Scientific Research Publishing

Modern Economy, 2023, 14, 427-454
https://www.scirp.org/journal/me
ISSN Online: 2152-7261
ISSN Print: 2152-7245

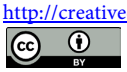
Fundamentals and Misalignment of the Real Effective Exchange Rate in the Democratic Republic of Congo

Gastonfils Lonzo Lubu[1,2], Eddy Mananasi Mabala[3], Jean Pierre Ntal Onim[4], Eleo Ambroise Jr.[5]

[1]Cheikh Anta Diop University (UCAD), Dakar, Dakar Region, Senegal
[2]University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[3]Development Economic and Social Law at University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[4]Development Economics at University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[5]University of Kinshasa, Kinshasa, Democratic Republic of the Congo
Email: gastonfils.lonzo@unikin.ac.cd, gastonfils.lubu@ucad.edu.sn, eddymananasi@gmail.com, alphantal8@gmail.com, junioreleoa@gmail.com

How to cite this paper: Lubu, G. L., Mabala, E. M., Onim, J. P. N., & Ambroise Jr., E. (2023). Fundamentals and Misalignment of the Real Effective Exchange Rate in the Democratic Republic of Congo. *Modern Economy, 14,* 427-454.
https://doi.org/10.4236/me.2023.144025

Received: February 24, 2023
Accepted: April 27, 2023
Published: April 30, 2023



Abstract

This study aims to assess the determinants of the real exchange rate and to study the impact of exchange rate misalignment on economic growth in the DRC over the period from 1980 to 2020. This article uses a dual methodology to achieve its objective, first the BEER (Behavioral Equilibrium Exchange Rate) approach of Clark and Mc Donald to determine the fundamentals of TCER, then the approach of Lawson to assess the impact of misalignment of the exchange rate on economic growth based on the augmented Solow endogenous growth model. In view of the results obtained using econometric modeling (Cointegration, VCEM and ARDL), it has been observed that there is a long relationship between the real effective exchange rate (REER) and its fundamentals. In addition, the results of the REER fundamentals (relative productivity, term of trade, public expenditure and foreign exchange reserves) verify the Balassa-Samuelson effect in the DRC. In addition, the misalignment of the exchange rate exerts a negative impact on real GDP growth in the DRC. However, a disaggregation of the REER misalignment shows that exchange rate depreciation strengthens economic activity while an appreciation constrains economic growth in the DRC.

Keywords

Misalignment, Real Effective Exchange Rate, Economic Growth, DR Congo, Pesaran and Johansen Cointegration, VCEM and ARDL Model

1. Introduction

The monitoring of the evolution of the exchange rate and its level always attracts the attention of the monetary authorities of the countries and more particularly in the DRC given its relationship to macroeconomic variables. Indeed, any deviation of the exchange rate from its equilibrium level (misalignments) can affect them significantly and ultimately impact the overall economic situation.

These misalignments create various problems, ranging from uncertainty about the profitability of investment in the tradable goods sector, to the management of public finances, external debt, foreign exchange reserves. Removing the impacts of misalignments and uncertainty associated with fluctuations in major currencies was the main expected objective of exchange rate management (Fadlallah & Mouhil, 2014).

The emergence of a trade war, in the global economy, and the recent develop from the trade crisis between China and the United States coupled with the COVID-19 health crisis to economic impacts (2019-2022) without precede without forgetting the recent military crisis of the invasion of Russia on Ukraine in (February-April 2022) whose Western economic sanctions lead to the financial deregulation of the world economy. In this context, real exchange rate misalignment (depreciation or appreciation) is of particular importance, because a competitive real exchange rate helps promote economic growth (Lawson et al., 2019).

However, as noted by Aguirre and Calderon (2005), the determination of the so-called "equilibrium" level is not unanimously accepted and still remains today a major problem in international macroeconomics. There is indeed a debate around the choice of the determinants of the equilibrium exchange rate and the appropriate approach to determine the latter. The most widespread approaches currently being those of FEER (Fundamental Equilibrium Exchange Rate), BEER (Behavioral Equilibrium Exchange Rate) and NATREX (Natural Real Exchange Rate), respectively introduced by Williamson (1983), Clark & Mc Donald (1998) and Stein (1994).

Regardless of the approach adopted, it remains important to determine an equilibrium level for exchange rates, particularly in order to assess short-term exchange rate fluctuations or misalignments. Defined by Edwards (1998) as "sustained deviations of the observed real exchange rate from its long-term equilibrium level", this situation can be detrimental to the economy, ranging from uncertainty in the investment decision, from the management of public finances, to the management of public debt and foreign exchange reserves. Therefore, limiting misalignments should be an indispensable objective to ensure macroeconomic stability (Youssouf et al., 2018).

Countries may choose to pursue a policy that aims to maintain an undervalued currency in order to achieve competitiveness against their main competitors, thereby boosting their exports (Gala, 2008; Holtemoller & Mallick, 2013).

Indeed, for many authors, the Asian miracle is the result of a growth strategy

driven by exports, supported by a deliberate manipulation of exchange rates (Rodrik, 2008; Razmi et al., 2012). By pegging the yuan to the US dollar, China managed to halt the appreciation of its currency and artificially kept the exchange rate of its currency undervalued, thanks to the accumulation of foreign exchange reserves (Owoundi, 2016).

This strategy has enabled it to stimulate exports and maintain its competitiveness. Generally speaking, the example of Asian countries has given rise to an abundant literature (Frenkel, 2004; Mejia-Reyes et al., 2010; Couharde & Sallenave, 2013; Owoundi, 2016).

From the above, determining the degree of misalignment (undervaluation or overvaluation) of real exchange rates and its potential impact on economic growth is also a major concern in the context of choosing an appropriate exchange rate regime.

In the DRC, the economic situation since 1990 can be summed up into four distinct phases following the following inflationary trends:

- The first phase is that of the episodes of hyperinflation which characterized the years 1990-1994. During the 1980s, inflation, measured by the annual growth rate of the consumer price index, was around 50%. It rose to 256% in 1990. It continued to rise during the years 1991-1993 with an annual rate of between 3000% and 4500%, before reaching its historic level of nearly 10,000% in 1994.
- The second phase covers the years 1995-1997. It is a phase of relative stabilization during which inflation fell back to 370% in 1995, following a policy of control of monetary issues and public expenditure carried out at the time. The relative calm observed at that time was abruptly interrupted in 1996 by the outbreak of the first war which led to the overthrow of Marshal Mobutu's regime in May 1997. With the war, inflation rose to 753% in 1996. The regime change that took place in May 1997 was accompanied by a brief period of disinflation, with a negative inflation rate (−0.4%) in 1997.
- The third phase began in 1998 and ended in 2001. This was the period of the second episode of the war which involved several African countries and which resulted in the total destruction of the country's economic infrastructure. In order to support the war effort, the monetary financing of public expenditure was reactivated. Inflation picked up very sharply, standing at 135% at the end of 1998 and around 500% over the period 1999-2000, before falling back to 130% in 2001.
- The last phase began in 2002 and continues to this day. Breaking hyperinflation, opening the economy more and more to the outside world and laying the foundations for strong and sustainable growth; these are the main objectives that the Congolese government had set itself in its Reinforced Interim Program/RIP (spread for May 2001-March 2002) and its economic program/EPG (covering the period April 2002-July 2005).

The "total or partial" execution of these two programs enabled the government to control inflation, the rate of which was reduced from 511% in 2000, to

235% in 2001 and 16% in 2002; to unify the two exchange rates, parallel and official, thanks to the liberalization of foreign exchange activities, and to ensure their relative stability; to put in place a State cash flow plan on a cash basis, thanks to which the treasury balance went from a deficit of 10.59 billion (i.e. 3.1% of GDP) to a surplus of 12.81 billion franc (i.e. 0.85% of 2002 GDP); to increase the GDP, the general trend of which is upward for the whole decade although its content is not pro-poor (Ntalaja, 2003) and to carry out an 84.1% devaluation of the Congolese franc-USD dollar.

Furthermore, recent data on the Congolese economy; if we only consider that the last four years seem to bear witness to the almost total absence of the State in the economic sphere. Indeed, the situation is such that the actions of the State are neutralized by the forces of the market, to such an extent that the imbalance is in the process of taking up residence in the various markets (sectors) in order to be in full swing there. The most notorious imbalance is to be observed in the foreign exchange market, reflected in the velocity of the exchange rate. Indeed, Fixed at 925 CDF in 2015, the exchange rate went to CDF; 1010 CF; CDF 1464; CDF 1623; 1648 CDF and 1851 CDF, respectively during the years 2016; 2017; 2018; 2019 and 2020 (CBC, 2020). If we do descriptive statistics for this series, there appear to be strong irregularities in the evolution of the exchange rate, especially over the past three years when the average inter-annual differences are around 159; 25 and 203, respectively for the years 2018; 2019 and 2020.

