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Article

Exchange rates and trade balance in West African economy and monetary union countries: does the content of the traded goods matter?

Cogent Economics & Finance

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Suggested Citation: Guidime, Camille Detondji; Diaw, Adama; Biao, Barthélémy (2024) : Exchange rates and trade balance in West African economy and monetary union countries: does the content of the traded goods matter?, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-14,
<https://doi.org/10.1080/23322039.2024.2413963>

This Version is available at:

<https://hdl.handle.net/10419/321629>

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To cite this article: Camille Detondji Guidime, Adama Diaw & Barthélémy Biao (2024) Exchange rates and trade balance in West African economy and monetary union countries: does the content of the traded goods matter?, Cogent Economics & Finance, 12:1, 2413963, DOI: [10.1080/23322039.2024.2413963](https://doi.org/10.1080/23322039.2024.2413963)

To link to this article: <https://doi.org/10.1080/23322039.2024.2413963>



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Exchange rates and trade balance in West African economy and monetary union countries: does the content of the traded goods matter?

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ABSTRACT

This paper analyzes the role of the nature of traded goods in the effect of the real exchange rate on the trade balance in West African Economy and Monetary Union countries. Empirically, the estimation of the parameters of a distributed lag autoregressive model using the technique of dynamic common correlation estimators is carried out. The results show that, firstly, the low level of intra-industry trade comfort positive real exchange rate effect on trade balance. However, WAEMU countries export raw materials used by their foreign trading partners to manufacture products, which WAEMU countries import in turn; but the raw materials percentage used in the manufacture of those products is negligible to have a beneficial impact on trade balance. Secondly, foreign income levels are less favorable to the countries' balance of trade, as partners have a preference for increasingly sophisticated goods that WAEMU countries do not produce. In terms of economic policy implications, a currency devaluation would have an expected positive effect if trade policy would encourage the consumption of goods and services containing, in their manufacturing process, a significant quantity of their exported products. This article contributes to the existing economic literature by taking into account the characteristics of traded goods in the analysis of the influence of the real exchange rate on the trade balance. A low content of exported goods in the manufacturing process of imported goods from a less advanced country could limit the rebalancing of its trade balance following a change in the real exchange rate.

IMPACT STATEMENT

The importance of this research is to empirically show the significant role of the quantity of domestic goods contained in the manufacture of imported goods in studying the relationship between exchange rate changes and the trade balance. The implementation of a specific trade policy coupled with an exchange rate policy in favour of the transformation of primary products into semi-manufactured goods is important for the economy of WAEMU countries.

ARTICLE HISTORY

Received 11 May 2024
Revised 30 September 2024
Accepted 2 October 2024

KEYWORDS

Real exchange rate; nature of goods exchanged; trade balance; ARDL model; WAEMU countries

SUBJECTS

Economics and development; economics; finance; African studies

JEL

F10; F31; C23; 055

1. Introduction

Rebalancing the trade balance is an issue of scientific importance for researchers and decision-makers. Economic theory establishes the basis for external rebalancing of the balance of payments through devaluation or depreciation of the national currency. Depending on the evolution of the exchange rate, countries' trade balances improve or deteriorate (Dogru et al., 2019; Bahmani-Oskooee & Aftab, 2017; Bahmani-Oskooee, 1991; Magee, 1973). For small-scale economies, such as those of the WAEMU, the exchange rate plays an crucial role in macroeconomic equilibrium under the hypothesis of Marshall-Lerner-Robinson critical elasticities (Keho, 2021b; Hunegnaw & Kim, 2017; Guillaumont & Guillaumont

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/23322039.2024.2413963>.

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Jeanneney, 1993). The result is a mechanism whereby the trade balance has a short-term deficit and a surplus in the long term with an adjustment coefficient: this phenomenon is referred to as the J-curve. However, empirical verification of the J-curve phenomenon remains relatively observed (Ng et al., 2008). Moreover, the mechanisms describing the effects of the exchange rate on trade balance are not free of uncertainty. Therefore, the exchange rate can have positive or negative effects on a country's trade balance (Ayele, 2019; Dogru et al., 2019; Hunegnaw & Kim, 2017; Keho, 2021b). These contrasting results can be observed particularly in developing or less advanced countries (Bahmani-Oskooee, 1991). For WAEMU countries, the work of Keho (2021b) shows the positive effect of the exchange rate on the trade balance in the presence of heterogeneity in countries' gross domestic product per capita. However, the nature of the goods traded between countries, which could slow down or accelerate the expected effect of real exchange rate evolution on the trade balance, is not taken into account. In this article, we show that the nature of the goods traded between WAEMU countries and their trading partners could limit the positive effect of the real exchange rate on the balance of trade, given the relative trade dependence of countries with intermediate incomes.

The aim of this article, therefore, is to analyse the role of the nature of the goods traded between WAEMU countries and their trading partners in the expected effect of a change in the real exchange rate on their trade balances. This article contributes to the theoretical and empirical debate on the relationship between the real exchange rate and the trade balance of developing countries, especially those of the WAEMU. WAEMU countries are known for their exports of raw materials and their imports of manufactured products, made from raw materials that do not come sufficiently from them. Taking into account the shares of exported raw materials that are contained in the manufacturing of imported manufactured goods improves the understanding of the effect of the real exchange rate on the trade balance of developing countries. Furthermore, a low share of exported goods in the manufacturing process of goods imported from a less advanced country could limit or reduce the expected rebalancing of its trade balance following a variation in the real exchange rate. The rest of the paper is structured as follows: stylized facts on trade and exchange rate evolution in WAEMU countries are presented in Section (2); a literature review outlines the effects of the real exchange rate on the trade balance in Section (3); empirical analysis of exchange rate effects on the trade balance is described in Section (4); results of econometric estimations are discussed in Section (5); economic policy implications presented as conclusion in section (6).

