2: Cross-sectional Dependency Results

Test	Probability
Breusch-Pagan LM	0.9007
Pesaran scaled LM	0.3234
Pesaran CD	0.8986

Source: Computation from using EViews 12

5.5.2 UNIT ROOT TEST

The results of the unit roots tests (table 5.3 in the appendix) show that the p -value of GDP is less than 0.05, indicating that the null hypothesis for non-stationarity is rejected at a 0.05 significance level.¹⁵⁷ Economic growth is stationary at level (i.e., integrated of order zero - $I(0)$). The other variables are not stationary at level, so we performed first difference. The results from the first difference shows that all the variables are stationary at $I(1)$, as their p -values < 0.05. The results of the panel unit root tests, therefore show that there is a mix of $I(0)$ and $I(1)$, and none of the variables is $I(2)$. This confirms the use of the panel ARDL model, which is appropriate for a mixture of $I(0)$ and $I(1)$ variables. Muchapondwa and Pamhidzai (2011) emphasised the panel ARDL model as the new cointegration procedure because the panel ARDL model allows for the estimation of both the short-term and long-term relationship between economic growth and its fundamentals.

5.5.3 LONG-RUN ANALYSIS

The panel ARDL results were estimated by applying the correct optimal lag using the Akaike info criterion (AIC), as seen in the table below.¹⁵⁸ The correct optimal lag length must be applied, as seen below.

Table 5.4: Optimal Lag Length Results.

Optimal lag value (AIC)	Optimal Lag length
37.11774*	1

AIC: Akaike information criterion

Source: Computation from time-series data using EViews 12

The PMG result in Table 5.5 below shows both the positive and negative long-run relationship between the independent variables and economic growth. The PGM estimator shows that the panel is heterogenous in the short-run and homogeneous in the long-term. The existence of a long-run relationship is that the pooled ECT should be negative and statistically significant (i.e., the t -statistic > |2|). In the long-run, GDP growth should be targeted homogeneously, while in the short-run each of the CEMAC nations should be treated independently and heterogeneously (i.e., each nation should adopt its strategy to increase its economic growth).

¹⁵⁷ The Levin, Lin, and Chu (2002), Pesaran and Shin (2003), ADF, and PP panel unit root tests are performed using intercept, intercept and trend.

¹⁵⁸ Applying the wrong lag (too many lags) in an analysis could result in loss of degree of freedom, cause multicollinearity among the regressors, serial correlation in the error terms, and misspecification error. On the other hand, too few lags could result in specification errors.

Table 5.5: Long-run Results (PGM Estimator)

Variables	Coefficient	t-Statistic	P-value
REER	-0.0242	-1.74	0.0852
OPEN	0.0212	4.952	0.0000
GOVCON	-0.8101	-4.4035	0.0000
FDI	0.2533	0.7566	0.4512
TOT	-0.0154	-0.9907	0.3245

Source: Computation from using EViews 12

The result shows that in the long-run, only OPEN has a positive impact on economic growth as an increase in OPEN by 1 lead to an increase in the region's economic growth by 0.02, and it is statistically significant with $t\text{-statistic} > |2|$ (i.e., $t\text{-stat}$ of 4.952). On the other hand, GOVCON has an inverse (negative) relationship with economic growth (i.e., it causes a drop in economic growth). An increase in GOVCON by 1 causes a (-0.81) drop in economic growth *ceteris paribus*. The result is statistically significant with a $t\text{-statistic} > |2|$ (i.e., $t\text{-stat}$ of -4.4).

Meanwhile, REER, FDI, and TOT do not impact economic growth (i.e., there is no long-run relationship between these independent variables and economic growth). This is because their $p\text{-value}$ is more than 0.05 (i.e., 0.0852, 0.4512, and 0.3245, respectively) and are statistically insignificant with $t\text{-statistic} < |2|$ (i.e., -1.74, 0.7566, -0.9907 respectively). This implies that exchange rate devaluation does not impact/ improve the economic growth of the CEMAC region. On the other hand, we could assume that because the currency is at its equilibrium, it could not impact the economic growth (i.e., when the CFA franc is at equilibrium, it does not influence the economic growth - this is because, after the 1994 devaluation, the currency has been revolving around its equilibrium till the year 2018). Thus, the CEMAC governments and monetary authorities should use other strategies to improve their economic growth. This result is in line with that of Kangami and Akinkugbe (2019), investigating “the effect of a common currency on economic growth: Evidence from CEMAC Custom Union”. They analysed the causal effects of the common currency on economic growth. Their findings showed that the monetary policy change instituted in the CEMAC region in 1994 has not played any significant role in promoting economic growth in the CEMAC region.

Statistics from the World Bank's World Development Indicators (2018) show that the GDP per capita growth (annual %) of individual CEMAC nations has been very mediocre. As of the year 2018, the GDP per capita growth (annual %) for Cameroon, CAR, and Gabon was 1.121%, 1.792%, and -1.545%, respectively. For the other CEMAC nations, Chad, Congo, and Equatorial Guinea, their GDP per capita growth (annual %) was -1.027%, -7.057%, and -9.445%, respectively. All these show that the standard of living of CEMAC nations is

low.¹⁵⁹ CEMAC's poor economic performance in terms of GDP growth could be attributed to several obstacles. These obstacles are mostly institutional and political in nature.

Beginning from the investment or business climate, statistics indicate that CEMAC region does not have an attractive business environment/ climate. According to the World Bank's Doing Business Report (2020), CEMAC nations' business environment is far from being attractive, as can be seen in Table 5.7 in the appendix C. None of the indicators used indicate a good or positive condition for any of the six CEMAC nations, implying that their business climate is unconducive. It is a consensus among economists that international trade acts as an engine to the economic growth of nations (Metougue, *et al.*, 2020; Bond *et al.*, 2005; Barro and Sala-i-Martin, 1997). They believe that trade, especially international trade, promotes the efficient allocation of resources, allows nations to experience the benefit of economies of scale, transfer of knowledge, fosters technological progress, and propagates competition, which is good for the nation. However, the data on Table 5.7 in the appendix C "Doing Business Index for the six CEMAC nations shows an unhealthy business climate.

Moreover, the statistics from Transparency International (2018) indicate that corruption is endemic in the CEMAC region.¹⁶⁰ The figures reveal the following:

- Gabon is ranked 124th out of 180 nations with a score of 31/100.
- CAR is ranked 149th out of 180 with a score of 26/100.
- Cameroon is ranked 152nd out of 180 with a score of 25/100.
- Chad and Congo are both ranked 165th with a score of 19/100.
- Equatorial Guinea is ranked 172nd with a score of 16/100.

None of the scores is up to 50, and this does not speak well of the region. Such unconducive conditions repel investors from the region and cause adverse economic growth.

Finally, the region has suffered much economic stagnation as well as economic decline due to political instability in the region. After enjoying decades of political stability, Cameroon has been wrestling for years now with attacks by Boko Haram in the Far North Region of the nation, Rebel attacks in the East Region, and the Secessionist insurrection in the Anglophone regions

¹⁵⁹ *The poor GDP per capita growth (annual %) performance of CEMAC nations could be corroborated by their GDP growth (annual %). But for Cameroon, CAR, and Chad that had positive GDP growth (annual %) in the year 2018 (i.e., 3.955%, 3.789, 2.374% respectively), the other three nations GDP growth (annual %) was not good (i.e., 0.838%, -4.805%, and -6.236% for Gabon, Congo, and Equatorial Guinea respectively) (World Bank, nd). Though Cameroon, CAR, and Chad have good GDP growth (annual %), it is not reflected in the standard of living of their population, and this could be due to the various war crises faced by these nations.*

¹⁶⁰ *The Corruption Perceptions Index (CPI) ranks nations by their perceived levels of public sector corruption determined by expert assessment and opinion surveys. The CPI currently ranks 180 nations on a scale from 100 (very clear) to 0 (highly corrupt).*

of the nation, which has caused the death of thousands of citizens. These political instabilities have seriously impeded the free flow of goods and services within Cameroon as well as within the CEMAC region, which led to a drop in the economic growth of both the nation and the region (Metougue, *et al.*, 2020). Central African Republic (CAR) has also been experiencing armed rebel conflicts over the years.¹⁶¹ With regards to Equatorial Guinea, there have been failed coup attempts in the years 2004 and 2017, which has kept the government on a constant alert. Finally, the pirates along the Gulf of Guinea have made the region very vulnerable to instability. Thus, institutional, and political obstacles act as impediments to the growth of trade flow and economic growth in the CEMAC region. As such, policymakers ought to take urgent and consistent actions to dismantle these impediments so that the CEMAC region can enjoy economic prosperity.