In order to fight against the misalignment of the exchange rate carrying the seeds of uncertainty which fuels inflationary expectations, the monetary authorities have diversified their interventions on the foreign exchange market; this is the case of purchases and sales of currencies by the Central Bank of Congo (CBC). On this subject, it should be noted by way of illustration that in January 2010, the CBC sold 10 million USD in order to counter the volatility of the exchange rate. In addition, from March to August of the same year, currency purchase operations enabled the CBC to acquire USD 157 million, thus strengthening the cushion of foreign exchange reserves (CBC, 2011). However, despite the various measures implemented by these monetary authorities, the foreign exchange market does not seem to reveal its modus operandi to them,

The recent performance achieved since September 2021 by the Central Bank of Congo (CBC) on exchange rate stability and mainly foreign exchange reserves[1] which resulted in a significant record of foreign exchange reserves at 3.3 billion US dollars, i.e. more than 7 weeks of imports, while it stood at 500 million US dollars in April of the same year, a spectacular increase of 560% in less than 6 months.

The various indicators show that the macroeconomic framework remains stable. On the foreign exchange market, the official exchange rate stood at 1992.41 CDF for one US dollar against a slight appreciation of 2038.33 Congolese francs

[1]Foreign exchange reserves are reserves in foreign currencies or gold held by central banks. They can be considered as savings allowing a country to continue to import despite the vagaries of international trade, according to experts.

for one US dollar on the parallel market.

This stability results from the good coordination of budgetary and monetary policies which must be maintained in order to strengthen this macroeconomic stability. In order to sustain the internal and external stability of the Congolese franc, the Government and the Central Bank of Congo have reiterated their mutual commitment to continue the implementation of prudent policies.

On the goods and services market, he adds, there is reason to note the slowdown in the pace of price formation during the second week of the current month of September, evidenced by a weekly inflation rate of 0.043% against 0.098% recorded the previous week. Year-to-date, inflation stood at 3.22% compared to 13.77% in the same period in 2020.

The focus of this article is determining the impact of real exchange rate misalignment on economic growth in the DRC. This study aims to assess the determinants of the real exchange rate and to study the impact of exchange rate misalignment on economic growth in the DRC over the period from 1980 to 2020. This article uses a dual methodology to achieve its objective, first the BEER (Behavioral Equilibrium Exchange Rate) approach of Clark and Mc Donald (1998) to determine the fundamentals of ERRE, then the approach of Lawson et al. (2019) to assess the impact of misalignment of the exchange rate on economic growth based on the augmented Solow endogenous growth model.

The rest of the article is divided into three sections. Section 1 develops the literature review of exchange rate misalignment and its impact on economic growth. Section 2 presents the methodology. The presentation, interpretation and discussion of the results are the subject of Section 3.

2. Literature Review

This section revisits the theoretical and empirical literature. In a first subsection, we review the theoretical literature review on approaches to determining the equilibrium exchange rate and the link between misalignment and the economy. In a second subsection, we discuss how existing empirical work.

2.1. Theoretical Review

The theoretical literature review revolves around the theoretical analysis of the approaches for determining the equilibrium exchange rate and that of the link between the misalignment of the exchange rate and the economy.

2.1.1. Theoretical Analysis of Approaches for Determining the Equilibrium Exchange Rate

The literature on the determination of the equilibrium exchange rate dates back to the sixties (Balassa, 1964) and the second half of the first decade of the 21st century marked the beginning of an increase in the number of empirical research on the misalignment of the exchange rate change and its impact on economic growth. The literature has not reached a consensus on the measurement of exchange rate misalignment. Part of the literature is based on deviations from

purchasing power parity (PPP). Beyond the approach based on purchasing power, other approaches have emerged from economic theory: the theory of the fundamental exchange rate (FEER), the theory of the natural equilibrium exchange rate (NATREX), behavioral equilibrium exchange rate theory (BEER) and purely statistical techniques.

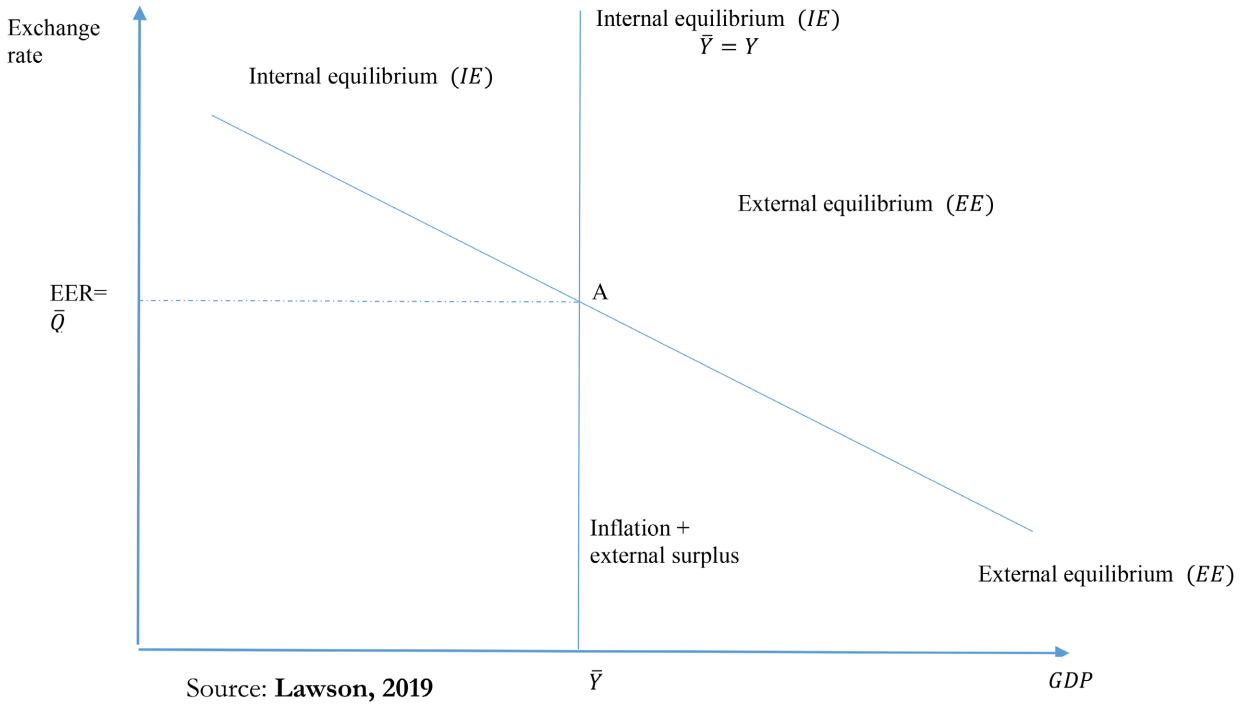
✓ **Macroeconomic approach to the real exchange rate: fundamental equilibrium exchange rate (ERRE or FEER)**

Given the limitations of the purchasing power approach, the IMF introduced the equilibrium exchange rate approach. The notion of the fundamental equilibrium exchange rate was defined in 1983 by John Williamson. This approach is defined as the effective real exchange rate ensuring the simultaneous achievement of internal and external balance in the medium term. The FEER is defined as the level of the exchange rate which makes it possible to simultaneously achieve internal and external equilibrium (Williamson, 1983).

As part of the determination of the ERRE, it is assumed that potential output is determined by profit maximization on the part of firms does not depend on the real exchange rate. Figure 1 shows the internal and external balance and the determination of the ERRE.

The internal balance represented by the equality between the real GDP and the potential GDP constitutes a situation of absence of inflation and unemployment.

The external equilibrium is represented by the descending curve indicating the combination of real exchange and activity for which the current account is at a predetermine level, called equilibrium. Following a Keynesian approach, any rise in domestic demand increases, ceteris paribus, domestic GDP and degrades



Source: **Lawson, 2019**

Figure 1. ERRE, internal balance and external balance.

the current account and the trade balance, hence to maintain equilibrium, the ERRE must depreciate. As a result, in external equilibrium, an increase in GDP above the potential level increases imports. To maintain external equilibrium, the real exchange rate must depreciate.

The ERRE is the real exchange rate which brings the external balance back to equilibrium, the GDP itself being at the potential level note Y. The external equilibrium corresponds to a balanced current account. It can be summed up as the current account balance.