2. Stylized facts about intra-industry trade and the real exchange rate in the WAEMU countries

2.1. Evolution of trade

Trade between WAEMU countries has increased over the last ten years, rising from 6750.3 billion in 2006 to 17753.0 billion in 2020 (BCEAO, 2021, 2006). Overall, imports remain higher than exports of goods and services (Cf. Figure 1). Moreover, the index of main exported products rose from 0.2% in 2019 to 1.8% in 2020 (BCEAO, 2021). Exports of goods remain dominated by gold (31.8%) and cocoa (16.8%), followed by petroleum products (6.8%), cotton (4.8%) and cashew nuts (3.9%). Imports fell from 8097.6 billion in 2006 to 18664.3 billion in 2020. The structure of the Union's goods imports is dominated mainly by consumer goods (33.7%), capital goods (22.4%), intermediate goods (17.9%) and energy products (15.1%) (BCEAO, 2021). In short, exports are still dominated by primary products, and imports by manufactured goods. The Union's trading partners are mainly the United States, Asian countries, Europe and, to a lesser extent, ECOWAS and African countries.

2.2. Trade balance and real exchange rate

WAEMU countries are experiencing a structural imbalance in their trade balance, with the exception of Côte d'Ivoire (BCEAO, 2021). The real exchange rate is relatively correlated with the trade balance of UEMOA countries (Cf. Figure 1). Côte d'Ivoire did not experience a relative decline in its trade balance over the study period.

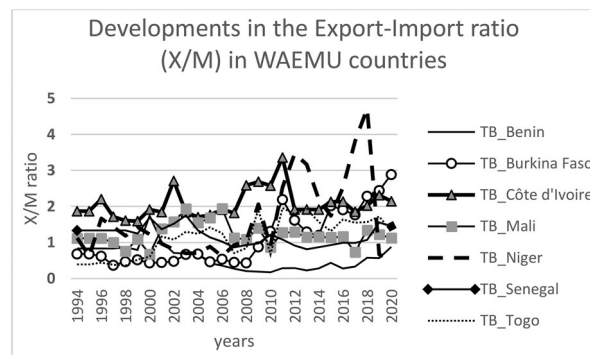


Figure 1. Statistical relationship between the real exchange rate and the trade balance of WAEMU countries from 1994 to 2020.

Source: Authors' calculations.

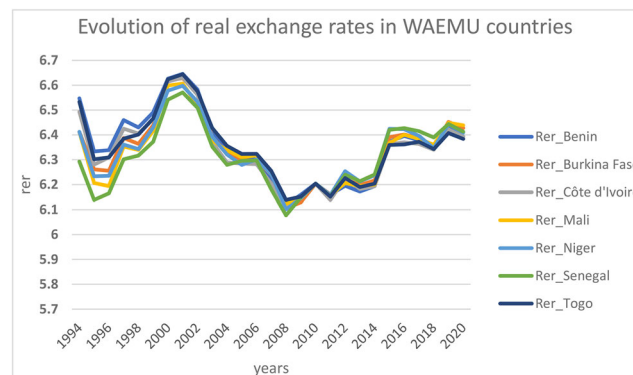


Figure 2. Real exchange rates in WAEMU countries.

Source: Authors' calculations.

In fact, the trade balance deficit of WAEMU countries is worsening over time, reaching -6.4% of GDP in 2021, compared with -5.1% in 2020 and -5.7% in 2019 (BCEAO, 2022). This deficit in the union's trade balance has persisted since 1970. These trends can be explained in particular by the international economic conjuncture, which influences the economies of WAEMU countries with regard to the high dependence of their imports on the outside world, and the evolution of raw material prices and export revenues. It's depended also by the evolution of real exchange rate.

The real exchange rates of the WAEMU countries have undergone a three-phase evolution since 1994 (the year their common currency was devalued). From 1994 to 2002, the evolution is increasing with a plus at the peak of 6.6. After 2002, the real exchange rate experienced a decline until 2010 then started to appreciate again until 2020 even if the level remains lower than that of 2002 (Cf. Figure 2).

The real exchange rate seems to decrease with the type of goods traded between trading partners. WAEMU countries import manufactured goods whose inputs do not come essentially from their exports of raw materials. The sensitivity of the trade balance following the movement of the real exchange rate would be low for countries with a low level of intra-industry trade (Kharroubi, 2011) because no national industry can easily and quickly replace imports which have become more expensive because of devaluation. Intuitively and following this idea, countries specialized in the production of raw materials cannot have high intra-industry trade.

3. Literature review

This session presents theoretical and empirical views of the relationship between the exchange rate and the trade balance. It shows how the nature of traded goods determines the effect of exchange rate movements on the balance of trade by taking into account their manufacturing inputs.

