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Research article

Degree of sustainability of current account: evidence from Côte d'Ivoire using a non-linear approach

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ABSTRACT

The current account deficit is a macroeconomic indicator that provides information on the health of an economy. Its sustainability is particularly crucial for developing countries such as Côte d'Ivoire, one of the largest economies in West Africa. Given the country's exposure to external vulnerability, this paper analysed the degree of sustainability of its current account. Beyond this, the study looked at the resilience of the economy to external shocks by examining how exports behave following an asymmetric shock on imports plus interest on external borrowing. To this end, the model developed by Shin et al. (2014) was applied to the intertemporal approach to current account sustainability using quarterly macroeconomic data from 1985q1 to 2017q4. The study found that Côte d'Ivoire's current account balance is sustainable. However, this sustainability is weak in the sense of Hakkio and Rush (1991), thus leading to a high risk of government failure in this respect. Also, the study shows that exports react differently to asymmetric shocks on increased imports, with a return to equilibrium often very slow. Therefore, the strengthening and stability of the socio-political environment is to be encouraged, as well as the implementation of policies aimed at sound public finance management and minimising the economy's vulnerability to external shocks.

1. Introduction

The current account is one of the components of the balance of payments, which covers all transactions in goods, services, income flows and current transfers between an economy and the rest of the world. Its balance is an important macroeconomic indicator. Indeed, its short-run evolution is able to provide information on the national and international economic situation. In the long run, it can provide information on the competitiveness of the economy.

The issue of the current account deficit sustainability is debated in the sense that it may be synonymous with a healthy economy or, on the contrary, may be a symptom of distortions in the domestic economy that could harm growth. Some argue that the current account deficit is sustainable if the ratio of net external assets as a percentage of GDP is stable or declining over time (Milesi-Feretti and Razin, 1996; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2012). For others, it is if the country is able to meet its intertemporal budget constraint (Taylor 2002; Obstfeld and Rogoff, 1995; Trehan and Walsh, 1991; Husted, 1992). The latter view, although having received much attention in the economic literature, has led to contradictory results due to differences in methodological approaches and countries considered. However, one of the potential problems in obtaining same results is that the current account is likely to adjust non-linearly (Chortareas et al., 2004; Christopoulos and Leon-Ledesma, 2010).

This non-linear adjustment of the current account, which is generally attributable to transaction costs, as well as to the twin-deficit channel and the level of indebtedness of countries (Chortareas et al., 2004), seems to be the case for countries of the West Africa Economic and Monetary Union (WAEMU). Indeed, the fiscal and current account balances of the WAEMU are structurally in deficit, leading these countries to rely mainly on external debt to absorb their deficits (IMF, 2017). This recourse, reinforced by WAEMU Regulation No. 06/2001 on Treasury Bills and Bonds issued by tendering procedure by member states of the Union (BCEAO 2013), is likely to support this non-linearity in the adjustment of the current account deficit of the sub-region. In addition, policies that aim to reduce the use of external debt to finance the current account deficit may be a source of asymmetric adjustment of the current account deficit since this may reflect the reluctance of governments to finance the

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deficit in relation to its long-run balance (Christopoulos and Leon-Ledesma, 2010; Dissou and Nafie, 2019).

Among the WAEMU countries, Côte d'Ivoire has the role of locomotive with nearly 40% of the sub-region's GDP. The sustainability of Côte d'Ivoire's current account is of major importance for the country, but also for the entire WAEMU area, to avoid, among other things, harmful excessive debt.

Côte d'Ivoire's current account has evolved erratically. In 1985, it recorded a surplus balance of 0.9% of GDP in current dollars. The decade that followed (1986–1999) saw a surplus except in 2004 and 2007 when the deficits were 0.33 and 0.6% of GDP, respectively. From 2012 to 2017, the current account balance showed an average deficit of 1.55% of GDP, except in 2014, when it recorded a surplus of 1.44% of GDP (International Debt Statistics, 2019; World Bank, 2019). However, the country recorded the most promising average balances over the period as a whole, making it clear that the sustainability of the entire WAEMU zone is dependent on the sustainability of Côte d'Ivoire's current account (BCEAO 2013).