ERRE is represented by the dot $\overline{Q}$. The vertical line indicates the internal equilibrium (IE) corresponding to the equality between the GDP, Y and the potential GDP ($\overline{Y}$) as mentioned above.

The different prevailing situations are shown in **Figure 1**.

- Above the line (EE) the exchange rate is too high compared to the level of GDP and the current account is in deficit. Below the line (EE), the real exchange rate is too weak relative to GDP and the current account balance is in surplus.
- To the left of the line representing the internal balance (EI), the demand for goods and services is too low and there is underemployment. To the right of full employment, aggregate demand is on the contrary high, which leads to inflation.

The theoretical model for determining the fundamental equilibrium exchange rate is obtained through the inversion of a current account balance equation as a function of the real exchange rate and the output gap. It takes place in three steps:

- Estimation of trade equations linking the current account to the real exchange rate and the level of real GDP.
- Calculation of the implicit current account balance: We determine the implicit current account balance that would be observed if GDP were at its long-term level if the output gap is zero.
- Calculation of the fundamental equilibrium real exchange rate: the equilibrium exchange rate is then calculated to achieve the current account balance target assuming that GDP is at its potential level.

The real exchange rate misalignment ($q-\overline{q}$) is determined by the difference between the real effective exchange rate and its fundamental equilibrium value.

The real exchange rate is overvalued ($q>\overline{q}$) if the current account is below its target value. In this situation, the exchange rate must be depreciated to increase the balance of the implicit current account to the level of its target in order to have internal and external balance.

The exchange rate is undervalued ($q<\overline{q}$) if the current account balance is above the target. Another approach used in the theoretical literature is the behavioral exchange rate approach of Clark and MacDonald (1998).

✓ **The behavioral equilibrium exchange rate (CEER or BEER)**

The econometric approach to determining the behavioral equilibrium exchange rate (BEER) was introduced by Clark and Mac Donald (1998). This ap-

proach explains the dynamics of the exchange rate with some variables that affect this long-term dynamic. This approach to analysis of the real exchange rate introduced by Clark and Mac Donald (1998) has the advantage of accounting for changes in exchange rates empirically.

According to this approach, the equilibrium real exchange rate is determined by long-term components of the fundamentals. The factors likely to influence the systematic component (the long-term exchange rate) have been widely discussed in the literature (Couharde et al., 2012). This approach is based on four steps (Mac Donald et al., 2005):

- Estimation of the relationship between the real exchange rate, fundamentals and short-term variables.
- Calculation of the current misalignment: we consider the hypothesis according to which the short-term variables are zero and that the values of the fundamentals correspond to the observed values.
- Determination of the long-term value of fundamentals from the breakdown of series into permanent and transient components.
- Calculation of the total misalignment: it is assumed that the short-term variables are zero and that the values of the fundamentals have reached their long-term equilibrium level.

✓ **The NATREX technique: a dynamic approach**

The NATREX (Natural Real Exchange Rate) was developed by Stein and Allen (1997). It is defined as the real exchange rate which allows the simultaneous achievement of the internal and external balances of the economy. In other words, it corresponds to the exchange rate which ensures equilibrium of the balance of payments in the absence of speculative and cyclical factors, the unemployment rate being at its NAIRU level. As, in the majority of equilibrium exchange rate models, saving and investment play a primary role in the dynamics of the real exchange rate of NATREX.

The NATREX constitutes a first-class reference for the determination of the misalignments of the exchange rates, because of its dynamic characteristic. Indeed, he suggests that it is possible to break down the trajectory of the exchange rate according to the three horizons which are the short, the medium and the long term. In the short term, the real exchange rate (E) for the period depends on the stock of capital (K), the stock of debt (D), and speculative capital flows (Ω). In the medium term, the equilibrium real exchange rate defined by NATREX is no longer influenced by speculative capital flows, it depends solely on stocks (capital and debt) and the fundamentals F which determine their variations. In the long run, on the other hand, the equilibrium exchange rate depends only on fundamentals, as inventories have stabilized at their stationary levels. Therefore, the exchange rate is constant and converges towards its long-term purchasing power parity (PPP) value. As such, it can be said that the NATREX approach is an extension of the PPA (Stein, 2005).

More precisely, the NATREX approach makes it possible to explain the dynamics of convergence of the current real exchange rate on the one hand, be-

tween the short term and the medium term, and on the other hand, between the medium term and the long term. It therefore supports the idea that the current real exchange rate is not necessarily at equilibrium (Camanho et al., 2022; Siregar, 2011).

✓ **Exclusively statistical techniques**

These techniques are based on the decomposition of the real exchange rate into a transient and trend component representing the long-term exchange rate. The trend exchange rate is determined using Hodrick Prescott (HP) filters, Christiano-Fitzgerald filters or univariate and multivariate Beveridge and Nelson decompositions. The latter has been subject to criticism in the literature given its excessively mechanical aspect.

2.1.2. Theoretical Analysis of the Links between Misalignment and Growth

The first works highlighting the real exchange rate and economic growth were proposed in works on the strategy of trade-led growth (Krueger, 1983; Williamson, 1994; Dollar, 1992; Sachs, Warner et al., 1995).

According to this research, exchange rate misalignments constitute macroeconomic imbalances that are harmful to growth. Specifically, a less restrictive monetary policy generating an overvaluation of the real exchange rate under a fixed exchange rate regime, can cause a contraction in economic activity and the level of imports. Similarly, a competitive devaluation of currencies leads to undervaluation. This competitive devaluation can be a source of imported inflation, thus reducing the country's objective of strong economic growth.

The misalignment of exchange rates has a negative impact on growth except in the situation of maintaining the current account of the economy at a sustainable level (Williamson, 1994). For Dollar (1992), exchange rate distortions have a negative impact on growth.

If for Williamson and Dollar, the negative impact of misalignment on growth is more probable, other authors analyze in a disaggregated way the misalignment following undervaluation and overvaluation.

The incidence of misalignment may therefore be asymmetrical. Relative price distortions stemming from exchange rate misalignments can have potentially adverse effects, such as lower labor and capital productivity in the event of overvaluation, or a low return on investment for export industries (Mengistae & Pattillo, 2004).

These negative effects have been demonstrated by Cottani et al. (1990), Fosu (2000), Loayza & Fajnzylber (2005), Johnson et al., (2007). Contrary to the negative impact of overvaluation, in the event of undervaluation, the profitability of investment in the tradable goods sector could be improved, by creating incentives for production in this sector. There may also be inflationary pressures leading to an increase in import prices, which eventually weakens economic growth by reducing investment. For Hausman et al. (2005), Rodrick (2008), Berg et al. (2010), undervaluation is a factor of economic growth.

2.2. Empirical Review

2.2.1. Analysis of Empirical Works on the Determination of the Equilibrium Exchange Rate

Several empirical results are obtained thanks to the estimates of the equilibrium exchange rate and its misalignment. They differ from one research to another, taking into account the data used, the different specifications and the different estimation methodologies adopted. One of the first studies on misalignment and growth is developed by Edwards (1989) who assesses the relationship between the real exchange rate and growth. One of his results states that the misalignment of the real exchange rate is associated with a distortion between the sector of tradable and non-tradable goods, a consequence of non-allocation of resources across the different sectors of the economy contributing to a negative impact on the growth.

Using the behavioral approach to determining the equilibrium real effective exchange rate (BEER), Lawson et al. (2019) conducted research on the economies of ECOWAS countries over the period 1985-2014. It shows that the level of overvaluation is higher in WAEMU countries than in other ECOWAS countries. By applying two theoretical methods for determining the equilibrium exchange rate, namely those of BEER and NATREX, Owoundi (2019) showed that misalignments tend to be greater in countries with fixed exchange rate regimes. Mohammed et al. (2021) show an undervaluation, since 2014, of the value of the dirham after reaching a maximum level of overvaluation in 2012.

2.2.2. Analysis of Empirical Work on the Impact of Misalignment on Economic Growth

Rodrick (2008) studied the misalignment of real exchange rates and economic growth over the period 1950-2004. Using a time series methodological approach on 184 countries, the author used an index to measure the degree of undervaluation of the real exchange rate adjusted by the Balassa-Samuelson effect using the per capita GDP indicator. The research results reveal that an overvaluation of the real exchange rate harms economic growth, while the opposite effect occurs in case of undervaluation.

Nubukpo (2015) analyzed the degree of resilience of the growth of member countries of the CEMAC zone in the face of a misalignment of the real exchange rate. Two results are highlighted in his research: on the one hand, the dynamic panel estimates show that there is a weak misalignment of the real exchange rate in the CEMAC member countries with a negative impact on economic growth. On the other hand, the presence of low resilience of CEMAC member countries to exchange rate misalignments.