3.1. Critical elasticity approaches and the J-curve phenomenon

A reasoning that goes back to classical economists' states that a change in the real exchange rate improves the competitiveness-price of the national economy in the following ways: (i) higher import prices in domestic currency – leading to lower imports – and (ii) lower export prices in foreign currency – leading to increased exports. For the balance of trade to improve, the effect of increasing exports and decreasing imports must be sufficiently strong for the resulting balance to offset the effect of deterioration in the terms of trade (Magee, 1973). The Marshall-Lerner-Robinson critical elasticity hypothesis is therefore introduced, which states that, as long as the sum of export and import elasticities is greater than unity, a devaluation of the national currency will improve the balance of trade in the long term (Bahmani-Oskooee, 1991). Furthermore, the process of the theoretical positive effect of devaluation on the balance of trade is nuanced through the J-curve; an empirical observation which shows that the balance of trade initially becomes more in deficit, then becomes progressively in surplus again in a second phase. Himarios (1985), criticizing Miles' article (1979), shows that the real exchange rate is still well suited to understanding the effect of a devaluation of the national currency on the balance of trade. He again specifies the trade balance equation and emphasizes the temporal nature of the shift in the real exchange rate needed to influence the trade balance. However, it should be noted that a significant number of empirical analyses have been carried out, without any absolute agreement on the direct and positive effect of a change in the exchange rate on the balance of trade. If it has been shown that for small countries two successive devaluations are necessary to hope for a positive effect on the balance of trade (Prakash and Maiti, 2016), it remains to be shown that the quantity of goods imported by small countries, containing in their manufacture a given level of products exported upstream by the same small countries, is a key factor in the expected effect of the exchange rate on the trade balance: this is what our paper is concerned with. To the best of our knowledge, there is no research on the role of the nature of trade between countries in the effect of the exchange rate on the trade balance for WAEMU countries.

3.2. Key factors in the impact of exchange rates on the trade balance

In developed countries, exogenous economic shocks can influence the expected effect of a change in the real exchange rate on the trade balance (Bahmani-Oskooee & Zhang, 2013; Hunegnaw & Kim, 2017; Kang & Dagli, 2018). In emerging countries, the favorable effect of the real exchange rate on the trade balance is observed in the long term, while in the short term, the trade balance appears to deteriorate (Bahmani-Oskooee et al., 2019; Serdar & Hakan, 2017; Prakash & Maiti, 2016; Baharumshah, 2001). Thus, it emerges that the time it takes for the effects of an exchange rate change to be realized determines the difference between the short-term and long-term results of the expected effects (Acar, 2000). On the other hand, depending on the country's economic status – least developed, developed and developing country – the long-term outcome is mixed (Ayele, 2019). In less advanced and developing countries, the effects found relate to the consideration of the temporal factor, short-term and long-term, (Bahmani-Oskooee et al., 2019), the transmission mechanism of the exchange rate effect on the trade balance (Prakash & Maiti, 2016) and the consideration of real exchange rate horizons. Furthermore, Keho (2021a) performs a heterogeneous panel analysis and finds that the trade balance is negatively influenced by domestic and foreign products over the period 1975–2017, while it is positively influenced by the real exchange rate in the long term in UEMOA countries. In the short term, there is no deterioration in the trade balance. From a methodological point of view, it would be useful to take into account the heterogeneity of the countries in a panel in order to assess differently the effects of the real exchange rate on the trade balance. Moreover, an appreciation of the real effective exchange rate worsens Côte d'Ivoire's trade balance, while a depreciation improves it over the period 1975–2017 (Keho, 2021b). However, the difference in econometric tools used in the work could explain the difference in results. Nevertheless, country specificities and economic dynamics, particularly the degree of intra-industry trade with trading partners, could influence the expected effect of the real exchange rate on the balance of trade. In addition, WAEMU countries are relatively heterogeneous in the diversification of the products they export (Keho, 2021a). Furthermore, the difference in effects may stem from the nature of traded products

(Burçak & Payaslıoğlu, 2016; Dogru et al., 2019; Kharroubi, 2011), industrial integration between trading countries and country dependence in the nature of exported products.

Two cases are identified: the effect of the real exchange rate on the trade balance is amplified when, the part of the goods and services imported by a country from its trading partner contain, to a significant extent in their manufacture, the goods and services exported by the latter to the trading partner is high. The second case is the opposite phenomenon. In addition, the development of trade is linked to industrial development, which increases the volume of trade (sometimes in products of the same type). This increases substitutability between the types of imported and exported goods, making the trade balance more sensitive to movements in the real exchange rate. Furthermore, countries import and export different types of goods according to their revealed comparative advantages. Thus, when the normalized sum of trade balance deviations of firms in an industry relative to total trade is high, this would mean that the country is trading different types of goods with its partners. Consequently, the sensitivity of the trade balance to real exchange rate movements is low for countries with a low level of intra-industry trade, as no domestic industry can easily and quickly replace imports that have become more expensive following a devaluation (Kharroubi, 2011). Intuitively, and following this idea, countries specializing in the production of raw materials cannot have high intra-industry trade. Intra-industry trade in products would be low, and therefore the effect of a change in the real exchange rate could not significantly affect the balance of trade in the sense of improving it.

4. Methodology

4.1. Model specification and variables description

The econometric modeling derives from the work of Bahmani-Oskooee (1991), Hunegnaw and Kim (2017) and Keho (2021b) and leads to the construction of a delayed autoregressive distribution model by considering the expression of the trade balance as follows:

$$\ln(TB)_{it} = \alpha_{it} + \beta \ln RER_{it} + \chi \ln Y_{dit} + \delta \ln Y_{fit} + \varepsilon_{it} \quad (1)$$

With TB , RER , Y_d , Y_f representing respectively the trade balance, real exchange rate, and domestic production by value and foreign production by value. The equation is in log-linearizing.