The country's strong growth in recent years and its continuation are the result of an increased macro prudential framework and large investments rich in foreign goods and services. This could eventually lead to a larger deficit and higher external debt. External indebtedness as an alternative to deficit financing and growth appears to be constraining facing the country's certain exposure to external vulnerability, since the deterioration in the terms of trade, the low level of diversification of export products, the country's low level of industrialisation and the high dependence of export earnings on commodities remain important factors of external vulnerability. Thus, although the National Public Debt Committee (CNDP, 2016) indicates that Côte d'Ivoire's risk of over-indebtedness remains moderate, it is cautious about projections. For the latter, in the event of vulnerability to an adverse shock to macroeconomic conditions, issues of sustainability or current account viability will arise. That is to say, the realisation of trade surpluses will not make it possible to ensure the external commitments contracted.

In the light of the above, it is important to question the degree of sustainability of the Ivorian current account by adopting a non-linear analytical framework. Thus, under the hypothesis that the current account deficit is sustainable in the weak sense, the present study aims to investigate the degree of sustainability of the Ivorian current account through the approach developed by Hakkio and Rush (1991) and Husted (1992), i.e. by analysing the cointegration between exports and imports plus interest on external debt.

However, insofar as the various pressures on the Ivorian economy are likely to keep the current account below its equilibrium value in the long run, the adjustment speed can be modelled by a single-threshold model, which would moreover depend on the nature of the imbalance, as Balke and Fomby (1997) pointed out. Thus, the analysis of current account sustainability in the non-linear framework must consider the sign and magnitude of the imbalance in its asymmetric adjustment speed towards its long-run equilibrium level (Chen, 2014; Chen and Xie, 2015). Moreover, an important aspect of non-linearity is that even if the current account meets the conditions for long-run sustainability, persistent short-run deficits may jeopardize its future sustainability (Raybaudi et al., 2004). For all these reasons, we apply the autoregressive distributed lag model in the non-linear framework developed by Shin et al. (2014) to examine the sustainability of the current account of Côte d'Ivoire. This model, in addition to jointly modelling asymmetries and cointegration dynamics in a single step around a zero threshold, considers both short- and long-run dynamics and then allows for asymmetric adjustment profiles from positive and negative shocks to the regressors.

The contribution of this paper is twofold. First, it highlights the fragility of the sustainability of Côte d'Ivoire's current account and proposes to implement better economic policies to ensure its sustainability. Second, the methodological approach confirms the options for analysing current account sustainability with a NADRL-type model (Nonlinear Autoregressive distributed lag model).

The paper is divided into five main sections. The first and second sections present, respectively, the literature review and the theoretical approach. The third section deals with the stylised facts. The fourth section addresses the empirical approach used. The fifth section leads the results analysis and the discussions. The study ends with the conclusion recalling the main findings and policy implications.

2. Literature review

Theoretically, the sustainability of an economy's current account balance is assessed in relation to its intertemporal budget constraint. Thus, the balance is sustainable when the present value of its future trade surpluses equals the current level of debt. Generally, the criterion used is that the current account deficit ratio as a percentage of GDP should not exceed 5%, in which case it would become worrying (Summers, 1996; Summer, 2004; Milesi-Ferretti and Razin, 1996). However, it should be recalled that the literature on the sustainability of the current account deficit has generally adopted two analytical frameworks. The first follows an accounting framework in which the current account is sustainable if the ratio of net external assets as a percentage of GDP is stable or declining over time. Some work that addresses this considers the valuation effects of international portfolio asset price changes and their effects on current account dynamics (Milesi-Feretti and Razin, 1996; Gourinchas and Rey, 2007; Lane and Milesi-Ferretti, 2012). The second framework essentially relies on two approaches to account for the sustainability of an economy's current account. These approaches, based on theories of intertemporal budget constraint, suggest relying on the univariate and bivariate properties of time series. Basically, the idea is to know whether a country is able to meet its long-run intertemporal budget constraint without resorting to drastic policies or a sharp change in its domestic absorption (Hakkio and Rush, 1991; Taylor, 2002).

Trehan and Walsh (1991) will show that the stationarity of a country's current account is a sufficient condition for the sustainability of the intertemporal budget constraint and thus for its current account deficit. This assertion, which according to Obstfeld and Rogoff (1995), is compatible with modern intertemporal balance-of-payments theory, will be taken up by many other authors in the analysis of the sustainability of the current account of several economies. Other studies will show that a stationary current account balance is a sufficient condition for current account sustainability, but this stationarity is not a necessary condition for external debt sustainability (Bohn, 2007). Indeed, the work of Husted (1992) already indicated that under the null hypothesis that the economy satisfies its intertemporal budget constraint, exports and imports are expected to have a cointegrating relationship with the cointegrating vector (1, -1).