5.5.4 SHORT-RUN ANALYSIS

After establishing the long-run relationship between the independent variables and economic growth in the above section, this section discusses the short-run results of the study. Table 5.6 below illustrates the short-run results of the Error Correction Model estimated by the PMG estimator.

Table 5.6: Short-run Results

Variables		Coefficient	t-Statistic	P-value
ECT		-0.9786	-5.2144	0.0000
Δ REER		-0.0682	-2.828	0.0058
Δ OPEN		-0.355	-2.6091	0.0106
Δ GOVCON		-0.683	-2.4009	0.0184
Δ FDI		0.075	0.1416	0.8877
Δ TOT		-0.0355	-0.4574	0.6485
C		0.7891	0.3202	0.7495
Cameroon				
ECT		-1.0125	-51.0869	0.0000
Δ REER		-0.0365	-10.2376	0.002
Δ OPEN		-0.1205	-20.6988	0.0002
Δ GOVCON		-0.1857	-0.5407	0.6263
Δ FDI		-0.4776	-5.3689	0.0126
Δ TOT		-0.0819	-79.4273	0.0000
C		2.1167	0.1614	0.882
CAR				
ECT		-1.2854	-61.3633	0.0000
Δ REER		-0.0526	-7.7461	0.0045
Δ OPEN		-0.5918	-14.2102	0.0008
Δ GOVCON		-0.6923	-2.6327	0.0077
Δ FDI		1.1342	1.5775	0.2128
Δ TOT		0.116	32.8539	0.0001

¹⁶¹ On the 6th of February 2019, the government of CAR signed an African Union-mediated peace agreement with fourteen armed groups. The International Community and the African Union endorsed the agreement. The Mission of The United Nations Peacekeeping Force to Central Africa (MINUSCA) played a vital supportive role in the process.

C		4.2358	0.2106	0.8467
Gabon				
ECT		-0.6379	-27.6531	0.0001
ΔREER		-0.1155	-35.053	0.0001
ΔOPEN		-0.3526	-31.0747	0.0001
ΔGOVCON		-1.1711	-5.7063	0.0107
ΔFDI		-0.4315	-6.2449	0.0083
ΔTOT		-0.1407	-47.1919	0.0000
C		-3.9852	-0.32	0.77

Source: Computation from using EViews 12

The PGM short-run results show a negative and statistically significant error correction term (ECT) of -0.9789 with a *t-statistic* of $|-5.2144|$, which is greater than $|2|$. It takes 1.02 ($1/0.9789$) years for economic growth to move back to equilibrium after a shock on the independent variables. The high error correction term (ECT) shows that there is a stable relationship between economic growth and the independent variables. The result shows that in the short-run, REER, OPEN, and GOVCON have a negative relationship with economic growth. Noteworthy is that REER has a negative relationship with economic growth in the short-term, but there is no relationship in the long-term. This means that the REER devaluation contributes to economic growth in the short-run but has no long-run relationship.¹⁶² OPEN has a negative relationship with economic growth in the short-run and a positive relationship in the long-run. While GOVCON has a negative relationship with economic growth in both the short-term and long-term. Both FDI and TOT do not have any relationship with economic growth in the short-run and long-run.

The PGM result stipulates that in the long-run, GDP growth should be targeted homogeneously, while in the short-run each of the CEMAC nations could be treated independently and heterogeneously (i.e., each nation should adopt its own strategy to increase its own economic growth). After looking at the short-run result from a homogeneous perspective, we now look at it from a heterogeneous perspective (i.e., the individual CEMAC nations' short-run results). Beginning with Cameroon, as seen in Table 5.6 above, the short-run result shows that all the independent variables but for GOVCON have a negative relationship with economic growth. While there is no relationship between GOVCON and economic growth, meaning that GOVCON does not impact economic growth in the short-run. CAR result shows that REER, OPEN, and GOVCON have a negative relationship with economic growth. TOT has a positive relationship with economic growth in the short run. While

¹⁶² In this chapter, we consider that when the REER is above the equilibrium (100), it is overvalued, while it is undervalued when it is below. A negative relationship with economic growth means that a devaluation will cause an improvement in economic growth.

there is no relationship between FDI and economic growth in the short-run. Gabon's result shows that there is a negative relationship between all the independent variables and economic growth in the short-run.

5.6 POLICY RECOMMENDATION

Debates on the valuation of the CFA franc have intensified, and there was speculation of a possible devaluation of the CFA franc during the CEMAC Head of States Summit held in Ndjamena–Chad, on 25th October 2018 (Kapital Afrik, 2018). This was due to the poor macroeconomic fundamentals in the region's balance of payments.¹⁶³ It is no longer news that political constraints have contributed to the poor economic performance of the CEMAC region. As earlier mentioned, most of the nations in the region have witnessed or are witnessing some political crises.¹⁶⁴ Political instability has a negative impact on a nation's economic growth because firms cannot work at their full capacity, thereby impeding economic growth. Having politically unstable neighbours influences a nation's trade pattern, investment, and mobility of factors of production, thereby leading to lower economic development. So, policies geared to enhance economic growth at the individual regional level could be stalled if the security issues are not addressed. Thus, one of the ways to address the security issues is for the nations to have an inclusive dialogue with the different stakeholders that contribute to the crises in the nations concerned.

It is obvious from the analysis that the CFA franc (common currency), along with 12th January 1994 devaluation, has, on average, not contributed to the region's economic growth. As such, policymakers ought to be careful when adopting policy changes like currency devaluation with the goal of improving their economic growth. This work has shown that the real effective exchange rate does not have a long-run impact on the region's economic growth. Improving economic growth in the CEMAC region requires a comprehensive approach that addresses various underlying factors. Below are some policy recommendations that could contribute to the enhancement of the CEMAC region's economic growth:

There is a need for an improvement of governance and institutions, enhancing accountability, transparency, and efficiency of public institutions. Anti-corruption measures should be

¹⁶³ *The slow progress of reforms, increase in public debt, and deterioration of budget balance drew wide speculations of the CFA franc devaluation. Nevertheless, the devaluation did not occur during the meeting as BEAC governor said there was no reason for CEMAC to risk devaluation. This was because the economic situation in the CEMAC zone was nowhere close to that of the 1994 CFA franc devaluation.*

¹⁶⁴ *The piracy along the Gulf of Guinea, the security threat posed by Boko Haram in the northwest CEMAC region, the anti-Balaka and Séléka militias continual threat to the region's security, and the series of failed coup attempts such as 6th April 1984 coup in Cameroon, 7th March 2004 and 27th to 28th December 2017 coup in Equatorial Guinea.*

implemented, the rule of law should be strengthened by empowering the judicial system, and good governance practices should be promoted. These improvements could foster the confidence of investors, attract Foreign Direct Investment (FDI) and enable economic growth in the region.

Secondly, policymakers should promote the development of financial sectors in the region by strengthening the financial and banking sectors of the region. This could be done by promoting financial inclusion, improving financial regulations, and expanding access to credit for small and medium-sized enterprises (SMEs). They need to develop a sound and comprehensive financial system that supports entrepreneurship, investment, and economic growth.