Furthermore, taking into account the role of content of the traded goods on the effects of the exchange rate on the trade balance, the model to be estimated is as follows:

$$\ln(TB)_{it} = \alpha_{it} + \beta \ln RER_{it} + \chi \ln Y_{dit} + \delta \ln Y_{fit} + \phi \ln RER_{it} * IIT_{it} + \varepsilon_{it} \quad (2)$$

where is the trade balance of country "i" at date "t". The trade balance is calculated as the relation between countries' exports and imports to avoid negative sign for the log expression (Bahmani-Oskooee et al., 2019). RER_{it} is the real exchange rate of country i against the currencies of its trading partners. The real effective exchange rate controls a country's external competitiveness. The interaction between the real exchange rate and trade dependency allows us to understand how the types of exported versus imported goods affect the expected effect of a change in the real effective exchange rate on the trade balance. We use the Grubel and Lloyd (1975) index¹ as a proxy to capture the share of product exported by a WAEMU country, contained in the manufacture of products imported by this country. And this share valued by the real exchange rate is measured by the product between the real exchange rate and the intra-industry trade index. The expected sign of the interaction between the real exchange rate and the intra-industry trade index will be negative if the degree of intra-industry trade is low. The effects of a change in the real exchange rate are observed over time. Therefore, Pesaran et al. (2001) represent an ARDL-type equation with error term correction to understand long and short term dynamics in a context where variables have an order of integration between I(0) and I(1). On the other hand, several previous works use the ARDL-type cointegration analysis approach to the detriment of error-correction vector autoregression analyses on large samples. Bahmani-Oskooee and Aftab (2017) indicate that the ARDL approach makes it possible to simultaneously assess the short-term effects – through the coefficients of the exogenous variables in first difference, and the long-term effects through the coefficients – of the influence of the real exchange rate on the trade balance (Cf. Equation (4)). The equation is as follows:

$$\Delta \ln TB_{it} = \alpha_i + \sum_{j=1}^n \omega_{0i} \Delta \ln TB_{i,t-j} + \sum_{j=0}^m \omega_{1i} \Delta \ln RER_{i,t-j} + \sum_{j=0}^m \omega_{2i} \Delta \ln Y_{di,t-j} + \sum_{j=0}^m \omega_{3i} \Delta \ln Y_{fi,t-j} + \rho ECT_{i,t-1} + \eta \ln TB_{i,t-1} + \beta \ln RER_{i,t} + \chi \ln Y_{di,t} + \delta \ln Y_{fi,t} + \varepsilon_{it} \quad (4)$$

In order to consider the constraint that the degree of intra-industry trade could pose on the effect of changes in the real exchange rate, Equation (5) is established:

$$\Delta \ln TB_{it} = \alpha_i + \sum_{j=1}^n \omega_{0i} \Delta \ln TB_{i,t-j} + \sum_{j=0}^m \omega_{1i} \Delta \ln RER_{i,t-j} + \sum_{j=0}^m \omega_{2i} \Delta \ln Y_{di,t-j} + \sum_{j=0}^m \omega_{3i} \Delta \ln Y_{fi,t-j} + \sum_{j=0}^m \omega_{4i} \Delta \ln RER_{i,t-j} * IIT_{i,t-j} + \rho ECT_{i,t-1} + \eta \ln TB_{i,t-1} + \beta \ln RER_{i,t} + \chi \ln Y_{di,t} + \delta \ln Y_{fi,t} + \phi \ln RER_{it} * IIT_{it} + \varepsilon_{it} \quad (5)$$

With $n \geq 1$; $m \geq 0$, maximum lag of the model. Δ is the first difference operator. α, ω are the short-run coefficients and $\eta, \beta, \chi, \delta, \phi$ are the long-run coefficients of the model. ECT the speed of adjustment between short-term and long-term dynamics; a negative and statistically significant sign is expected. ε is the error term.

4.2. Technical estimation

The parameters of Equation (7) are estimated to understand the short and long term dynamics of the area as a whole, as well as of the countries making up the area. The Im, Pesaran et al. (2001) unit root test is applied to study the stationary properties of the model's variables. The distributed autoregressive in delay (ARDL) model developed by Pesaran (2006) is used to study short and long term relationships in the event that the variables have an integration order $I(0)$ and $I(1)$. To assess a cointegrating relationship between variables, the test of Pedroni (2004, 2000) is applied. The test considers the heterogeneity between the panel's cross-sectional units (taking into account the presence of diversification in the countries' economies). Thus, under the alternative hypothesis, there is a cointegrating relationship for each panel unit. Cointegration vectors are rarely identical from one panel unit to the next (Hurlin & Mignon, 2007), which means that cross-sectional dependency between error terms must be taken into account. Taking into account the heterogeneity of coefficients estimated from panel data is becoming increasingly demanding (Chudik & Pesaran, 2015). There are often unobserved dependencies between panel units, and ignoring these leads to auto-correlation of the error term and biased least squares regression results (Kao & Liu, 2000). A cross-sectional panel dependence test is proposed by Pesaran (2015) and (Chudik & Pesaran, 2015). Ditzgen (2018) shows that Mean Group estimators are unbiased and consistent. On the other hand, when the ARDL model parameters suggest a cross-sectional dependence of the panel with the presence of heterogeneity, it is of interest to use the cross-sectional Mean Group estimator (CS-ARDL Mean Group estimator) of Pesaran (2015) and Chudik and Pesaran (2015) programmed by Ditzgen (2018) under the name `xtdcce2`. Formally, the following model estimators are proposed by:

$$y_{i,t} = \lambda_i y_{i,t-1} + \beta_i x_{i,t} + u_{i,t} \quad (6)$$

hence

$$u_{i,t} = \gamma_i' f_t + e_{i,t} \quad (7)$$

With $U_{i,t}$, the error term including the common unobservable factor, the heterogeneous factor present and the white noise. The heterogeneous coefficients are distributed around a common mean $\beta_i = \beta + v_i$, $v_i \sim \text{IID}(0, \Omega_v)$ and $\lambda_i = \lambda + \zeta_i$, $\zeta_i \sim \text{IID}(0, \Omega_\zeta)$.