However, the econometric literature shows that the presence of non-linearity in the data generating process of the current account tends to invalidate the unit root and cointegration tests commonly used because the latter in this case have a low power. To this end, Christopoulos and Léon-Ledesma (2010) using smooth transition autoregressive (STAR) modelling find that the dynamics of the US current account are non-linear and sustainable. Chen (2011) using Markov chains shows that the intertemporal budget constraint is not sustainable for several European countries. Topalli and Dogan (2016) find that the current account in Turkey is weakly sustainable. Ordoñez-Callamand et al. (2018) use a threshold error correction vector model and find the current accounts of five Latin American countries to be sustainable.

While for some, non-linearity may be due to the presence of structural breaks that would tend to distort the examination of current account sustainability (Liu and Tanner, 1996; Kónya, 2009; Andre et al., 2018), for others, it has to consider the sign and magnitude of shocks in the process of current account adjustment. This is because the current account reacts differently depending on the sign of the shock, but also because larger deviations from the long-run equilibrium value of the current account lead to faster asymmetric adjustments (Clarida et al., 2006; Kim et al., 2009). To this end, Chen (2014) and Chen and Xie

(2015) in their work simultaneously consider asymmetric size, sign and smooth break effects to highlight the current account sustainability in nine European countries. Kuo (2016) highlights the influence of shocks of different signs and magnitudes on current account sustainability in 6 Asian countries.

In sum, a multitude of studies on the issue have emerged on data from American and European countries (Irandoust and Sjöö, 2000; Apergis et al., 2000; Arize, 2002; Llorca, 2017; Monastiriotis and Tunali, 2019; Afonso et al., 2019) but a handful of studies exist only in the African case and even less in sub-Saharan Africa.

Considering a set of African countries, Osakwe and Verick (2009) examine the sustainability and determinants of current account deficits in the short and medium run. Their study reveals that countries are more likely to have a deficit above 5 per cent if the economy is small, less open, undiversified and experiences macroeconomic instability. In Nigeria, Egwaikhide (1997) using a macro-econometric model highlights the effect of the budget deficit on the current account and arrives at the fact that it is necessary for the country to observe some fiscal discipline to achieve external balance. Adedeji (2001) finds that during the period 1960–1997, Nigeria's current account deficit was sustainable, but macroeconomic instability and weak economic structure were likely to lead to current account crises. Shuaibu and Oyinlola (2017) re-examine the sustainability of Nigeria's current account over four decades using time series analysis on annual data between 1981 and 2013 and then find that the current account is sustainable despite structural changes suggesting that exports were able to finance imports. Djeutem and Nguimkeu (2013) use two approaches to investigate the sustainability of the current account deficit in Cameroon over the period 1970–2002. The first uses a structural procedure to compare the deficit to an optimal benchmark using Campbell-Shiller's (1987) methodology. The second uses a reduced-form approach to test the intertemporal budget constraint through tests of cointegration between imports and exports plus net transfers on foreign bonds. All these techniques indicate that Cameroon's current account imbalance is excessive and that in its current state, this deficit is unsustainable. Andre et al. (2018) analyse the sustainability of the current account of several BRICS countries within the framework of the intertemporal budget constraint. Considering structural breaks in the data on quarterly current account balances as a percentage of gross domestic product, they show that only South Africa's current account is sustainable compared to those of India and Brazil. Adamu and Audu (2018) in a study of all Economic Community of West African States (ECOWAS) countries during the period 2000 to 2016 show that the sustainability of the current account deficit of the area depends on the promotion of foreign direct investment and the substitution of imported goods for local products. Dissou and Nafie (2019) argue that, in the case of Egypt, the reaction of exports to negative and positive import shocks ensures current account sustainability.

In the light of the lessons of the literature, the degree of sustainability of the current account must consider an analytical framework that proposes necessary and sufficient conditions for its examination as discussed by Bohn (2007). Thus, the following section presents the relevant theoretical framework.

3. Theoretical approach

In our work, we base ourselves on the theoretical approach developed by Hakkio and Rush (1991) and Husted (1992). Let us consider a small open economy such as that of Côte d'Ivoire, whose budgetary constraint in the current period can be expressed as:

$$C_0 = Y_0 + B_0 - I_0 - (1 + r_0)B_{-1} \tag{1}$$

With $C_0, Y_0, B_0, I_0, (1+r_0)B_{-1}$ representing respectively current consumption, current production, international borrowing, capital expenditure, repayment of the debt in precedent period plus interest payments. r_0 is the world interest rate.