3. Methodology

The adopted methodology consists of three steps. The first is that of the presentation of the method for determining the equilibrium effective exchange rate using the BEER approach. The second step is to determine the method of calculating the real exchange rate misalignment and the last step is the impact of the

misalignment on economic growth.

3.1. Model and Estimation Technique for Determining the Equilibrium Effective Exchange Rate (Behavioral Equilibrium Exchange Rate (BEER) Approach)

This subsection allows us to show the theoretical model followed by the empirical one.

The concept of behavioral equilibrium exchange rate (or BEER), introduced by Clark and MacDonald (1998), belongs to the class of so-called "underlying equilibrium" models. Unlike other models of the same class (the FEER and the NATREX for example), it has the advantage of being based on a simple theoretical framework, and focuses above all on accounting for the evolution of the exchange rates of empirical way.

Thus, to illustrate their approach, Clark and Mac Donald (1998) start from the condition of financial equilibrium defined by the uncovered parity relationship of interest rates, which has very often served as the basis for modeling the exchange rate of balance. Formally, by considering a maturity horizon of the securities "$t+K$" and under the assumption of risk neutrality, the model is broken down as follows:

$$E_t\left(\Delta S_{t+k}\right) = -\left(i_t - i_t^*\right) \tag{11}$$

with S_t the logarithm of the nominal exchange rate quoted at certain; i_t the domestic nominal interest rate; i_t^* the foreign nominal interest rate; Δ the difference operator and E the mathematical expectation. Integration of the expected inflation differential $E_t\left(\Delta\rho_{t+k}^*\right)$ leads to a relation between real variables. It follows the equation:

$$q_t = E_t\left(q_{t+k}\right) + \left(r_t - r_t^*\right) \tag{12}$$

where $r_t = i_t - E_t\left(\Delta P_{t+k}\right)$ is the ex-ante real interest rate; $q_t = s_t + p_t - p_t^*$ is the ex-ante real exchange rate. This last equation means that the current exchange rate t_q is determined by the expected period exchange rate $t+kE_t\left(q_{t+k}\right)$, and the interest rate differential $\left(r_t - r_t^*\right)$. $E_t\left(q_{t+k}\right)$ is interpreted as the long-term component of the real exchange rate, resulting from the influence of the expected values of the medium and long-term fundamentals by setting $\overline{q}_t = E_t\left(q_{t+k}\right)$, Equation (12) becomes:

$$q_t = \overline{q}_t + \left(r_t - r_t^*\right) \tag{13}$$

In short, according to the BEER approach, the current exchange rate includes a systematic component ($\overline{q}_t$) to which is added the real interest rate differential (Crespo-Cuaresma et al., 2004; 2005). The factors likely to influence the exchange rate in the long run are widely discussed in the literature. Let us simply note that most authors take into account the intrinsic characteristics of the entities they study, in order to identify the fundamentals of the exchange rate. Thus, in the context of this study, we consider that the REER and its fundamentals are

linked by the following relationship:

$$ERRE_t = \alpha Open_t + \beta EXPOS_t + \delta Prod_t + \lambda Inv_t + \gamma Gov_t + \omega Tot_t + \theta Rdiff_t + \varepsilon_t \quad (14)$$

The explanatory variables of the previous equation are defined as follows:

- *Open*, the rate of openness of the economy, which reflects the influence of the trade policy of the country considered. If we stick to Goldfajn and Valdes (1999), its increase generates a moderation in the rise in domestic prices which tends to depreciate the RER;

- *Expos*, the net external position. It is defined by the determinants of domestic savings and investment. It is assumed that there is a positive relationship between this variable and the REER;

- *Tot*, the terms of trade. They are defined as the ratio of export prices to import prices. If only its internal (or microeconomic) definition is taken into account, the RER is the ratio of the price of non-tradable goods to that of tradable goods. However, the price of tradable goods is a weighted average of the prices of exportable and importable goods. Consequently, it is difficult, a priori, to determine the effect of the terms of trade on the RER;

- *Inv*, social investment, defined as the sum of private investment and public investment. It is measured by net fixed capital formation. According to Edwards (1989), if we consider that the increase in the ratio of investment to GDP modifies the structure of expenditure in favor of tradable goods, then any increase in investment has the effect of depreciating the real exchange rate.

More intuitively, we can consider, in accordance with Equation (13), that the increase in investment results, all other things being equal, from a fall in the real interest rate. However, a fall in the real interest rate itself comes from a depreciation of the real exchange rate, as we have already underlined. Therefore, any decrease in the real exchange rate leads to an increase in investment.

- *Gov*, government consumption expenditure. It is considered, following Chinn (1997), that the bulk of public expenditure is intended for the acquisition of non-tradable goods, so that an increase in public consumption leads to an increase in the demand for these goods and therefore, their price. The latter itself has the effect of appreciating the RER;

- *Prod*, the relative productivity of a given country. It captures the Balassa-Samuelson effect, which consists of an appreciation of the ERR following an increase in productivity in the exposed sector, compared to the rest of the world. There is a positive relationship between this variable and the RER (Béreau et al., 2009).

- *Rdiff*, the real interest rate differential between country "i" and the rest of the world. It has a positive effect on the exchange rate in accordance with the interest rate parity relationship (see above).

3.2. Equilibrium Real Exchange Rate and Exchange Rate Misalignment

The level of real exchange rate misalignment is determined by the following

formula:

$$misal_t = ERRE_t - EQREE_t \quad (15)$$

With *mesal* the exchange rate misalignment, *ERRE* the real effective exchange rate, *EQREE* the equilibrium real effective exchange rate. The equilibrium real effective exchange rate (*EQREE*) is determined by estimating the real exchange rate on the long-term values of the various fundamentals. It is given by the cointegration relationship assuming that the fundamentals are at their long-term level. The long-term level of fundamentals is determined using filters: Baxter King filter, Christiano-Fitzgerald filter and Hodrick Prescott (HP) filter. We have taken into account the HP filter with the lambda smoothing parameter equal to one hundred (100) to determine the long-term level of the fundamentals given its simplicity and convenience

A positive sign of real exchange rate misalignment is synonymous with real exchange rate overvaluation (overev) and a negative sign denotes real exchange rate undervaluation (undev). The calculation of misalignment precedes the determination of its impact on economic growth (Table 1).

3.3. Specification of the Model of the Impact of Misalignment on Economic Growth

The economic literature shows that economic growth is a function of certain

Table 1. Studies of expected signs.

Exogenous and instrumental variables	Ratings	Expected signs
Regression (1) with REER as endogenous variable		
Economy open rate	OPEN	−
Net external position	EXPOS	+
Terms of trade	TOT	+/−
Social investment	INV	+
Public Spending	PUBSP	+
Country's relative productivity	PROD	+
Real Interest Rate Differential	RDIFF	+
Regression (2) with GDPR as endogenous variable		
Exchange rate misalignment	MISAL	−
Over evaluation	OVERVAL	−
Undervaluation	UNDEVAL	+
Exchange rate volatility	VOLEXCH	−
Population	POP	+
Inflation	DEF	−
Investment	INVEST	+

Source: Authors, estimate based on R software.

fundamental variables (Solow, 1956; Barro et al., 1996). The model for analyzing the impact of misalignment on economic growth in the DRC will revolve around the equation inspired by the work of Lawson et al. (2019):

$$GDP_t = GDP_{t-1} + \alpha_1 misal_t + \lambda_2 volmisal_t + \gamma inv_t + \vartheta pop_t + \delta Inf_t + \varepsilon_t \quad (16)$$

With real GDP_t at time t, $misal$ the misalignment of the real exchange rates determined from the BEER method. $volmisal$ Overvaluation and undervaluation are also taken into account. represents the volatility of exchange rate misalignment.

4. Presentation and Discussion of the Results

As with the presentation of the methodology, the presentation and discussion of the results will be structured around three stages. The first is that of determining the equilibrium effective exchange rate using the BEER approach. The second step determines the level of real exchange rate misalignment and the last step is to present and discuss the results of the misalignment's impact on economic growth.

4.1. Analysis of Real Exchange Rate Fundamentals

4.1.1. Unit Root Test

Several tests help verify the level of data integration. These tests deal with both time-series data and panel data. An important difference between time series unit root tests and panel tests is that the latter have statistics that admit normal distributions in their distributions (Lawson et al., 2019).

Each stationarity test has advantages and disadvantages. This results in submitting the series studied to various tests to be sure of the level of integration of the series. To determine the order of integration of the series studied, we carried out various tests: Augmented Dickey-Fuller/ADF test, Phillippe-Perron/PP test and the Ng-Perron test, KPSS (Table 2).