To estimate the parameters, (Chudik et al., 2016) propose two methods for estimating the coefficients: the cross-sectionally augmented estimator ARDL (CS-ARDL) and the cross-sectionally augmented and distributed lag estimator. The CS-ARDL estimator directly estimates the long-run coefficients, by adding the explanatory variables in difference and their lags. The CS-ARDL first estimates the short-term coefficients, then calculates the long-term coefficients. Optimal lags are those with a high frequency over the whole

panel. In other words, using the unrestricted model and an information criterion, decide on the choice of lags for each country by variable, then choose the most common lag for each variable to represent the lags for the model. Here, we obtain ARDL (1,0,0,0) after testing. The performant test program of Pedroni (2000) which introduced the panel ordinary least squares dynamics (PDOLS) estimation technique, is run for robustness of results.

4.3. Data

To examine the effects of changes in the real exchange rate on the trade balance of WAEMU countries, time-series data from 1994 to 2020 are provided by World Development Indicators and the Central Bank of West African States (BCEAO). Only countries whose data are available at regular frequency are included, namely Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. The dependent variable studied is the trade balance, measured by the ratio between exports and imports (Hunegnaw & Kim, 2017; Keho, 2021b). An increase in this ratio reflects an improvement in the trade balance, and a deterioration in the opposite case. Domestic and foreign incomes are approximated by the gross domestic products of WAEMU countries and the ten (10) main trading partners on the basis of traded volumes. The real effective exchange rate is obtained by transforming the nominal exchange rate from the BCEAO. The construction of the real effective exchange rate through the intersession of intra-industry trade is based on data on exports and imports of goods and services from the primary, secondary and tertiary sectors between countries and their ten (10) main trading partners. WAEMU countries have been exporting raw materials since independence in the 1960s, and importing the end products resulting from their exports. They devalued their currencies in 1994, hoping for a favourable effect on their trade balance. This effect cannot be assessed without taking into account the degree of integration of their exports with imported products. It is therefore necessary to cross-reference the effective exchange rate with the degree of intra-industry trade with the main trading partners. Table 1 describes the observations by country and at panel level. The correlation coefficients between the real effective exchange rate and the trade balance are positive and statistically significant for Benin, Senegal and Togo, but statistically insignificant for Côte d'Ivoire, Mali and the panel. For Burkina Faso and Niger, the correlation coefficients are negative but not significant. As for the correlation between the trade balance and the real effective exchange rate crossed with the degree of intra-industry trade, it is negative and statistically significant for Benin, Burkina-Faso and the panel, but not significant for Mali and Niger. The correlation is positive and statistically significant for Senegal, but not significant for Togo and Côte d'Ivoire over the period 1994–2020 (Cf. Table A1, Supplementary Appendix 1). The heterogeneity test shows that the space studied is not homogeneous in terms of economic dynamics and their trade balances (Cf. Figure A1 in Supplementary Appendix). Which corroborates the result of kého (2021b).

5. Results and discussion

5.1. Data

The following Table 2 shows the unit root test results.

Table 1. Mean values of variables by country and correlation coefficient.

Countries	Intb	Inyd	Inyf	Inrer	Inrer* ^{iit}	r	$\hat{\rho}$
Bénin	−1.27	22.82	27.36	6.35	6.60	0.58*	−0.63*
Burkina faso	−0.79	22.75	26.80	6.33	6.34	−0.23	−0.94*
Côte d'Ivoire 0,30	24.26	28.47	6.33	5.91	0.37	0.12	
Mali	−0.45	22.93	27.43	6.32	6.22	0.26	−0.33
Niger	−0.53	22.60	27.80	6.33	6.13	−0.10	−0.30
Sénégal	−0.98	23.31	28.56	6.31	6.22	0.40*	0.50*
Togo	−0.57	21.84	26.70	6.348	6.30	0.39*	0.25
WAEMU	−0.61	22.93	27.59	6.33	6.25	0.07	−0.59*

Note. Intb, Inyd, Inyf, Inrer*^{iit} are trade balance, domestic and foreign income, real exchange rate, real exchange rate associated with the level of intra-industry trade, respectively. \hat{r} and $\hat{\rho}$ are respectively correlation coefficients between trade balance and real exchange rate and between trade balance and real exchange rate associated with the level of intra-industry trade. Data are sample averages.

Source: Authors' calculations.

Table 2. Unit root test results.

	At the level		In first difference	
	ADF-fisher test	IPS test	ADF-fisher test	IPS test
Lntb	40.68*** [0.00]	−2.45*** [0.00]		
Lnyd	05.06 [0.98]	−1.72 [0.28]	57.30*** [0.00]	−3.13*** [0.00]
Lnyf	10.08 [0.75]	−0.53 [0.99]	37.40*** [0.00]	−3.09*** [0.00]
Inrer	16.53 [0.28]	−1.97 [0.09]	80.97*** [0.00]	−4.57*** [0.00]
Inreer* _{iit}	20.09 [0.12]	−1.68 [0.37]	114.14*** [0.00]	−4.38*** [0.00]

Note. *p*-Values are in square brackets. ***Corresponds to statistical significance at the 1% level. ADF fisher test is Augmented Dicker fuller test and IPS test..