Thirdly, policymakers should prioritise investing in human capital, such as investing in healthcare, education, and skills training to develop a productive workforce. Improving access to healthcare services and quality education will improve human capital and promote innovation, thereby driving economic growth in the long-term.

Fourthly, the region needs to diversify their economy from depending on primary commodities into sectors that foster exports like manufacturing and technology. They should promote innovation and encourage entrepreneurship in these sectors, which could create new sources of employment and growth.

Fifthly, they could invest in infrastructure development such as telecommunication networks, transportation, and energy. These robust infrastructure systems will reduce transportation costs, facilitate trade, attract investments in the private sector, and, by so doing, stimulate economic activities in the entire region.

Finally, there should be partnerships and collaborations with regional organisations and international financial institutions to share knowledge and technical expertise. This could help address their common challenges and promote economic growth in the region. The above policy recommendation, if properly implemented, could contribute to enhancing the economic growth in the CEMAC region. It is also necessary to tailor the recommendations to specific circumstances and priorities of every CEMAC nation and, at the same time, foster collective regional cooperation and integration.

5.7 CONCLUSION

In this chapter, we examined the relationship between REER and economic growth. Because one of the goals of the CFA franc devaluation was to improve the Zones' economic growth, we investigated the impact of CFA franc devaluation on CEMAC Zone's economic

growth.¹⁶⁵ The variables used in the study include gross domestic product (GDP) – proxy by GDP per capita being the dependent variable.¹⁶⁶ The independent variables are real effective exchange rate (REER), government consumption (GOVCON), trade openness (OPEN), foreign direct investment (FDI), and terms of trade (TOT). The datasets are secondary, within the period 1980 to 2018, and gathered from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. The study showed that stationarity of the variables was achieved at both levels and first differencing, which implies the autoregressive distributed lag (ARDL) model was the appropriate estimation technique needed to estimate the coefficients of the variables. Because we were interested on the impact of REER on the entire CEMAC region's economic growth, the Pooled Mean Group (PMG) panel ARDL approach was used, which assumes that all long-run coefficients are the same across groups, while the short-run coefficients could differ across groups.

The results showed that in the long-run, only OPEN has a positive impact on economic growth. On the other hand, GOVCON has an inverse (negative) relationship with economic growth (i.e., it causes a drop in economic growth). Meanwhile, REER, FDI, and TOT do not impact economic growth (i.e., there is no long-run relationship between these independent variables and economic growth). The result shows that in the short-run, REER, OPEN, and GOVCON have a negative relationship with economic growth. Noteworthy is that REER has a negative relationship with economic growth in the short-term, but there is no relationship in the long-run. This means that the REER devaluation contributes to economic growth in the short-run but has no long-run relationship.¹⁶⁷ OPEN has a negative relationship with economic growth in the short-run and a positive relationship in the long-run. While GOVCON has a negative relationship with economic growth in both the short-term and long-term. Both FDI and TOT do not have any relationship with economic growth in the short-run and long-run. Thus, it is recommended that the region uses other tools to improve the region's economic growth, as recommended within the chapter.

¹⁶⁵ *The following three CEMAC nations were used to represent the region: Cameroon, Central Africa Republic – CAR, and Gabon.*

¹⁶⁶ *It represents the total value of goods and services produced in a nation over a specific period. The GDP is a measure of the size of an economy and represents the growth or economic production of a nation. While GDP per capita is the GDP divided by the total population of the nation, and it is a better indicator of the standard of living of a nation than the GDP.*

¹⁶⁷ *In this chapter, we consider that when the REER is above the equilibrium (100), it is overvalued, while it is undervalued when it is below. A negative relationship with economic growth means that a devaluation will cause an improvement in economic growth.*

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 INTRODUCTION

This thesis analysed the state of the CFA franc in the CEMAC zone nations, evaluating if it is aligned (within its equilibrium). It is almost three decades since the CFA franc was devalued. As such, it is necessary to know if it is still at equilibrium. As a vital relative price affecting the economy via numerous channels, the impact of changes in the real exchange rate on economic growth has been of growing attention in recent policy debates. The debate was renewed due to the series of economic crises (1994 Mexican Peso crisis, 1997 Southeast Asia financial crisis, 1998 Russia financial crisis, 1999 Brazil currency crisis, 1998 -2002 Argentina great depression), whereby unsustainable exchange-rate regimes were identified as the cause (Gluzmann *et al.*, 2012, Farrant and Peersman, 2006).

Nations are constantly evaluating their competitiveness in the global market and seeking to empirically provide explanations on the fundamentals that drive their international competitiveness. With competitiveness being the ability of a nation to attain sustained, inclusive growth under stable macroeconomic conditions, a nation's international competitiveness in the foreign trade pivots on its real exchange rate (RER) level. Over the years, policymakers and economists focused on fiscal policy and exchange rate policy. While the fiscal deficit's role is well understood, the opposite is the situation concerning the exchange rate policy.

It is unanimously accepted that a persistently overvalued RER leads to factor misalignment, loss in efficiency, and loss of competitiveness, which hinders growth and slows convergence. But the theoretical and analytical equivalent for its alternative – the RER undervaluation being helpful to economic growth – is not. This is partly due to the issues of its definition and measurement, which include: How do we define the real exchange rate? How is it measured? Most importantly, how does one measure the equilibrium exchange rate? It is from the latter that the misalignment is measured. This has made the RER and misalignment among the most debated macroeconomic policies on national and international platforms (Hinkle and Montiel, 1999; Williamson, 1994).

The 'Washington Consensus' by Williamson (1994) acknowledges the vital role of RER in the growth process. According to it, an appropriate real exchange rate should be consistent with macroeconomic objectives (price stability, full employment, economy growth, balance of payment equilibrium, and social welfare) in the medium run and "sufficiently competitive" such that exports grow at a rate consistent with external balance.

Contrary to the 'Washington Consensus' is the view championed by Rodrik (2008), that RER undervaluation promotes economic growth, and overvaluation harms it. This stance is in part due to the point of view that exchange-rate – precisely an undervalued currency could be used in protecting home-based infant industries and the competitiveness of their exports. This perspective was recently rekindled due to the success story of the export-led growth in conjunction with apparently undervalued currency in East-Asian nations. Finally, Rodrik (2008) says that due to institutional weakness and market failure, the manufacturing sector in developing nations is unduly subject to distortions. As such, it is below its optimal size in equilibrium. Because removing those distortions appears difficult, an undervalued RER serves as a 'more practical' second-best option for optimally re-allocating resources towards the manufacturing sector (Rodrik, 2008).

Some empirical results do not support the conclusion that an undervalued RER contributes to economic growth. Easterly (2005) review of the updated Dollar (1997) measure of currency devaluation concludes that RER devaluation was insignificant as a determinant of economic growth. Acemoglu *et al.* (2003) and the IMF (2005) also concluded that the outcome was even weaker when institutions were introduced in the growth model. Nevertheless, some evidence of a positive effect of RER devaluation has surfaced, with the East-Asian nations (China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, Taiwan, and Thailand) being perfect examples. It is believed that their "miraculous" growth between the periods 1965 to 1990 was due to the support of "smart" in their export-led growth strategy, alongside their manipulation of the exchange rate (Razmi *et al.*, 2012; Rodrik, 2008; World Bank, 1993).

It is highly contested among economists that currency devaluation improves a nation's trade balance (TB) deficit, leading to a reduction of the current account deficit and improving economic growth (Kurtović, 2017). A RER devaluation could lead to the deterioration of TB in the short run while improving the TB in the long run. The response of the TB over time looks like a tilted J shape. The *J*-curve theory is the economics traditional wisdom of analysing the dynamic effect of exchange rate changes on TB. If the Marshall-Lerner Condition (MLC) holds, it is likely that following a devaluation, an initial drop in TB occurs before an improvement follows. The *J*-curve effect is attributed to the lagged adjustment of quantities to changes in the relative prices (Magee, 1973).