The Intertemporal Budget Constraint (IBC) can be obtained as the sum of budget constraints period by period. The latter is expressed as follows:

$$B_t = \sum_{i=1}^{\infty} \phi_i (Y_{t+i} - C_{t+i} - I_{t+i}) + \lim_{i\to\infty} \phi_i B_i \tag{2}$$

Knowing that $Y_t - C_t - I_t = X_t - M_t = BC_t$ with X_t, M_t and BC_t representing respectively exports, imports and trade balance in period t; Eq. (2) can be rewritten as follows:

$$B_t = \sum_{i=1}^{\infty} \phi_i (BC_{t+i}) + \lim_{i\to\infty} \phi_i B_i \tag{3}$$

With ϕ_i the discount factor. Also, the last term of Eqs. (2) and (3) reflect the fact that when the limit $\lim_{i\to\infty} \phi_i B_i$ is zero; the amount of Côte d'Ivoire's borrowing equals the present value of future trade surpluses.

Assuming that the world interest rate is stationary with an unconditional average r, Eq. (3) can be expressed as:

$$M_t + rB_{t-1} = X_t + \sum_{i=0}^{\infty} \frac{\Delta X_{t+i} - \Delta Z_{t+i}}{(1+r)^{i-1}} + \lim_{n\to\infty} \frac{B_{t+i}}{(1+r)^{i-1}} \tag{4}$$

With $Z_t = M_t + (r_t - r)B_{t-1}$. However, the left-hand side of Eq. (4) represents the value of imports and interest on external borrowing. The current account balance of Côte d'Ivoire is obtained by subtracting X_t from both sides of Eq. (4) and multiplying by -1. This gives the following current account equation:

$$CC = X_t - M_t - rB_{t-1} = \sum_{i=0}^{\infty} \frac{\Delta X_{t+i} - \Delta Z_{t+i}}{(1+r)^{i-1}} - \lim_{n\to\infty} \frac{B_{t+i}}{(1+r)^{i-1}} \tag{5}$$

Assuming that X and Z are integrated of order 1 and that the last right-hand term of Eq. (5) is zero, then by adding a residual term, we can have the following writing:

$$X_t = \alpha_0 + \alpha_1 M^* + \varepsilon_t \tag{6}$$

with $M^* = M_t + rB_{t-1}$. Note that M measures imports of goods and services and rB_{t-1} measures unilateral transfers, i.e. interest payments on external debt. Thus, the satisfaction of the necessary condition of the intertemporal budget constraint requires the satisfaction of a stationary error structure. In other words,ε_t must be stationary in level. Hence, if, X and M^* are integrated of order 1 and co-integrated with $\alpha_1 = 1$ then the current account balance of Côte d'Ivoire is sustainable in the strong sense (Hakkio and Rush, 1991). However, if X and M^* are not co-integrated, then this would mean that the Ivorian economy is unable to meet its intertemporal budget constraint, leading to a default on its external borrowings (Husted, 1992).

However, Hakkio and Rush (1991) point out that, if X and M^* are non-stationary variables in level, condition $0 < \alpha 1 < 1$ is a sufficient condition for the budget constraint to be respected but, in this case, it is weak. Indeed, low sustainability is certainly compatible with the intertemporal budget constraint, but in this case, the undiscounted value of the debt increases infinitely and the incentive for government default increases (Hakkio and Rush, 1991; Ordoñez-Callamand et al., 2018).

4. Stylised facts about the current account in Côte d'Ivoire

Côte d'Ivoire's current account balance remains marked by more than a decade of deficit from 1986 to 1999. However, the years preceding the devaluation of the CFA franc were marked by excessive current account deficits, averaging more than 9.18% of current GDP between 1986 and 1993 (see Figure 1). This period was one of the country's darkest periods, as the country was characterized by the persistence of a sluggish economic situation, the manifestations of which were deceleration of growth, fairly significant demographic change, low investment, and

specialization based on primary products whose world prices remained unstable.

From 1994, the devaluation of the currency allowed gains in competitiveness and an increase in exports. This led to a continuous reduction of the deficit over the next five years, reaching an average deficit of 1.77% of GDP between 1994 and 1999. Starting in 2000, the current account returned to a surplus of 0.8% of GDP. This trend will continue until 2012, except for the years 2004 and 2007, when the balance recorded deficits due to soaring food and energy prices. Performance over the period was also the result of the improvement in commodity prices, particularly for the coffee and cocoa couple, which accounts for the largest share of the country's commodity exports, but also by the fall in interest payments on the public debt, in line with the relief granted to the country, and the reduction in certain types of heavy investment following the political and military crisis in 2002 (see Figure 2).