Source: Authors' calculations.

The unit root tests indicate that the variables are stationary at the I (1) first difference level, except for the trade balance, which is stationary at the I (0) level. This result enables the implementation of the ARDL model.

5.2. Cointegration test

The presence of a long-term stability relationship between the trade balance and the real exchange rate is tested by controlling the domestic and foreign income levels and the degree of intra-industry trade between WAEMU countries and their trading partners. The Bound test approach of Pesaran et al. (2001) is initially used, based on the ARDL optimal lag model (1,0,0,0) (Cf. Table A2 in Supplementary Appendix). This test is completed by that of Pedroni (2004) to consider heterogeneity in the panel, both in short-term dynamics and in long-term slope and ordinate coefficients. Pedroni (2004) indicates that group and panel ADF statistics have the best power properties when the number of time periods is less than one hundred ($T < 100$). Pedroni's (2004) test complements that of Pesaran et al. (2001) with the results in Tables A3 and A4 (in Supplementary Appendix).

The results of the cointegration test indicate that the trade balance, domestic and foreign income, real exchange rate and the cross between the real exchange rate and the degree of intra-industry trade are cointegrated. There is a long-run relationship between these variables when considering the panel. The result on the long-term relationship between these variables in Senegal and Niger is not conclusive. However, Canetti and Greene (1991) and Kremers et al. (1992) have suggested considering the cointegration relationship in inconclusive cases. Therefore, in all countries, the cointegration relationship is considered. Furthermore, it is of interest to consider the error correction model (ECT) estimator to assess short and longterm dynamics (Hunegnaw & Kim, 2017).

5.3. Long-term elasticities

Given the existence of cointegration between variables, and depending on the presence of country specificity, the long-term relationship is estimated using long-term elasticities. The estimators are those of ARDL (1,0,0,0,0), from the techniques for estimating pooled (CS-ARDL) average, pooled (CS-DL) average and dynamic least squares (DOLS) but not for the Equation (3). The results are reported in Table 3.

The Hausman test performed gives $\chi^2(3) = 1.85$ with $\text{Prob} > \chi^2 = 0.6032$. This result does not indicate the primacy of the CS-ARDL medium group estimate over the DOLS medium group estimate. We interpret the results according to the interest of the two estimated models. The dynamic least squares method of Saikkonen (1991) and Stock and Watson (1993) in the case of panel data, Mark and Sul (2003) show that this technique leads to estimators asymptotically distributed according to a normal distribution of zero mean. Thus, for the WAEMU, the coefficient of the real exchange rate (−0.46) is statistically significant, as is the result obtained by Keho (2021b). It appears that devaluation improves the trade balance in the long term. However, this level of improvement is getting weaker (28%) due to exports from the WAEMU zone being weakly contained in the manufacture of products imported into

Table 3. Results of long-term relationships.