Economists see the RER as a policy instrument for promoting economic growth of a nation. This view is championed by Rodrik (2008) who stated that RER undervaluation promotes economic growth and overvaluation harms it. This stance is in part due to the view that exchange-rate – precisely an undervalued currency could be used in protecting home based infant industries and the competitiveness of their exports (Nouira and Sekkat, 2015; Grekou,

2015; Rodrik, 2008). Thus, in this thesis, we reviewed the RER, economic growth and the TB channel through which economy grows with our focus on CEMAC zone nations of the CFA franc.

The CFA franc zone by their history have inherited a fixed exchange rate regime since their colonial past. Hence, these nations saw their currency match the French Franc (FF), which was the currency of their metropolis. Created on 26th December 1945 in the wake of the Bretton Woods conference, the Franc of African Financial Community (FCFA) – was initially known as the Franc of French Colonies of Africa (Franc des Colonies Francaises d'Afrique acronym - FCFA). The CFA franc (FCFA) is the currency used in 15 African states grouped into three zones.¹⁶⁸ In the year 1948, 1 FF was equivalent to 50 CFA franc and the parity did not change till the 12th January 1994 devaluation by 50%, whereby the parity changed to 1FF worth 100 CFA franc in the nominal rate.¹⁶⁹ The devaluation was meant to reverse the domestic and external disequilibria that had built up since the mid-1980s. The internal deficit was due to unemployment on the one hand caused by; low level of legal, administrative and institutional framework, human capital, structural policies and financial policies. While the external deficit on the other hand, was due to foreign interests and terms of trade shocks (Bahmani-Oskooee, 1998; Nashahibi and Bazzoni, 1994).

The FCFA and FF monetary arrangements included the FCFA convertibility into the FF backed by the French treasury. The convention encompassed strict fiscal and monetary rules, which provided much financial and monetary stability. The advantages, such as greater stability and discipline and low inflation, made the FCFA zone suitable for foreign investment, economic development, and growth (Amin, 2000; Devarajan and De Melo, 1991). Such macroeconomic stability was to attract foreign investors/capital into the nations, which will be used to improve productivity/output, create employment, and growth in the economy, which will eventually result in the improvement in the standard of living of the citizens.

¹⁶⁸ CEMAC (acronym for Communauté Économique et Monétaire de l'Afrique Centrale - Central African Economic and Monetary Community), UEMOA (acronym for Union Economique et Monetaire Ouest Afraine - West Africa Economic and Monetary Union –WAEMU), and Comoros. The CEMAC zone consists of the following countries: Cameroon, Central Africa Republic, Chad, Republic of the Congo, Equatorial Guinea, and Gabon. The currency is redistributed in this zone by the Banque des Etats de l'Afrique Centrale (BEAC) – Bank of Central African States. UEMOA zone consists of the following countries: Benin, Burkina Faso, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo. The currency is redistributed in this region by Banque Central des Etats de l'Afrique de l'Ouest (BCEAO) – Central Bank of the West African States. In the Comoros, the currency is redistributed by Banque Centrale des Comoros (BCC) – Central Bank of Comoros (Coleman, 2008; Banque de France, 2010; Adom, 2015).

¹⁶⁹ The parity of the CFA franc was change from 50 CFA francs to 100 CFA francs per French franc in the CEMAC and UEMOA region. While in the Comoros, the currency was devalued from 50 Comoran francs per French franc to 75 Comorian francs per French franc (Devarajan, 1994).

However, it is believed that the same institutional arrangements that contributed to the good economic performance of the FCFA zone nations before the 1980s had also hindered them from adjusting timely to internal and external shocks. For instance, the fixed exchange rate system practiced by the FCFA nations made it difficult for their currency to change quickly to adjust to shock (Amin, 2000; Devarajan and De Melo, 1991). Therefore, if the institutional arrangements hindered the timely adjustment of the FCFA, it is necessary to ensure that it does not re-occur, mindful that it has been more than two decades since the currency was devalued. This leaves us with the question of whether the 1994 FCFA devaluation achieved its objectives and if the currency is still at its optimal level (equilibrium or not).

This research was aimed at analysing the state of the CFA franc in each of the CEMAC nations, to know if it was aligned. With TB channel being one of the main channels through which the exchange rate impacts economic growth, we investigated the relationship between the REER and the TB for the presence of the *J*-curve. From an overview perspective, we investigated if the objective of the CFA franc devaluation was attained via the impact of the currency on economic growth of CEMAC zone. Thus, the following research questions were addressed:

- ❖ Is there a real exchange rate misalignment problem in the CEMAC nations?
- ❖ Is there a relationship between the REER and the TB in the CEMAC nations?
- ❖ Is there a relationship between the REER and economic growth in the CEMAC Zone?

6.2 POLICY RECOMMENDATION

This thesis is focused on answering the above three research questions and proposing policy recommendations.

Empirical Question 1

This question was focused at investigating the state of the CFA francs (i.e., if it is aligned or not) in the CEMAC zone nations (Cameroon, Central Africa Republic – CAR, Gabon, Equatorial Guinea, Chad, and Congo). Based on the classical works of Clark and MacDonald (1998), we used the Vector Autoregression (VAR) approach, which consists of the full-information maximum likelihood (FIML) method due to Johansen (1995).¹⁷⁰ This econometrics methodology corrects for autocorrelation and endogeneity parametrically using the vector error correction mechanism (VECM) specification. It was used to investigate both the long-term and short-term relationship between the REER and its fundamentals in four CEMAC nations (Cameroon, Central Africa Republic – CAR, Gabon, Equatorial Guinea). The

¹⁷⁰ MacDonald and Ricci (2003) used the Johansen FIML in estimating the equilibrium real exchange rate of South Africa. Eita and Sichei (2006) also used this approach at estimating the cointegration of Namibia.

fundamentals used are government expenditure (or government debts - *GEXP*), terms of trade (*TOT*), net foreign assets (*NFA*), trade policy (proxy by openness - *OPEN*), and productivity differentials (*PROD*). The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were done, and the results showed that all the variables were non-stationary at level, and stationary at their first difference. The VECM result showed the presence of long-term relationship between REER and all its fundamentals in CAR and Equatorial Guinea models (but for *OPEN*, which had no long-term relationship). While there is no long-term relationship between REER and its fundamentals in the models of Cameroon and Gabon. The result of Cameroon, CAR, and Equatorial Guinea shows the presence of short-term relationship between some of the fundamentals and REER. While the result of Gabon shows that there are no short-term relations between the fundamentals and REER.

The behavioural equilibrium exchange rate (BEER) approach by Clark and MacDonald (1998) was used to ascertain the state of the CFA francs in all the CEMAC nations. The results were within the period 1980 to 2018, showing that prior to the 12th January 1994 devaluation, the currency experienced series of fluctuations between undervaluation and overvaluation. After the devaluation, the currency was undervalued, and thereafter, it has been within its equilibrium. Thus, as of the year 2018, the CFA franc was within the equilibrium (i.e., 1.85%, 3.73%, 4.59%, -0.70%, -4.45%, and 1.08% misalignment for Cameroon, CAR, Gabon, Equatorial Guinea, Chad, and Congo respectively)¹⁷¹. It should be of no concern to the CEMAC nations' monetary authorities since they are all within the 5% threshold. However, the results of Equatorial Guinea and Gabon revealed that prior to the devaluation, the currency was within equilibrium and did not warrant devaluation. Because CEMAC is a common currency zone, decisions made impact the entire Zone. The CFA franc could not be devalued (treated) on a country-by-country base.