Table 2. Unit root test.

	ADF Test			PP Test			KKPS Test		
	Calculated Value	Critical Value (Level at 5%)	Integration order	Calculated Value	Critical Value (Level at 5%)	Integration order	Calculated Value	Critical Value (Level at 5%)	Integration order
Gdp	−1.46	−3.53	I (1)	−1.46	−3.55	I (1)	−2.41	−3.53	I (1)
Erre	−3.16	−4.22	I (1)	−3.16	−3.53	I (1)	−2.43	−3.53	I (1)
Open	−2	−3.53	I (1)	−2	−3.53	I (1)	−1.93	−3.53	I (1)
Posext	−2.63	−3.53	I (1)	−2.63	−3.54	I (1)	−0.09	−3.53	I (1)
Tot	−0.45	−3.53	I (1)	−0.45	−3.54	I (1)	−0.78	−3.53	I (1)
Invest	−2.94	−3.53	I (1)	−2.94	−3.54	I (1)	−1.54	−3.53	I (1)
Pubspend	−2.94	−3.53	I (1)	−1.54	−3.54	I (1)	−2.23	−3.53	I (1)
Prod	−1.45	−3.53	I (1)	−1.89	−3.54	I (1)	−2.45	−3.53	I (1)

Source: Authors, estimate based on R software.

Unit root tests show that most of the variables taken into account are stationary in first difference I (1). The variables real effective exchange rate (REER), terms of trade (tot), investment (invest), government expenditure (depub), relative productivity (prod), foreign exchange reserves (rchange) are stationary in first difference while inflation (def) and population (pop) are stationary in level.[2]

4.1.2. Cointegration Test

The use of cointegration techniques to test the presence of potential long-term relationships between different variables has received particular attention in the empirical literature in recent years. Like those of unit roots, several tests exist to determine the absence or not of cointegration between the different series.

We used two cointegration tests in this article, the cointegration test of Pesaran et al. (2001) and the cointegration test of Johansen (1995).

From **Table 3**, the test of Pesaran et al. (2001) confirms the existence of a cointegration relationship between the real exchange rate and its fundamentals (the value of F-stat is >than that of the upper bound).

Table 4 presents the result of the trace test. We reject the null hypothesis that there are no cointegrating relations 163.07 > 44.91). Nevertheless, we accept the null hypothesis that there are at most 6 cointegrating relationships (6.37 < 8.14).

Table 3. Cointegration test of Pesaran et al. (2001).

Variables	ERRE, PROD, TOT, PUBSP, OPEN, EXPOS, INVEST	
F-stat calculated	14.27	
Critical threshold	I (0)	I (1)
1%	2.35	3.59
5%	2.797	4.21
10%	3.8	5.64

Source: Authors, estimate based on R software.

Table 4. Johansen cointegration test.

Null Hypothesis: Rank	Trace Statistics	Critical value 10%	Critical value 5%	Critical value 1%
r = 0	163.07	42.06	44.91	51.30
r <= 1	115.20	36.25	39.43	44.59
r <= 2	89.66	30.84	33.32	38.78
r <= 3	53.05	24.78	27.14	32.14
r <= 4	29.71	18.90	21.07	25.75
r <= 5	20.73	12.91	14.90	19.19
r <= 6	6.37	6.50	8.18	11.65

Source: Authors, estimate based on R software.

[2]The results of the unit root tests are in the appendix.

The cointegration of the variables depends on the value of the probability associated with each test statistic. Based on the two tests, the alternative hypothesis of the presence of cointegration between the real effective exchange rate and its fundamentals cannot therefore be refuted. At this stage, we can conclude that there is a cointegration relationship between the real effective exchange rate and its fundamentals. We can therefore estimate the long-term relationship between the real effective exchange rate, relative productivity, the degree of openness, government expenditure, the terms of trade and the foreign exchange reserves of the DR Congo.

4.2. Estimation and Interpretation of Results

The results of the estimates from the three methods OLS, VCEM, and ARDL are presented in Table 5. Thus, the ARDL estimator will serve as the basic estimator of our analyzes and the results of OLS and VCEM allow us to analyze the robustness of results.

Table 5. Summary of rresults of the fundamentals of REER long term.

		Regr.1	*Regr.2*	*Regr.3*
Estimation methods				
endogeneous Var.	**exogeneous Var.**	**OLS**	**VCEM**	**ARDL**
ERRE	C	12**	15.27**	5.08
		(3.44)	(2.14)	(1.01)
	PROD	0.3	0.16	0.21**
		(1.2)	(0.01)	(2.56)
	TOT	0.13	−0.71**	-0.01**
		(0.55)	(−2.71)	(3.40)
	PUBSPEND	−0.41*	−2.48	-0.91**
		(−1.67)	(−0.11)	(-3.24)
	OPEN	−0.09	0.75***	0.08
		(−0.54)	(7.98)	(1.45)
	RER	−0.004	−0.001	-0.0001***
		(−1.29)	(−1.45)	(-7.45)
	INVEST	−0.007	0.71	-0.01***
		(−0.09)	(0.70)	(-3.21)
R^2 Ajusté		0.97	0.96	0.83
Obs		39	39	39

Source: Authors, estimate based on R software. Legend: *Denote significance at the 10 percent level; **Denote significance at the 5 percent level; ***Denote significance at the 1 percent level. (…): The values in parentheses correspond to the values of the STUDENT test.

The overall evaluation of the model ARDL attests to a very high explanatory power of exogenous variables on the variability of the endogenous variable (REER), i.e. an R-squared of 83.18% (Table 6).

The exchange rate effective real in DR Congo, in the long term has as main determinants the following variables: relative productivity (PROD), the term of the trade (TOT), public expenditure (PUBSPEND), foreign exchange reserves (RESEXCH) and social investment (INVEST).

In the long term, following the expected sign, relative productivity exerts a positive impact on the real exchange rate with a value of 0.21. The relative productivity sign found in our research confirms the presence of the Ballasa Samuelson effect. Following an increase in relative productivity of 1 point, the real effective exchange rate of the economy of the DR Congo is overvalued by 1.80 points.

The coefficient associated with the terms of trade is negative, that is to say, an increase in the terms of trade of 1% leads to a decrease in the real exchange rate of 0.01%. As a result, the substitution effect outweighs the income effect in DR Congo. Because in DR Congo, the consumption of imported goods outweighs those of domestic goods, thus leading to a decrease in demand for non-tradable goods. This last situation leads to a depreciation of the exchange rate.

Foreign exchange reserves have a negative effect on the real effective exchange rate. Its coefficient (0.0001), which is statistically significant, shows that foreign exchange reserves have an impact on the real exchange rate of the economy of the DR Congo.

4.3. Presentation and Interpretation of the Results of the Impact of Misalignment on Economic Growth with the ARDL Model

- **Different tests**

We refer to different tests to examine the stability and validity of the results obtained. Indeed, the joint significance of the coefficients of the model provided, through Fisher's F statistic, increases the explanatory scope of the variables retained as explanatory factors of GDP in the DRC. Similarly, the R^2 statistic attests to the good adjustment of the model because the endogenous variable is explained at 99.66% by the explanatory variables of the model thus retained. Moreover, with regard to the tests which help to diagnose the estimated ARDL model, we note the absence of autocorrelation of the errors, there is no heteroscedasticity and there is

Table 6. Estimation of the fundamentals of the REER of long term.

Equation Var_depend	PROD	TOT	PUBSPEND	OPEN	RER	INVEST	Const
erre	0.21**	−0.01**	−0.91**	0.08	−0.0001***	−0.01***	5.08
	(2.56)	(3.40)	(−3.24)	(1.45)	(−7.45)	(−3.21)	(1.01)
R^2 = 83.18							
obs = 39	Paramètres = 6						P_ch^2 = 0.000

Source: Authors, estimate based on R software.

normality of the errors.

- **Empirical results**

From the resultsmodeling (equations 15) (Annex 2 to 15)[3] (Table 7).

In order to obtain robust results corrected for endogeneity bias, we estimated our equation 3 using estimation methods from the simplest to the most robust, i.e. by passing by the method of Ordinary Least Squares (OLS)), the vector error correction model (VECM)and the Autoregressive Scaled Lag (ARDL) model. This exercise allowed us to obtain very comfortable and effective results (Table 8).

Table 7. There Summary of estimation results.