Dependent variable: Intb		CS-ARDL			CS-DL			DOLS	
Countries	Variables explicatives	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]
Bénin	<i>lny_d</i>	3.87*** (1.19)	3.24*** (0.86)	3.26*** (1.19)	3.43*** (0.91)	3.09*** (0.76)	2.74*** (0.98)	0.44 (-0.62)	-1.6*** (-4.68)
	<i>lny_f</i>	-2.24*** (0.67)	-1.88*** (0.47)	-1.88*** (0.66)	-1.96*** (0.48)	-1.74*** (0.41)	-1.55*** (0.53)	-0.76*** (-3.58)	-0.03*** (-5.19)
	<i>lnr_{er}</i>	-0.09 (0.35)		-0.01 (0.34)	0.02** (0.26)		0.15 (0.26)	-0.43*** (-7.02)	
	<i>lnr_{er}*iit</i>		-0.61** (0.34)	-0.61* (0.35)		-0.40 (0.26)	-0.45 (0.26)		4.35*** (4.52)
Burkina Faso	<i>lny_d</i>	5.43 (3.75)	0.28 (2.43)	1.20 (1.49)	4.00** (1.89)	1.35 (1.38)	1.63 (1.02)	9.47*** (3.32)	2.33 (1.09)
	<i>lny_f</i>	-6.59 (5.55)	-0.60 w(3.41)	-2.55 (2.13)	-4.03 (3.11)	-1.43 (2.14)	-2.85* (1.61)	-14.53*** (-3.38)	-2.55 (-1.70)
	<i>lnr_{er}</i>	-0.05 (0.60)		1.12*** (0.28)	-0.14 (0.35)		1.06*** (0.23)	0.59** (-2.22)	
	<i>lnr_{er}*iit</i>		-1.15*** (0.30)	-1.50*** (0.23)		-0.87*** (0.18)	-1.37*** (0.17)		-0.49*** (-15.04)
Côte d'Ivoire	<i>lny_d</i>	-0.14 (0.18)	0.09 (0.21)	-0.11 (0.15)	-0.14 (0.16)	0.02 (0.17)	-0.09 (0.12)	1.60*** (7.43)	1.05 (0.46)
	<i>lny_f</i>	-0.89 (0.62)	-1.40* (0.73)	-0.73 (0.58)	-0.84 (0.51)	-1.16** (0.53)	-0.98*** (0.36)	-2.95*** (-32.41)	-2.24*** (-17.44)
	<i>lnr_{er}</i>	0.26 (0.18)		1.24*** (0.28)	0.27 (0.16)		0.99*** (0.19)	-1.70*** (-30.78)	
	<i>lnr_{er}*iit</i>		-0.15 (0.15)	-0.78*** (0.19)		-0.09 (0.11)	-0.60*** (0.12)		-0.62*** (-14.26)
Mali	<i>lny_d</i>	1.66 (1.01)	1.65* (1.00)	-0.97 (0.87)	1.57* (0.90)	1.75** (0.85)	-1.13 (0.79)	-2.60* (-1.84)	1.48 (0.54)
	<i>lny_f</i>	-1.10* (0.58)	-1.12** (0.56)	0.54 (0.51)	-1.07** (0.54)	-1.17** (0.50)	0.64 (0.48)	1.61 (0.48)	-0.98*** (-3.35)
	<i>lnr_{er}</i>	0.27 (0.29)		1.66*** (0.40)	0.26 (0.27)		1.80*** (0.34)	-0.02 (-1.66)	
	<i>lnr_{er}*iit</i>		-0.19 (0.19)	-1.09*** (0.26)		-0.19 (0.17)	1.17*** (0.22)		-0.17* (-1.78)
Niger	<i>lny_d</i>	0.23 (3.1)	1.50 (1.55)	1.35 (2.00)	1.08 (0.02)	1.69 (0.41)	1.86 (1.68)	32.12*** (9.76)	33.28*** (11.21)
	<i>lny_f</i>	-0.45 (3.19)	-2.02 (1.57)	-1.87 (2.01)	-1.28 (1.97)	-2.25 (1.41)	-2.41 (1.66)	-28.83*** (-10.16)	-29.19*** (-12.42)
	<i>lnr_{er}</i>	-0.73 (1.14)		0.09 (0.76)	-0.80 (0.72)		-0.12 (0.62)	-2.01*** (-3.27)	
	<i>lnr_{er}*iit</i>		-0.66*** (0.19)	-0.67*** (0.21)		-0.66*** (0.17)	-0.65*** (0.19)		-6.65*** (-8.63)
Sénégal	<i>lny_d</i>	1.33 (1.48)	2.98** (1.29)	-0.72 (1.76)	-0.09 (1.05)	1.59 (1.04)	-1.53 (1.29)	-5.19*** (-20.05)	-2.81*** (-5.44)
	<i>lny_f</i>	-2.14 (1.71)	-4.10*** (1.47)	0.29 (2.04)	0.03 (1.15)	-2.25 (1.15)	1.74 (1.45)	5.90*** (17.03)	-4.46*** (-18.97)
	<i>lnr_{er}</i>	0.59 (0.36)		1.41*** (0.54)	0.76*** (0.25)		1.36*** (0.41)	1.93*** (19.62)	
	<i>lnr_{er}*iit</i>		0.04 (0.39)	-1.00*** (0.52)		0.36 (0.31)	-0.77** (0.43)		-1.25*** (-22.18)
Togo	<i>lny_d</i>	0.11 (0.74)	1.00 (0.67)	0.40 (0.53)	0.04 (0.46)	0.62 (0.44)	0.36 (0.39)	10.01** (2.81)	2.68*** (8.64)
	<i>lny_f</i>	-0.38 (0.99)	-1.72* (0.92)	-0.96 (0.73)	-0.20 (0.58)	-0.84* (0.50)	1.74 (1.45)	-9.96*** (-3.39)	-4.46*** (-18.97)
	<i>lnr_{er}</i>	0.38 (0.49)		1.11*** (0.41)	0.29 (0.30)		1.36*** (0.41)	-6.32*** (-4.07)	
	<i>lnr_{er}*iit</i>		-0.52* (0.27)	-0.81*** (0.65)		-0.35* (0.18)	-0.65*** (0.18)		-1.25*** (-22.18)
WAEMU	<i>lny_d</i>	1.78** (0.79)	1.54*** (0.46)	0.63 (0.55)	1.41** (0.64)	1.45*** (0.36)	0.54 (0.60)	0.67 (0.30)	0.69*** (4.47)
	<i>lny_f</i>	-1.97** (0.81)	-1.84*** (0.42)	-1.02** (0.43)	-1.33** (0.51)	-1.52*** (0.16)	-1.89 (0.61)	-0.48*** (-13.51)	-0.61*** (-21.49)
	<i>lnr_{er}</i>	0.09 (0.16)		0.95*** (0.24)	0.09 (0.18)		0.87*** (0.25)	-0.46*** (-11.12)	
	<i>lnr_{er}*iit</i>		-0.46*** (0.15)	-0.92*** (0.11)		-0.31** (0.15)	-0.81*** (0.12)		-0.28*** (-14.19)

t-Statistic in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Source: Authors' calculations.