Empirical Question 2

The second question analyzed the impact of CFA franc devaluation on CEMAC nations' trade balance by looking for the presence of the *J*-curve.¹⁷² The variables used in the study include log trade balance (LNTB) being the dependent variable, and independent variables are; log real effective exchange rate (LNREER), log domestic income (LNDI) – proxy by each of the CEMAC nations' gross domestic production (GDP), and log foreign income (LNFI) – proxy by the main trading partners' GDP. The datasets are secondary, within the period 1980 to 2018,

¹⁷¹ Because the REER is seldom at equilibrium, we assumed it is at equilibrium when the misalignment (differences between REER and EREER) revolves around absolute 5%.

¹⁷² The three CEMAC nations used (Cameroon, Central Africa Republic – CAR, and Gabon) and their individual five main trading partners (Cameroon's main trade partners are; China, France, India, Netherlands, and Spain; CAR partners are Cameroon, China, France, India, and Nepal; while Gabon's partners are China, Ireland, Korea, Netherlands, and USA).

and gathered from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. The study showed that stationarity of the variables was achieved at both level and first differencing, which implies the ARDL model was the appropriate estimation technique needed to estimate the coefficients of the variables.

The aggregate bilateral trade data approach by Rose and Yellen (1989) was used to investigate the presence of the *J*-curve in the trade balance relationship between each of the three CEMAC nations and their individual main trade partners. To have an overview of the impact of CFA franc devaluation on the nation's trade balance, we used the aggregate trade data approach by Magee (1973). The presence of the *J*-curve means that the CFA franc devaluation leads to the deterioration of the TB in the short-run, while improving it in the long-run, *ceteris paribus*. The presence of the *J*-curve is achieved when the short run coefficient of LNREER is negative and statistically significant (i.e., the *t*-statistics $\geq |2|$), while the long run coefficient of LNREER is positive and statistically significant (i.e., the *t*-statistics $\geq |2|$).

The results of the aggregate bilateral trade data approach show the presence of a *J*-curve in the TB between Cameroon and all her five main trade partners. While the results of both CAR and Gabon show the absence of *J*-curve in the TB between them and all their trade partners. From a holistic perspective, the aggregate trade data approach shows the presence of a *J*-curve in the TB between Cameroon and all her main trade partners combined, while there is no *J*-curve in both CAR and Gabon with their major trade partners combined. This research shows that only Cameroon could benefit from the CFA franc devaluation at improving its TB. Thus, the governments of both CAR and Gabon should use different policies to improve their TB rather than using currency devaluation.

The objectives of the CEMAC region are primarily to promote economic integration, stability, and development among its member nations. Among others, some of CEMAC's main objectives are to foster regional cooperation,¹⁷³ and economic integration.¹⁷⁴ However, we saw that, but for CAR, which had Cameroon as one of its main trading partners, there was no main trading collaboration among the other CEMAC nations. This means that there is a need for an improvement of regional cooperation among CEMAC nations. Despite the supposed free movement of people, goods, services, and capital within the region, yet trade within the

¹⁷³ That is, it seeks to strengthen regional cooperation and collaboration among its member nations. This includes initiatives to promote regional trade, shared development projects, and infrastructure connectivity.

¹⁷⁴ CEMAC aims to promote economic integration among its member nations, which includes the free movement of people, goods, services, and capital within the region, as well as the harmonisation of economic policies and regulations to facilitate trade and investment across borders.

region is not maximised. Thus, CEMAC policymakers need to enforce and promote economic integration and regional cooperation.

Improving the TB in the CEMAC region demands a comprehensive approach which addresses both the demand and supply sides of trade, which entails the following recommendations: encourage and support the diversification of export sectors beyond traditional commodities. This could be done by promoting value-added industries like agro-processing, manufacturing, and services. These could generate higher export revenues and reduce the dependence on volatile commodities prices (i.e., they should diversify the economy by reducing their dependence on oil and other primary commodities to sectors like agriculture, manufacturing, services, and technology). This could be done by promoting entrepreneurship, encouraging investments, and supporting innovation in these sectors to create sources of employment and growth.

Policymakers should facilitate trade by simplifying trade procedures and shrinking administrative burdens to facilitate cross-border trade. This could be achieved by harmonizing trade regulations with neighboring nations and eliminating non-tariff barriers to ease regional and international trade and cost-effectiveness. This could improve trade within the region.

Also, policymakers could enhance the development of infrastructure via investment in infrastructure projects, which include transportation, telecommunication networks, and energy. This robust infrastructure system helps facilitate trade, attracts private sector investments, reduces transaction costs, and stimulates economic activities across the CEMAC region. Finally, policymakers should create favorable business climates that will address issues like bureaucratic red tape, corruption, and the enforcement of intellectual property rights. These could create a conducive business environment for trade and investment. As seen in section 4.6.5 and 4.6.6 (table 4.5 and figure 4.3a), only CAR has Cameroon as a main trade partner, yet there is no presence of *J*-curve in the TB. This means that there is need to improve the trade relationship within the CEMAC region, and an improvement of the business climate. Statistics indicate that CEMAC region does not have an attractive business environment/ climate. According to the World Bank's Doing Business Report (2020), CEMAC nations' business environment is far from being attractive, as can be seen in Table 5.7 in the appendix C. None of the indicators used reveal a good or positive condition for any of the six CEMAC nations, implying that their business climate is unconducive. Thus, it is imperative for CEMAC nations to collaborate and implement the above recommendations in a synchronized way, taking into consideration each nation's specific needs and circumstances to attain a sustainable improvement in their trade balance.

Empirical Question 3

In this third question, we examined the relationship between REER and economic growth in CEMAC zone. Because one of the goals of the CFA franc devaluation was to improve the Zones' economic growth, we investigated the impact of CFA franc devaluation on CEMAC Zone's economic growth.¹⁷⁵ The variables used in the study include gross domestic product (GDP) – proxy by GDP per capita being the dependent variable.¹⁷⁶ The independent variables are real effective exchange rate (REER), government consumption (GOVCON), trade openness (OPEN), foreign direct investment (FDI), and terms of trade (TOT). The datasets are secondary, within the period 1980 to 2018, and gathered from the World banks - World Development Indicators (WDI) database updated on 18/03/2020. The study showed that stationarity of the variables was achieved at both level and first differencing, which implies the autoregressive distributed lag (ARDL) model was the appropriate estimation technique needed to estimate the coefficients of the variables. Because we were interested on the impact of REER on the entire CEMAC region's economic growth, the Pooled Mean Group (PMG) panel ARDL approach was used, which assumes that all long-run coefficients are the same across groups, while the short-run coefficients could differ across groups.

The results showed that in the long-run, only OPEN has a positive impact on economic growth. On the other hand, GOVCON has an inverse (negative) relationship with economic growth (i.e., it causes a drop in economic growth). Meanwhile, REER, FDI, and TOT do not impact economic growth (i.e., there is no long-run relationship between these independent variables and economic growth). The result shows that in the short-run, REER, OPEN, and GOVCON have a negative relationship with economic growth. Noteworthy is that REER has a negative relationship with economic growth in the short-term, but there is no relationship in the long-run. This means that the REER devaluation contributes to economic growth in the short-run but has no long-run relationship.¹⁷⁷ OPEN has a negative relationship with economic growth in the short-run and a positive relationship in the long-run. While GOVCON has a negative relationship with economic growth in both the short-term and long-term. Both FDI and TOT do not have any relationship with economic growth in the short-run and long-run. Thus, it is recommended that the region uses other tools to improve the region's economic growth, as recommended within the chapter.

¹⁷⁵ The following three CEMAC nations were used to represent the region: Cameroon, Central Africa Republic – CAR, and Gabon.

¹⁷⁶ It represents the total value of goods and services produced in a nation over a specific period. The GDP is a measure of the size of an economy and represents the growth or economic production of a nation. While GDP per capita is the GDP divided by the total population of the nation, and it is a better indicator of the standard of living of a nation than the GDP.

¹⁷⁷ In this chapter, we consider that when the REER is above the equilibrium (100), it is overvalued, while it is undervalued when it is below. A negative relationship with economic growth means that a devaluation will cause an improvement in economic growth.