Estimation methods		Regr.1	Regr.2	Regr.3
endogeneous var.	exogeneous var.	OLS	VCEM	ARDL
ERRE	C	−1.48	0.04	−0.71
		(−0.51)	(0.009)	(−1.43)
	LGDP-1	Na	Na	−0.51**
				(−3.41)
	LMISAL	9.69	−8.87	−0.12
		(0.55)	(−0.08)	(−1.31)
	LOVEREVAL	2.83	6.53	0.01*
		(0.58)	(0.05)	(1.95)
	LSUNDEREVAL	1.49	na	−0.0003**
		(0.28)		(−2.69)
	LVOLEXCHANGE	−2.10	6.06	−1.61**
		(−1.03)	(0.01)	(−3.1)
	LPOP	1.86	1.57	−0.36***
		(1.65)	(0.17)	(−5.57)
	LDEF	−1.79*	−7.19	0.77***
		(−2.18)	(−1.19)	(11.26)
	LINVEST	9.58***	−1.02	2.70**
		(39.66)	(−0.005)	(2.97)
	DLMISAL	0.90	−29.9	0.87
		(0.37)	(−0.02)	(1.23)
	DLOVEREVAL	Na	−3.84	0.73***
			(−0.3)	(9.06)
	DLUNDEREVAL	−16.52	na	0.21
		(−0.13)		(1.99)

[3]The values in parentheses correspond to the values of the STUDENT test. In addition, for each case, the R^2 value obtained indicates the relevant quality of the fit.

Continued

DLVOLEXCHANGE	−0.02	646.94	0.06**
	(−0.39)	(0.04)	(4.67)
DLPOP	−0.11	−0.04	1.58***
	(−0.23)	(−0.16)	(8.38)
DLDEF	−0.17	1.78	0.014
	(−0.39)	(0.12)	(0.20)
DLINVEST	−0.40	1.09	0.014
	(−0.85)	(1.15)	(0.20)
R^2	0.985	0.99	0.83
Obs	32	39	39
Fisher/chi²	390.7		278.32

Source: Authors, estimate based on R software. Legend: *Denote significance at the 10 percent level; **Denote significance at the 5 percent level; ***Denote significance at the 1 percent level.

Table 8. Estimation of the impact of misalignment on growth long-term.

Equation 1 Var_depend	Lgdp-1	Lmisal	Lovereval	Lunderev	Lvolexch	Lpop	Ldef	Linvest	Const
Tcer	−0.51**	−0.12	0.01*	−0.0003**	−1.61**	−0.36***	0.77***	2.70**	−0.71
	(−3.41)	(−1.31)	(1.95)	(−2.69)	(−3.1)	(−5.57)	(11.26)	(2.97)	(−1.43)
R^2 = 83.18	Paramètres = 8								P_ch^2 = 0.000
obs = 39									

Source: Authors, estimate based on R software.

The growth of real GDP in DR Congo, in the long term has as main determining the variables here-after: the lagged real GDP growth rate (GDP-1), exchange rate misalignment (MESAL), depreciation of the exchange rate (UNDEREVAL), the volatility of the exchange rate (VOLEXCH), population (POP), inflation (DEF) and social investment (INVEST).

In view of the results, the lagged real GDP growth rate (GDP-1), exchange rate misalignment (MESAL), exchange rate volatility (VOLEXCH), population (POP) and inflation (DEF) exert a negative influence on GDP real in the DRC. While the depreciation (UNDEREVAL) and social investment (INVEST) positively affect real GDP growth in DR Congo.

The coefficient associated with the lagged GDP growth rate is negative (−0.51) and significant at 5%. An increase in economic activity of one percent results in a decrease in economic activity the following year of 0.52%.

The misalignment of exchange rates has a negative impact on economic growth in the DRC. An increase in exchange rate misalignment of 1% leads to a decrease in growth of 0.0001%. This sign is identical to the sign at the expected

sign. To understand this situation, we will analyze the effect of an undervaluation of the exchange rate. The coefficient of the binary variable making it possible to capture the undervaluation is positive and statistically significant. Conversely, the coefficient associated with the binary variable determining the appreciation is negative and statistically insignificant.

The statistically positive effect of depreciation initially seems intuitive because it is generally considered to restore competitiveness and the trade balance through the profitability of foreign trade.

The impact of population growth on economic activity is negative. An increase in population growth of 1% leads to a decrease in economic activity of 1.61%. The same also applies to the volatility of the exchange rate misalignment, exerting a negative and statistically significant influence on economic growth in the DRC.

The results of theshort-term estimate will be presented in Table 9.

It is found that in the short run, real GDP growth has as main determinants exchange rate misalignment (MISAL), exchange rate depreciation (UNDEVAL), population (POP) and inflation (DEF).

Thus, in the short term, any variation from 1% misalignment leads to acceleration of economic activity by 2.70 percent of similarly, a 1% variation in the depreciation of the rate of change toa positive impact on GDP growth real in DR Congo. In addition, population growth also has a positive influence on growth from Real GDP. The same effect occurs for economic inflation whose variation of 1% leads to an increase in growth of 1.98%.

4.4. Discussion of Results

This section allows you to operate a comparison of the results obtained from the empirical analysis and the review of the literature. This discussion of the results focuses on exchange rate fundamentals real as well as the incidence of misalignment on the growth.

4.4.1. Fundamentals of the Real Exchange Rate

The factors likely to influence the exchange rate in the long run are widely discussed in the literature.

Table 9. Estimation of the incidence of misalignment on growth in the Short Term.

Equation 2 Var_depend	LMISAL.D	LOVEREVAL.D	LUNDEREV.D	LVOLEXCH.D	LPOP.D	LDEF.D	LINVEST.D	const
LERRE.D	0.87	0.73***	0.21	0.06**	1.58***	0.014	0.014	−0.71
	(1.23)	(9.06)	(1.99)	(4.67)	(8.38)	(0.20)	(0.20)	(−1.43)
R^2 = 83.18								
obs = 39	Paramètres = 8						P_ch^2 = 0.000	

Source: Authors, estimate based on R software.

Relative productivity has acted positively on the real effective exchange rate (an increase of 1% of relative productivity leads an appreciation of the real effective exchange rate of 0.21%). This result is the same to that obtained in the literature, insofar as it confirms the existence of a Balassa-Samuelson effect in DR Congo. For exemple, the study by De Gregorio et al. (1994), relating to 14 OECD countries taken over the period from 1970 to 1985, made it possible to obtain values between 0.36 and 0.52. For their part, Elbadawi and Soto (2005) obtained a value of 0.505 by studying 84 developing countries over the period from 1980 to 2003 (2009) obtains coefficients of a different order of magnitude.

Of same only for the relative productivity, estimated impact of an increase from the term of the exchange (−0.01) is identical to that heard. Authors like Lawson et al. (2019) have for example obtained a value of −0.05 as part of a study on ECOWAS countries from1985 to 2014.

By some where else, we note that, contrary to the previous variables, public spending and reservations exchange are not affected signs heard. More precisely public spending affect negatively the real effective exchange rate (−0.91), deviates from results obtained in the literature.

The coefficient assigned to the investment variable is consistent with those predicted by the literature, and in particular those obtained by Baffes, Elbadawi and O'connell (1999). The latter indeed obtain coefficients ranging from −0.43 to −0.27, for two countries of the Franc zone, taken between 1965 and 1993.

4.4.2. Impact of Misalignment on Growth

Regarding the results from of the estimate, we first note the significance at 5% of all the coefficients. These results reveal that the coefficient of population growth is not affected by the sign heard.

Indeed, an increase of 1% of the population leads to a deceleration of economic activity by1.61%. This result is contrary to that obtained elsewhere. in the literature. As an example, Lawson et al. (2019) gets a positive value of 0.6 for a panel of ECOWAS countries over the period from 1985 to 2014.

On the other hand, we note that the misalignment variables, undervaluation overvaluation and exchange rate volatility are affected by the signs heard. Other said, the sign associated with misalignment is negative. This sign is the same to that obtained by some research (Williamson, 1994; Lawson et al., 2019).

5. Conclusion

This article has focused on the fundamentals and real effective exchange rate misalignment in the Democratic Republic of the Congo. In discussing this subject, he was to assess the determinants of the real exchange rate and to study the impact of the misalignment of the exchange rate on economic growth in the DRC.

To achieve these goals, this article has used a dual methodology, first the BEER (Behavioral Equilibrium Exchange Rate) approach of Clark and Mc Donald to determine the fundamentals of REER, then the approach of Lawson to

assess the impact the misalignment of the exchange rate on economic growth based on the augmented Solow endogenous growth model.