the region. In other words, the low proportion of products exported by the WAEMU region in the manufactured goods it imports has a negative impact on its long-term trade balance. Moreover, when net exports increase, they influence domestic income and therefore imports (Prakash & Maiti, 2016). The

increase in income will encourage consumption of foreign goods. This limits the effect of a change in the real exchange rate on net exports after a certain time, and tends to show a cyclical movement in net exports in response to this change, particularly for economically import-dependent countries. Domestic production has a positive impact on the balance of trade, increasing exports. On the other hand, an increase in foreign income or foreign production worsens the WAEMU area's trade balance. This is because higher foreign income stimulates consumption of increasingly sophisticated, and therefore manufactured, goods. Consequently, a preference for manufactured goods does not improve the trade balance. On the other hand, trade policy in the countries of the region facing foreign products must take measures to encourage the import of goods or services with a high content of products that the region exports. Table 4 shows the short-term results with a statistically significant adjustment coefficient to ensure that the series are not explosive for long-term equilibrium across all countries. The speed of adjustment varies from 36 to 1.12% in model 1, and in approximately the same proportions as in model 2. Overall, a deviation of the trade balance from its long-term equilibrium due to a shock in a previous year is corrected by approximately 70% in the current year. The coefficients of the effective exchange rate are statistically insignificant for all WAEMU countries in the short term in the estimated model 1. However, its degree of trade dependence worsens its trade balance in the short term in the post-devaluation period in 1994. This is due to the fact that WAEMU countries' imports contain only a small proportion of the raw materials they export to their trading partners. Considering the real exchange rate coefficients in estimated models 1 and 2 in both the short and long term, the J-curve hypothesis is not observed in WAEMU countries. This result corroborates those of Keho (2021b).

We applied Granger's non-causality test approach to panel data (Xiao et al., 2023) with Juodis et al. (2021) program. This test takes into account the presence of heterogeneity within the panel just like the Dumitrescu and Hurlin (2012) test and, is suitable for small sample sizes. The results of the panel causality test of Juodis et al. (2021) (Cf. Table 5) reveal that changes in the model's explanatory variables significantly lead to changes in the trade balance. However, the zero hypotheses for the real effective exchange rate not leading to a stable trade balance can be rejected at the 5% level for Benin, Burkina-Faso, Côte d'Ivoire, Mali, Niger, Senegal.

By creating a monetary union, the WAEMU countries have abandoned the nominal exchange rate as an adjustment variable. On the one hand, within the WAEMU zone, trade imbalances can no longer be reduced by depreciating the currencies of deficit countries and appreciating those of surplus countries. On the other hand, the countries of the WAEMU zone have the same nominal exchange rate with external countries, even though their levels of productivity and competitiveness differ. From a theoretical point of view, the strengths and weaknesses of the WAEMU currency are linked to the conditions required to form an "optimal monetary zone", to use the concept introduced by Mundell.

6. Conclusion

The aim of this article was to analyze the role of the nature of traded goods in the effect of the real exchange rate on the trade balance of WAEMU countries. Firstly, the low level of intra-industry trade between WAEMU countries and their trading partners diminishes the positive effect of exchange rate movements on the balance of trade. Secondly, foreign income levels are less favourable to the countries' balance of trade, as partners have a preference for increasingly sophisticated goods that WAEMU countries do not produce. Thirdly, the J-curve hypothesis is not observed in WAEMU countries. In the long term, the real effective exchange rate improves the trade balance of WAEMU countries. However, this improvement is lessened by the fact that the that WAEMU countries export raw materials which are used by their foreign trading partners to manufacture end products which WAEMU countries import in turn; but the percentage of the raw materials used in the manufacture of those end products is so negligible as to have a beneficial impact in the balance of trade for the WAEMU countries. Looking at individual countries, the real exchange rate has a different influence on the balance of trade. A trade policy favouring imports of manufactured goods with a high level of exports (raw materials) would significantly improve the trade balance through the promotion of regional value chains. In this case, domestic production of manufactured goods should be encouraged with regard to international trade regulations.

Table 5. Panel causality test by Juodis et al. (2021).

Variables	Benin	Burkina Faso	Côte d'Ivoire	Mali	Niger	Senegal	Togo	WAEMU
Dependent variable : lbc								
L.lnyd	−0.38 (1.32)	−4.07 (2.94)	−0.61*** (0.17)	2.91*** (1.02)	10.09*** (1.82)	−5.23*** (1.51)	1.02** (0.50)	0.52*** (0.16)
L.lnyf	0.01 (0.7)	1.76 (3.22)	0.78** (0.30)	−2.12*** (0.68)	−9.27*** (1.51)	4.84*** (1.62)	−1.31** (0.63)	−0.34*** (0.13)
L.lnrr	1.27*** (0.32)	2.33*** (0.76)	0.89** (0.38)	1.46** (0.71)	−1.80** (0.79)	1.22** (0.56)	0.54 (0.39)	−0.19 (0.15)
L.lnrr*lit	−1.04*** (0.40)	−1.37** (0.69)	−0.46* (0.23)	−0.34 (0.46)	0.07 (0.32)	−0.58 (0.50)	0.23 (0.24)	0.26*** (0.08)
HPJ Wald test	34.47	40.22	16.54	64.37	54.87	27.89	44.06	16.48
p-Value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Standard errors in brackets. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Source: Authors' calculations.

Note

1. Grubel and Lloyd (1975) -the index of intra-industry trade is derived using the following formular: $IIT_i = 1 - \frac{\sum |X_{it} - M_{it}|}{\sum |X_{it} + M_{it}|}$ (3)

Acknowledgment

No funding or grant was received.

Author contributions

Dr. Camille Detondji GUIDIME, is in the conception and design of this article, in analysis and interpretation of the data, the drafting of the paper. Dr. Camille Detondji GUIDIME, Professor Adama DIAW, and Professor Barthélémy BIAO involved in revising the paper critically for intellectual content and the final approval of the version to be published. All authors agree to be accountable for all aspects of the work.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

All data are available on world development indicator from World bank and Central Bank of West African States (BCEAO). And the authors are agree to make data and materials supporting the results or analyses presented in the paper available upon reasonable request.

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