Debates on the valuation of the CFA franc have intensified, and there was speculation of a possible devaluation of the CFA franc during the CEMAC Head of States Summit held in Ndjamena–Chad, on 25th October 2018 (Kapital Afrik, 2018). This was due to the poor macroeconomic fundamentals in the region's balance of payments.¹⁷⁸ It is no longer news that political constraints have contributed to the poor economic performance of the CEMAC region. As earlier mentioned, most of the nations in the region have witnessed or are witnessing some political crises.¹⁷⁹ Political instability has a negative impact on a nation's economic growth because firms cannot work at their full capacity, thereby impeding economic growth. Having politically unstable neighbours influences a nation's trade pattern, investment, and mobility of factors of production, thereby leading to lower economic development. So, policies geared to enhance economic growth at the individual regional level could be stalled if the security issues are not addressed. Thus, one of the ways to address the security issues is for the nations to have an inclusive dialogue with the different stakeholders that contribute to the crises in the nations concerned.

It is obvious from the analysis that the CFA franc (common currency), along with 12th January 1994 devaluation, has, on average, not contributed to the region's economic growth. As such, policymakers ought to be careful when adopting policy changes like currency devaluation with the goal of improving their economic growth. This work has shown that the REER does not have a long-run impact on the region's economic growth. Improving economic growth in the CEMAC region requires a comprehensive approach that addresses various underlying factors. Below are some policy recommendations that could contribute to the enhancement of the CEMAC region's economic growth:

There is a need for an improvement of governance and institutions, enhancing accountability, transparency, and efficiency of public institutions. Anti-corruption measures should be implemented, the rule of law should be strengthened by empowering the judicial system, and good governance practices should be promoted. These improvements could foster the confidence of investors, attract Foreign Direct Investment (FDI) and enable economic growth in the region.

¹⁷⁸ *The slow progress of reforms, increase in public debt, and deterioration of budget balance drew wide speculations of the CFA franc devaluation. Nevertheless, the devaluation did not occur during the meeting as BEAC governor said there was no reason for CEMAC to risk devaluation. This was because the economic situation in the CEMAC zone was nowhere close to that of the 1994 CFA franc devaluation.*

¹⁷⁹ *The piracy along the Gulf of Guinea, the security threat posed by Boko Haram in the northwest CEMAC region, the anti-Balaka and Séléka militias continual threat to the region's security, and the series of failed coup attempts such as 6th April 1984 coup in Cameroon, 7th March 2004 and 27th to 28th December 2017 coup in Equatorial Guinea.*

Secondly, policymakers should promote the development of financial sectors in the region by strengthening the financial and banking sectors of the region. This could be done by promoting financial inclusion, improving financial regulations, and expanding access to credit for small and medium-sized enterprises (SMEs). They need to develop a sound and comprehensive financial system that supports entrepreneurship, investment, and economic growth.

Thirdly, policymakers should prioritise investing in human capital, such as investing in healthcare, education, and skills training to develop a productive workforce. Improving access to healthcare services and quality education will improve human capital and promote innovation, thereby driving economic growth in the long-term.

Fourthly, they could invest in infrastructure development such as telecommunication networks, transportation, and energy. These robust infrastructure systems will reduce transportation costs, facilitate trade, attract investments in the private sector, and, by so doing, stimulate economic activities in the entire region.

Finally, there should be partnerships and collaborations with regional organisations and international financial institutions to share knowledge and technical expertise. This could help address their common challenges and promote economic growth in the region. The above policy recommendation, if properly implemented, could contribute to enhancing the economic growth in the CEMAC region. It is also necessary to tailor the recommendations to specific circumstances and priorities of every CEMAC nation and, at the same time, foster collective regional cooperation and integration.

6.3 SUGGESTION FOR FURTHER RESEARCH

This research contributes to the existing literature on the following. Despite all the institutional structures and strategic programs put in place by policymakers of the CEMAC zone, bilateral trade flows within the region, and economic prosperity within the entire region have not been encouraging. There are two main channels through which REER impacts a nation's economic growth: the trade balance channel and foreign direct investment. In this research, we focused on the trade balance channel. It is necessary to investigate the FDI channel and some other economic growth channels and see if they have a long-term relationship with the REER. Secondly, an effective currency devaluation is performed via the accumulation of foreign exchange reserves (FER) by the monetary authority (Central Bank). The FER accumulation is costly as the central banks hold their FER in the form of low-yield short-term US Treasury securities and other securities, which, if they were to be invested, could yield much. It is assumed that more than 85% of the CFA franc zone nations' FER is kept in an "operations account" held at the French Treasury instead of in the CEMAC nations' respective central banks (Busch, 2013). This could mean that the cost incurred by the CFA franc nations is

relatively higher as they get no yields from the FER, and with the 12th January 1994 devaluation, the FER increased.¹⁸⁰ Hence, it is necessary to investigate the exact amount of the FER contributed by each of the CEMAC nations, the exact amount held at the French Treasury, and the yield generated by the FER. This will help give us a better understanding of the opportunity cost these nations have incurred due to the devaluation.

¹⁸⁰ *There has been an aggregation of currency reserves since 1961, with the CFA franc nations having neither a clue of what the amount nor the earnings generated by their FER since it was invested on “la Bourse de Paris” (Paris Stock Exchange) in the name of the French Treasury, and not in the names of the African states (Busch, 2013).*

APPENDICES

APPENDIX A.

Table 3.2: ADF and PP Unit Root Test Results.

Cameroon								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
REER	-1.381	-1.837	-5.399	-5.320	-1.481	-2.021	-5.401	-5.322
TOT	-2.021	-2.802	-3.948	-4.376	-1.686	-1.973	-3.969	-3.984
NFA	-0.751	-1.486	-5.726	-5.721	-0.886	-1.631	-5.731	-5.726
GOVCON	-2.702	-2.685	-7.204	-7.243	-2.554	-2.619	-7.249	-7.308
OPEN	-2.422	-2.409	-6.524	-6.432	-2.460	-2.457	-6.775	-6.626
PROD	-0.928	-1.789	-6.812	-6.814	-0.835	-1.789	-6.871	-6.889
CAR								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
REER	-2.389	-1.048	-6.426	-6.905	-2.411	-0.994	-6.448	-7.003
TOT	-2.484	-2.869	-8.076	-7.973	-2.478	-2.939	-8.982	-9.612
NFA	-1.962	-1.912	-5.902	-5.836	-2.051	-2.004	-5.902	-5.837
GOVCON	-1.819	-1.875	-5.599	-5.537	-1.819	-2.012	-5.579	-5.513
OPEN	-1.753	-0.644	-4.051	-4.823	-1.911	-0.426	-5.451	-6.050
PROD	-1.779	-1.948	-6.199	-6.109	-1.975	-2.166	-6.197	-6.109
Gabon								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	

Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
REER	-1.850	-1.574	-3.474	-3.826	-1.851	-1.679	-6.577	-6.653
TOT	-2.545	-3.489	-8.212	-8.094	-2.519	3.464	-8.644	-8.512
NFA	-1.698	-2.112	-6.283	-6.186	-1.707	-2.112	-6.309	-6.206
GOVCON	-2.254	-2.792	-4.952	-4.909	-2.441	-2.919	-5.314	-5.258
OPEN	-2.514	-3.344	-9.151	-9.020	-2.514	-3.245	-9.111	-8.983
PROD	-1.266	-2.421	-6.131	-6.063	-1.264	-2.507	-6.147	-6.073
Equatorial Guinea								
	ADF Test	PP Test						
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
REER	-2.235	-3.287	-5.700	-6.152	-2.370	-3.390	-5.699	-6.163
TOT	-1.867	-2.175	-7.590	-7.496	-1.827	-2.269	-7.445	-7.366
NFA	-1.272	-0.811	-4.482	-3.959	-1.424	-0.354	-4.491	-4.572
PROD	-1.084	-1.222	-4.798	-4.752	-1.212	-1.597	-4.831	-4.779

Source: Computation from time-series data using Eviews 12

Note: The critical value for ADF & PP unit root tests at level at 5% are -2.941 (constant), and -3.533 (constant, Linear Trend). While the critical value for ADF & PP unit root tests at 1 difference at 5% are -2.943 (constant), and -3.537 (constant, Linear Trend).