In view of the results obtained using econometric modeling (Cointegration, VCEM and ARDL), it has been observed that there is a long relationship between the real effective exchange rate (REER) and its fundamentals. In addition, the results of the REER fundamentals (relative productivity, term of trade, public expenditure and foreign exchange reserves) verify the Balassa-Samuelson effect in the DRC. In addition, the misalignment of the exchange rate exerts a negative impact on real GDP growth in the DRC. However, a disaggregation of the misalignment of the REER shows that exchange rate depreciation strengthens economic activity while an appreciation constrains economic growth in the DRC.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Aguirre, A., & Calderón, C. (2005). Real Exchange Rate Misalignments and Economic Performance. *Documentos de Trabajo (Banco Central de Chile), 315,* 1-49.

Baffes, J., O'Connell, S. A., & Elbadawi, I. (1999). *Single-Equation Estimation of the Equilibrium Real Exchange Rate*. https://doi.org/10.1596/1813-9450-1800

Balassa, B. (1964). The Purchasing-Power Parity Doctrine: A Reappraisal. *Journal of Political Economy, 72,* 584-596. https://doi.org/10.1086/258965

Barro, R. J., Sala-i-Martin, X., & Mazerolle, F. (1996). *La croissance économique*. McGraw-Hill/Ediscience international.

Béreau, S., Bénassy-Quéré, A., & Mignon, V. (2009). Robust Estimations of Equilibrium Exchange Rates within the G20: A Panel BEER Approach. *Scottish Journal of Political Economy, 56,* 608-633. https://doi.org/10.1111/j.1467-9485.2009.00500.x

Berg, A. T., Berkovic, S. F., Brodie, M. J., Buchhalter, J., Cross, J. H., van Emde Boas, W., & Scheffer, I. E. (2010). Revised Terminology and Concepts for Organization of Seizures and Epilepsies: Report of the ILAE Commission on Classification and Terminology, 2005-2009. *Epilepsia, 51,* 676-685. https://doi.org/10.1111/j.1528-1167.2010.02522.x

Camanho, N., Hau, H., & Rey, H. (2022). Global Portfolio Rebalancing and Exchange Rates. *The Review of Financial Studies, 35,* 5228-5274. https://doi.org/10.1093/rfs/hhac023

CBC (2011, 2020). *Annual Report*. Kinshasa.

Chinn, M. D. (1997). Paper Pushers or Paper Money? Empirical Assessment of Fiscal and Monetary Models of Exchange Rate Determination. *Journal of Policy Modeling, 19,* 51-78. https://doi.org/10.1016/S0161-8938(96)00047-6

Clark, P. B., & Mac Donald, R. (1998). Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs. IMF Working Papers, Vol. 1998, International Monetary Fund. https://doi.org/10.2139/ssrn.882342 https://www.imf.org/en/Publications/WP/Issues/2016/12/30/Exchange-Rates-and-Economic-Fundamentals-A-Methodological-Comparison-of-BEERs-and-FEERs-2592

Cottani, J. A., Cavallo, D. F., & Khan, M. S. (1990). Real Exchange Rate Behavior and

Economic Performance in LDCs. *Economic Development and Cultural Change, 39,* 61-76. https://doi.org/10.1086/451853

Couharde, C., & Sallenave, A. (2013). How Do Currency Misalignments' Threshold Affect Economic Growth? *Journal of Macroeconomics, 36,* 106-120. https://doi.org/10.1016/j.jmacro.2012.11.002

Couharde, C., Coulibaly, I., & Damette, O. (2012). *Misalignments and Dynamics of Real Exchange Rates in the CFA Franc Zone* (No. hal-01411706). https://doi.org/10.1016/j.econmod.2013.05.005

Crespo-Cuaresma, J., Fidrmuc, J., & MacDonald, R. (2004). *The Monetary Approach to Exchange Rates in the CEECs, Macroeconomics 0401013.* University Library of Munich, Germany.

Crespo-Cuaresma, J., Fidrmuc, J., & MacDonald, R. (2005). The Monetary Approach to Exchange Rates in the CEECs 1. *Economics of Transition, 13,* 395-416. https://doi.org/10.1111/j.1468-0351.2005.00213.x

De Gregorio, J., Giovannini, A., & Wolf, H. C. (1994). International Evidence on Tradables and Nontradables Inflation. *European Economic Review, 38,* 1225-1244. https://doi.org/10.1016/0014-2921(94)90070-1

Dollar, D. (1992). Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985. *Economic Development and Cultural Change, 40,* 523-544. https://doi.org/10.1086/451959

Edwards, S. (1989). *Real Exchange Rates, Devaluation, and Adjustment: Exchange Rate Policy in Developing Countries* (pp. 16-25). MIT Press.

Edwards, S. (1998). Openness, Productivity and Growth: What Do We Really Know? *The Economic Journal, 108,* 383-398. https://doi.org/10.1111/1468-0297.00293

Elbadawi, I., & Soto, R. (2005). *Theory and Empirics of Real Exchange Rates in Sub-Saharan Africa and Other Developing Countries*. World Bank Mimeo.

Fadlallah, A., & Mouhil, I. (2014). Que coûtent les mésalignement du taux de change à l'économie marocaine? *Dossiers de Recherches en Economie et Gestion, 3,* 309-330. https://studylibfr.com/doc/2015432/que-coûtent-les-mésalignement-du-taux-de-change-à-l-économie https://doi.org/10.12816/0030892

Fosu, A. K. (2000). *The International Dimension of African Economic Growth*. CID Working Paper Series.

Frenkel, R. (2004). *Real Exchange Rate and Employment in Argentina, Brazil, Chile and Mexico*. https://doi.org/10.3848/iif.2004.223.5744

Gala, P. (2008). Real Exchange Rate Levels and Economic Development: Theoretical Analysis and Econometric Evidence. *Cambridge Journal of Economics, 32,* 273-288. https://doi.org/10.1093/cje/bem042

Goldfajn, I., & Valdes, R. O. (1999). The Aftermath of Appreciations. *The Quarterly Journal of Economics, 114,* 229-262. https://doi.org/10.1162/003355399555990

Hausman, W. H., Lee, H. L., & Subramanian, U. (2005). *Global Logistics Indicators, Supply Chain Metrics, and Bilateral Trade Patterns*. World Bank Policy Research Working Paper, (3773). https://doi.org/10.1596/1813-9450-3773

Holtemoller, O., & Mallick, S. (2013). Exchange Rate Regime, Real Misalignment and Currency Crises. *Economic Modelling, 34,* 5-14. https://doi.org/10.1016/j.econmod.2012.09.017

Johansen, S. (1995). Identifying Restrictions of Linear Equations with Applications to Simultaneous Equations and Cointegration. *Journal of Econometrics, 69,* 111-132.

https://doi.org/10.1016/0304-4076(94)01664-L

Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research, 1,* 112-133. https://doi.org/10.1177/1558689806298224

Krueger, A. O. (1983). *Exchange-Rate Determination*. Cambridge University Press.

Lawson, J., Du, K., & Bentum-Micah, G. (2019). The Impact of Macroeconomic Variables, Investment Incentives and Government Agreements on FDI Inflows in Ghana. *Journal of Economics and Business, 2,* 1039-1056. https://ssrn.com/abstract=3461108 https://doi.org/10.31014/aior.1992.02.03.149

Loayza, N., & Fajnzylber, P. (2005). *Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts*. World Bank Publications. https://doi.org/10.1596/0-8213-6091-4

Mac Donald, J. A., Pinheiro, E. M., Kadlec, L., Schupbach, T., & Montell, D. J. (2005). Spitz and Keren, But Not Gurken or Vein, Contribute to Guiding the Border Cells during Oogenesis. *A. Dros. Res. Conf. 46,* 146.

Mejia-Reyes, P., Osborn, D. R., & Sensier, M. (2010). Modelling Real Exchange Rate Effects on Output Performance in Latin America. *Applied Economics, 42,* 2491-2503. https://doi.org/10.1080/00036840701858117

Mengistae, T., & Pattillo, C. (2004). Export Orientation and Productivity in Sub-Saharan Africa. *IMF Staff Papers, 51,* 327-353.

Mohammed, S., Mohammed, A., & Nketiah-Amponsah, E. (2021). Relationship between Exchange Rate Volatility and Interest Rates Evidence from Ghana. *Cogent Economics & Finance, 9,* 1893258. https://doi.org/10.1080/23322039.2021.1893258

Ntalaja, K. (2003). *Third Meeting of the African Learning Group on the Poverty Reduction Strategy Papers*.