Table 3.8: The Hodrick-Prescott Filter

Cameroon				CAR			
Year	REER	BEER	MISALIGNMENT (%)	Years	REER	BEER	MISALIGNMENT (%)
1980	137.3424789	129.8981967	7.444282	1980	202.3474	192.5448	9.802571
1981	126.2282704	132.679707	-6.45144	1981	176.7697	188.7538	-11.9841
1982	123.4200695	135.5356601	-12.1156	1982	173.8849	185.0608	-11.1759
1983	128.3315012	138.4759845	-10.1445	1983	178.3887	181.4441	-3.05533
1984	130.6010195	141.3894528	-10.7884	1984	168.122	177.77	-9.64795
1985	136.5047012	144.0633926	-7.55869	1985	179.2576	173.8743	5.383224
1986	151.1238979	146.1772473	4.946651	1986	188.0925	169.4966	18.59583
1987	169.0696231	147.3348734	21.73475	1987	173.7204	164.43	9.290373
1988	164.3673383	147.1895939	17.17774	1988	160.347	158.6537	1.693296
1989	151.6657754	145.6120793	6.053696	1989	153.4849	152.2398	1.245094
1990	156.2406092	142.6447774	13.59583	1990	155.1533	145.2774	9.875892
1991	149.0396407	138.3906732	10.64897	1991	143.7035	137.8678	5.835725
1992	149.9276539	133.0887098	16.83894	1992	140.8976	130.2113	10.68635
1993	139.4509411	127.0843202	12.36662	1993	132.2499	122.5665	9.683377
1994	90.21931053	120.8913265	-30.672	1994	82.83549	115.2989	-32.4634
1995	96.94874193	115.1472174	-18.1985	1995	97.88825	108.8707	-10.9825
1996	98.03009479	110.1827612	-12.1527	1996	99.69212	103.4196	-3.72748
1997	97.03820135	106.1467415	-9.10854	1997	96.16359	98.97341	-2.80982
1998	100.4349359	103.0664152	-2.63148	1998	93.91736	95.52268	-1.60533
1999	99.37948393	100.877954	-1.49847	1999	89.84651	93.02987	-3.18335
2000	93.68777499	99.49121443	-5.80344	2000	87.00261	91.44136	-4.43876
2001	96.84682302	98.80106869	-1.95425	2001	88.87761	90.67174	-1.79413
2002	100.3336037	98.6443544	1.689249	2002	90.82385	90.59117	0.232677
2003	103.5604119	98.83836674	4.722045	2003	96.83504	91.0519	5.78314
2004	102.9415724	99.21729341	3.724279	2004	93.89304	91.90848	1.984561
2005	99.8708443	99.66254254	0.208302	2005	93.04301	93.07332	-0.03031
2006	101.512383	100.0927651	1.419618	2006	96.45685	94.47864	1.978212
2007	102.1073574	100.428695	1.678662	2007	97.42405	96.0564	1.367654
2008	105.0243175	100.6052623	4.419055	2008	104.0884	97.75831	6.33007

2009	106.4801327	100.5741839	5.905949
2010	100	100.331367	-0.33137
2011	100.22254	99.93177844	0.290762
2012	96.44922894	99.42707132	-2.97784
2013	98.90934994	98.87180639	0.037544
2014	99.72419221	98.29076595	1.433426
2015	93.51006141	97.70910775	-4.19905
2016	95.63358321	97.16632382	-1.53274
2017	96.58750666	96.65991569	-0.07241
2018	98.02705231	96.1720575	1.854995
Gabon			
Year	REER	BEER	MISALIGNMENT (%)
1980	223.64822	213.9434	9.7048123
1981	199.19001	211.39181	-12.201799
1982	200.99015	208.93726	-7.9471038
1983	197.81903	206.55479	-8.7357533
1984	189.85467	204.13995	-14.28528
1985	195.8232	201.50096	-5.6777627
1986	213.24217	198.30315	14.939012
1987	209.46064	194.15511	15.305539
1988	181.2535	188.81478	-7.561281
1989	214.19161	182.19319	31.998424
1990	215.26543	174.12574	41.139694
1991	167.63778	164.76781	2.8699617
1992	151.32173	154.68621	-3.364471
1993	146.69638	144.4764	2.2199867
1994	99.017016	134.70022	-35.683207
1995	109.45951	125.94173	-16.482215
1996	108.15813	118.42812	-10.269996
1997	106.3442	112.22178	-5.8775887

2009	106.3816	99.54976	6.831874
2010	100	101.4595	-1.45945
2011	98.43692	103.5844	-5.14748
2012	97.83703	106.007	-8.17
2013	105.1361	108.7583	-3.62216
2014	116.4247	111.7874	4.637322
2015	113.0131	115.0074	-1.99431
2016	119.1866	118.3778	0.808842
2017	123.3544	121.8378	1.516577
2018	129.0643	125.3352	3.729115
Equatorial Guinea			
Year	REER	BEER	MISALIGNMENT (%)
1985	125.3748	110.3505505	15.02427053
1986	105.5312	104.3494836	1.181753068
1987	91.28741	98.49865947	-7.211247924
1988	87.45613	92.96013825	-5.504009043
1989	85.64082	87.82386773	-2.183049557
1990	85.81038	83.12475557	2.685624506
1991	78.94511	78.87587895	0.069235285
1992	75.59356	75.11717128	0.476387309
1993	79.44577	71.88925832	7.556508717
1994	57.09972	69.23752973	-12.1378048
1995	68.03457	67.28294023	0.751630895
1996	68.01968	66.02506651	1.994609329
1997	62.8426	65.47100154	-2.62840515
1998	66.861	65.64778441	1.213217216
1999	63.82384	66.55617017	-2.732329943
2000	59.32544	68.209046	-8.883606192
2001	62.39398	70.59197582	-8.197996591
2002	68.25745	73.60168746	-5.344234903

1998	107.1369	107.2824	-0.1455074
1999	102.1353	103.51089	-1.3755893
2000	96.30816	100.8067	-4.4985375
2001	96.432363	99.055524	-2.6231611
2002	96.338294	98.098085	-1.7597915
2003	101.01181	97.748861	3.2629471
2004	100.99246	97.804735	3.1877249
2005	101.83765	98.095222	3.7424259
2006	97.979731	98.481712	-0.5019815
2007	102.34355	98.86302	3.4805313
2008	105.82821	99.13294	6.6952659
2009	106.58361	99.220073	7.3635361
2010	100	99.119972	0.8800279
2011	98.162558	98.901826	-0.7392673
2012	94.802287	98.643622	-3.8413347
2013	96.114269	98.415957	-2.301688
2014	100.31164	98.251014	2.0606227
2015	93.620481	98.157959	-4.5374774
2016	95.707539	98.166562	-2.4590233
2017	97.694191	98.261222	-0.5670315
2018	102.98808	98.401745	4.5863366
Chad			
Year	REER	BEER	MISALIGNMENT (%)
2004	94.921	99.226006	-4.305005999
2005	98.708	99.59353883	-0.885538826
2006	103.541	99.91802159	3.622978407
2007	93.947	100.1475489	-6.200548852
2008	100.726	100.2664449	0.459555061