Nubukpo, K. (2015). Le franc CFA, un frein à l'émergence des économies africaines? *L'Economie Politique, 68,* 71-79. https://doi.org/10.3917/leco.068.0071

Owoundi, F. (2016). Do Exchange Rate Misalignments Really Affect Economic Growth? The Case of Sub-Saharan African Countries. *International Economics, 145,* 92-110. https://doi.org/10.1016/j.inteco.2015.10.001

Owoundi, F. (2019). Exchange Rate Regimes and Real Exchange Rate Misalignments in Sub-Saharan Africa: Does the Level of Democracy Matters? *Revue deconomie du developpement, 27,* 53-95.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics, 16,* 289-326. https://doi.org/10.1002/jae.616

Razmi, A. Rapetti, M., & Skott, P., (2012). The Real Exchange Rate and Economic Growth: Are Developing Countries Different? *International Review of Applied Economics, 26,* 735-753. https://doi.org/10.1080/02692171.2012.686483

Rodrik, D. (2008). The Real Exchange Rate and Economic Growth. *Brookings Papers on Economic Activity, 2008,* 365-412. https://doi.org/10.1353/eca.0.0020

Sachs, J. D., Warner, A., Åslund, A., & Fischer, S. (1995). Economic Reform and the Process of Global Integration. *Brookings Papers on Economic Activity, 1995,* 1-118. https://doi.org/10.2307/2534573

Siregar, R. (2011). *The Concepts of Equilibrium Exchange Rate: A Survey of Literature*.

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics, 70,* 65-94. https://doi.org/10.2307/1884513

Stein, J. L. (1994). The Natural Real Exchange Rate of the US Dollar and Determinants of Capital Flows. In J. Williamson (Ed.), *Estimating Equilibrium Exchange Rates* (pp. 133-175). Institute for International Economics.

Stein, J. L., & Allen, P. R. (1997). *Fundamental Determinants of Exchange Rates.* Oxford University Press. https://doi.org/10.1093/0198293062.001.0001 https://books.google.cd/books?hl=fr&lr=&id=iZHL-HOTvowC&oi=fnd&pg=PA1&dq=Stein+and+Allen+(1997)&ots=ZDGOCiVIgP&sig=a92Hn6zwaqXmgAHHSE1CUqdR-BI&redir_esc=y#v=onepage&q=Stein%20and%20Allen%20(1997)&f=false

Stein, M. L. (2005). Space-Time Covariance Functions. *Journal of the American Statistical Association, 100,* 310-321. https://doi.org/10.1198/016214504000000854

Williamson, O. E. (1983). Credible Commitments: Using Hostages to Support Exchange. *The American Economic Review, 73,* 519-540. https://www.jstor.org/stable/1816557

Williamson, O., E. (1994). *Les institutions de l'économie, Paris, Interéditions,* 1-404. https://www.persee.fr/doc/forem_0759-6340_1995_num_49_1_2545_t1_0116_0000_12

Youssouf, N. N., de Paul, V., & Landry, B. J. (2018). *Mésalignements du taux de change réel dans la Zone Franc: La diversification des exportations importe-t-elle?* BEAC Working Paper, BWPN°07/18, 1-29. https://www.beac.int/wp-content/uploads/2016/10/Beac_working_paper_07-18.pdf

Appendix

Table A1.

		Regr.1	*Regr.2*	*Regr.3*
Méthodes d'Estimation				
endogeneous Var.	**exogeneous Var.**	**OLS**	**VCEM**	**ARDL**
ERRE	C	12**	15.27**	5.08
		(3.44)	(2.14)	(1.01)
	PROD	0.3	0.16	0.21**
		(1.2)	(0.01)	(2.56)
	TOT	0.13	−0.71**	−0.01**
		(0.55)	(−2.71)	(3.40)
	PUBSPEND	−0.41*	−2.48	−0.91**
		(−1.67)	(−0.11)	(−3.24)
	OPEN	−0.09	0.75***	0.08
		(−0.54)	(7.98)	(1.45)
	RER	−0.004	−0.001	−0.0001***
		(−1.29)	(−1.45)	(−7.45)
	INVEST	−0.007	0.71	−0.01***
		(−0.09)	(0.70)	(−3.21)
	R2 Ajusté	0.97	0.96	0.83
	Obs	39	39	39

Equation Var_depend	prod	tot	pubspend	open	RER	invest	const
erre	0.21**	−0.01**	−0.91**	0.08	−0.0001***	−0.01***	5.08
	(2.56)	(3.40)	(−3.24)	(1.45)	(−7.45)	(−3.21)	(1.01)
R2 = 83.18 obs = 39	Paramètres = 6						$P\_ch^2 = 0.000$

Table A2.

		Regr.1	*Regr.2*	*Regr.3*
Estimation methods				
endogeneous var.	**exogeneous var.**	**OLS**	**VCEM**	**ARDL**
ERRE	C	−1.48	0.04	−0.71
		(−0.51)	(0.009)	(−1.43)
	LGDP-1	na	na	−0.51**
				(−3.41)

Continued

LMISAL	9.69	−8.87	−0.12
	(0.55)	(−0.08)	(−1.31)
LOVEREVAL	2.83	6.53	0.01*
	(0.58)	(0.05)	(1.95)
LSUNDEREVAL	1.49	na	−0.0003**
	(0.28)		(−2.69)
LVOLEXCHANGE	−2.10	6.06	−1.61**
	(−1.03)	(0.01)	(−3.1)
LPOP	1.86	1.57	−0.36***
	(1.65)	(0.17)	(−5.57)
LDEF	−1.79*	−7.19	0.77***
	(−2.18)	(−1.19)	(11.26)
LINVEST	9.58***	−1.02	2.70**
	(39.66)	(−0.005)	(2.97)
DLMISAL	0.90	−29.9	0.87
	(0.37)	(−0.02)	(1.23)
DLOVEREVAL	na	−3.84	0.73***
		(−0.3)	(9.06)
DLUNDEREVAL	−16.52	na	0.21
	(−0.13)		(1.99)
DLVOLEXCHANGE	−0.02	646.94	0.06**
	(−0.39)	(0.04)	(4.67)
DLPOP	−0.11	−0.04	1.58***
	(−0.23)	(−0.16)	(8.38)
DLDEF	−0.17	1.78	0.014
	(−0.39)	(0.12)	(0.20)
DLINVEST	−0.40	1.09	0.014
	(−0.85)	(1.15)	(0.20)
R^2	0.985	0.99	0.83
Obs	32	39	39
Fisher/chi²	390.7		278.32

Table A3.

Equation 1 Var_depend	Lgdp-1	Lmisal	Lovereval	Lundereval	Lvolexchange	Lpop	Ldef	Linvest	const
tcer	−0.51**	−0.12	0.01*	−0.0003**	−1.61**	−0.36***	0.77***	2.70**	−0.71
	(−3.41)	(−1.31)	(1.95)	(−2.69)	(−3.1)	(−5.57)	(11.26)	(2.97)	(−1.43)
R^2 = 83.18	Paramètres = 8								P_ch^2 = 0.000
obs = 39									

Equation2 Var_depend	Lmisal.d	Lovereval.d	Lunderev.d	Lvolexch.d	Lpop.d	Ldef.d	Linvest.d	const
Ltcer.d	0.87	0.73***	0.21	0.06**	1.58***	0.014	0.014	−0.71
	(1.23)	(9.06)	(1.99)	(4.67)	(8.38)	(0.20)	(0.20)	(−1.43)
R2 = 83.18	Paramètres = 8							P_ch^2 = 0.000
obs = 39								

Table A4.

Valeur	ADF Test			PP Test			KPSS Test			Decision
	Calculated Value	Critical Value (Level at 5%)	Integration order	Calculated Value	Critical Value (Level at 5%)	Integration order	Calculated Value	Critical Value (Level at 5%)	Integration order	
gdp	−1.46	−3.53	I (1)	−1.46	−3.55	I (1)	−2.41	−3.53	I (1)	I (1)
erre	−3.16	−4.22	I (1)	−3.16	−3.53	I (1)	−2.43	−3.53	I (1)	I (1)
open	−2	−3.53	I (1)	−2	−3.53	I (1)	−1.93	−3.53	I (1)	I (1)
posext	−2.63	−3.53	I (1)	−2.63	−3.54	I (1)	−0.09	−3.53	I (1)	I (1)
tot	−0.45	−3.53	I (1)	−0.45	−3.54	I (1)	−0.78	−3.53	I (1)	I (1)
invest	−2.94	−3.53	I (1)	−2.94	−3.54	I (1)	−1.54	−3.53	I (1)	I (1)
pubspend	−2.94	−3.53	I (1)	−1.54	−3.54	I (1)	−2.23	−3.53	I (1)	I (1)
prod	−1.45	−3.53	I (1)	−1.89	−3.54	I (1)	−2.45	−3.53	I (1)	I (1)