2003	79.90045	77.05292881	2.847525015
2004	85.30339	80.70700538	4.596386169
2005	89.66533	84.35369797	5.311631865
2006	91.09907	87.8287512	3.270316619
2007	94.25523	91.02102604	3.234207283
2008	96.90791	93.85208662	3.055825349
2009	100.5386	96.27583911	4.262753051
2010	100	98.27674799	1.723252011
2011	102.3012	99.88190522	2.419320763
2012	99.4475	101.1356353	-1.688136658
2013	102.6753	102.106456	0.56879787
2014	106.1357	102.8460036	3.289652269
2015	99.31268	103.4116024	-4.098925463
2016	101.7227	103.8934732	-2.170796966
2017	102.2858	104.3408478	-2.055090339
2018	104.084	104.7812496	-0.697271594
Congo			
Year	REER	BEER	MISALIGNMENT (%)
2004	142.8968	149.9026842	-7.005902488
2005	139.8482	146.6652487	-6.817015864
2006	154.3082	143.3577543	10.95047843
2007	150.5504	139.8419716	10.70837921
2008	151.6148	136.0891763	15.52560814

2009	109.891	100.1970287	9.6939713
2010	100	99.86621453	0.133785465
2011	93.601	99.29785655	-5.696856552
2012	100.015	98.51714672	1.49785328
2013	100.5	97.49230844	3.007691564
2014	101.037	96.20654363	4.830456366
2015	95.693	94.67313116	1.019868837
2016	92.756	92.95365444	-0.197654435
2017	88.587	91.11989555	-2.53289555
2018	84.794	89.24166006	-4.447660065

2009	147.5054	132.1777278	15.32762608
2010	100	128.3412416	-28.34124158
2011	105.8215	124.9666093	-19.14514579
2012	115.7533	122.1573104	-6.404051062
2013	116.3138	119.8253727	-3.511533371
2014	117.8029	117.8187834	-0.015924932
2015	131.0816	115.9504148	15.13116254
2016	127.2182	114.0329794	13.1852467
2017	101.3594	112.0305017	-10.67114251
2018	111.1223	110.0388586	1.083456488

Source: Computation from time-series data using EViews 12

APPENDIX B.

Table 4.2: ADF and PP Unit Root Test Results.

Cameroon								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
LNTB	-2.740	-3.832	-9.874	-3.923	-2.585	-3.834	-11.177	-12.230
LNREER	-1.450	-1.946	-5.788	-5.703	-1.502	2.077	5.788	-5.702
LNDI	-0.353	-1.794	-6.451	-6.409	-0.257	-1.794	-6.457	-6.428
Partners	0.798	-2.684	-4.719	-4.627	0.582	-2.881	-4.675	-4.567
CAR								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
LNTB	-1.352	-2.352	-7.037	-6.299	-1.079	-2.161	-7.696	-15.485
LNREER	-2.002	-0.989	-6.598	-7.041	-2.001	-0.989	-6.614	-7.186
LNDI	-1.047	-2.040	-6.309	-6.216	-1.053	-2.251	-6.306	-6.215
Partners	1.326	-2.439	-4.594	-4.575	1.019	-2.524	-4.549	-4.545
Gabon								
	ADF Test				PP Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
LNTB	-2.307	-3.557	-5.647	-5.634	-2.371	-3.544	-6.953	-6.909
LNREER	-1.675	-1.391	-6.675	-6.737	-1.675	-1.485	-6.657	-6.725
LNDI	-0.144	-2.451	-5.509	-5.478	-0.197	-2.514	-5.495	-5.464
Partners	-1.603	-2.677	-4.957	-5.493	-2.318	-2.337	-5.315	-7.053
Partners								
	ADF Test	PP Test						

Variables	Level		First Difference		Level		First Difference	
	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept	Constant	Trend & Intercept
LnChinaFI	1.666	-2.202	-3.714	-3.716	0.892	-2.159	-3.714	-3.716
LnFranceFI	-0.903	-1.500	-4.643	-4.677	-0.939	-1.894	-4.583	-4.855
LnIndiaFI	1.136	-1.531	-5.688	-5.941	1.075	-1.572	-5.718	-5.959
LNirelandFI	-0.391	-1.517	-4.491	-4.455	-0.420	-1.881	-4.425	-4.284
LNKoreaFI	-2.003	-1.790	-4.411	-5.166	-2.105	-1.531	-4.935	-5.096
LNNepalFI	1.259	-0.932	-5.517	-5.978	1.248	-0.924	-5.514	-5.979
LNNetherlandsFI	-0.678	-1.672	-4.956	-4.969	-0.719	-2.103	-4.921	-5.234
LNSpainFI	-0.966	-2.194	-4.001	-4.068	-1.006	-1.766	-3.942	-3.953
LNUSAFI	-2.810	-1.339	-4.461	-5.354	-6.699	-2.438	-4.461	-6.662

Source: Computation from time-series data using EViews 12

Note: The critical value for ADF & PP unit root tests at level at 5% are -2.941 (constant), and -3.533 (constant, Linear Trend). While the critical value for ADF & PP unit root tests at 1 difference at 5% are -2.943 (constant), and -3.537 (constant, Linear Trend).

APPENDIX C.

Table 5.3: Panel Unit Root Tests Results (P-values)

Variables	Level & 1 st Diff.	intercept/trend	LLC	IPS	ADF	PP	Decision
GDP	Level	Intercept	0.0006	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0088	0.0000	0.0001	0.0000	I(0)
REER	Level	Intercept	0.1971	0.5144	0.6825	0.3018	I(1)
		Intercept & trend	0.9229	0.9615	0.9288	0.9323	I(1)
	1 st diff.	Intercept	0.0074	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0011	0.0000	0.0000	0.0000	I(0)
OPEN	Level	Intercept	0.4684	0.3205	0.4196	0.1042	I(1)
		Intercept & trend	0.8925	0.8902	0.7907	0.3257	I(1)
	1 st diff.	Intercept	0.0003	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0060	0.0000	0.0000	0.0000	I(0)
GOVCON	Level	Intercept	0.2224	0.0346	0.0525	0.1101	I(1)
		Intercept & trend	0.5754	0.1559	0.1852	0.2978	I(1)
	1 st diff.	Intercept	0.0000	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0004	0.0000	0.0000	0.0000	I(0)
FDI	Level	Intercept	0.0240	0.1327	0.1964	0.0000	I(1)
		Intercept & trend	0.0086	0.2373	0.2867	0.0000	I(1)
	1 st diff.	Intercept	0.0000	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0000	0.0000	0.0000	0.0000	I(0)
TOT	Level	Intercept	0.1765	0.1765	0.2266	0.0244	I(1)
		Intercept & trend	0.5497	0.3412	0.4439	0.1102	I(1)
	1 st diff.	Intercept	0.0003	0.0000	0.0000	0.0000	I(0)
		Intercept & trend	0.0117	0.0000	0.0000	0.0000	I(0)

Source: Computation from using EViews 12

Table 5.7: Doing Business Index for the Six CEMAC Nations

Doing Business Indicators	Cameroon	CAR	Chad	Congo	Equatorial Guinea	Gabon
Start a business	14 days	-	58 days	49.5 days	33 days	31 days
Register property	81 days	-	44 days	54 days	23 days	72 days
Enforce contracts	800 days	-	743 days	560 days	475 days	1,160 days
Get electricity	64 days	-	67 days		160 days	148 days
Resolve insolvency	2.8 years	4.8 years	4 years	3.3 years		5 years
Comply with Import documents	163 hours	120 hours	172 hours	208 hours	240 hours	120 hours
Comply with Import procedure at border	261 hours	121.7 hours	242 hours	397.3 hours	240 hours	84 hours
Comply with export documents	66 hours	48 hours	87 hours	120 hours	154 hours	60 hours
Comply with export procedure at border	202 hours	48 hours	106 hours	276 hours	132 hours	96 hours
Rank in Doing Business Index of 190 countries	167 th	184 th	182 nd	180 th	178 th	169 th
Ease of Doing Business score on 100	46%	35.56%	36.7%	38.2%	40.54%	44.5%

Source: World Bank Doing Business Report (2020)

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