Between 2012 and 2017, the current account balance was in deficit except in 2014. These deficits over the period are attributable to increased imports of goods and services following investments in mining, telecommunications and economic and social infrastructure to revive the economy following the post-election crisis.

5. Empirical approach

It is undoubtedly obvious that positive or negative year-on-year changes in the current account are of quite significant interest in the implementation of macroeconomic policies. Indeed, reducing the deficit or increasing the current account balance is generally perceived as a performance of the economy, whereas a reduction in the current account balance could be a cause for concern. The policies thus taken by the authorities may vary according to the positive or negative evolution of the current account balance. In addition, certain economic policies and the stock of debt are likely to keep the current account balance below its equilibrium value in the long run. Therefore, the study of the cointegration between exports and imports plus interest on external debt can be carried out using a non-linear single-threshold model.

Also, the work on current account sustainability in the non-linear framework has generally been inspired by the work of Balke and Fomby (1997), Psaradakis et al. (2004) including Markov chains or the smooth transition one developed by Kapetanios et al. (2006). However, these models require that the cointegrating relationship be represented as a linear combination of non-stationary variables. In addition to this restrictive hypothesis, the cointegrating relationship may be subject to asymmetry. Also, the difficulties in identifying functional forms of transition and threshold variables make it difficult to accept a specification which considers both short and long run dynamics (Shin et al., 2014).

However, Enders and Granger (1998) and Enders and Siklos (2001) modified the standard Dickey-Fuller cointegration test so that the hypothesis of a cointegrating relationship could be tested without maintaining the symmetry hypothesis in the long run adjustment. However, their model shows that, on average, 90% of the positive deviation from one period to the next persists while only 50% of a negative deviation persists, which would imply in our case that policy makers should be tolerant to a worsening of the current account deficit given the adjustment speed. In line with the proposals made by Caner and Hansen (2001), Enders and Siklos (2001) propose to study cointegration with an autoregressive threshold model, which this time is called Momentum-TAR. However, the problem is that the asymptotic distribution of the test statistics of the null hypothesis of symmetry or linearity are not only non-standard but also dependent on the transition variable (Shin et al., 2014). More importantly, tests for long-run asymmetry become invalid in cases of small sample sizes or slow adjustment speed (Schild and Schweikert, 2019).

For this paper we use an asymmetric cointegration test based on the partial sums of the positive and negative variations of the explanatory variable. Indeed, this type of model was initiated by Schorderet (2001) then extended by Granger and Yoon (2002) under the concept of "hidden cointegration". But it is Schorderet (2003) who generalises the concept by giving a linear combination of the partial sums of the variables concerned as follows:

$$Z_t = \beta_0^- y_t^- + \beta_0^+ y_t^+ + \beta_1^- x_t^- + \beta_1^+ x_t^+ \tag{7}$$

With β_0, β_1 the parameters;

$$x_t^+ = \sum_{i=1}^{t} \Delta x_t^+ = \sum_{i=1}^{t} \max(\Delta x_t, 0);$$

$$x_t^- = \sum_{i=1}^{t} \Delta x_t^- = \sum_{i=1}^{t} \min(\Delta x_t, 0);$$

$$y_t^+ = \sum_{i=1}^{t} \Delta y_t^+ = \sum_{i=1}^{t} \max(\Delta y_t, 0);$$

$$y_t^- = \sum_{i=1}^{t} \Delta y_t^- = \sum_{i=1}^{t} \min(\Delta y_t, 0)$$

Thus, if Z_t is stationary then y_t and x_t are said to be asymmetrically cointegrated. Note that when $\beta_0^- = \beta_0^+$ and $\beta_1^- = \beta_1^+$, this is a specific case where the cointegration is symmetrical or linear. However, Lardic and Mignon (2008) show that in this form, the estimated coefficients of asymmetric cointegration are difficult to interpret economically. Thus, to overcome this shortcoming, Shin et al. (2014) impose certain restrictions on the model by considering that $\beta_0^- = \beta_0^+ = \beta_0$ such as $\beta^+ = -\beta_1^+/\beta_0$ and $\beta^- = -\beta_1^-/\beta_0$ in the following long-run asymmetric relationship:

$$y_t = \beta^- x_t^- + \beta^+ x_t^+ + u_t \tag{8}$$

However, it is the strategy of cointegration at the bounds of Pesaran et al. (2001) that is taken up by Shin et al. (2014) to test cointegration in the asymmetric framework.

As for estimating the relationship, they generally use Engel-Granger's two-step technique, which is found to be less efficient than the one-step error correction method (Shin et al., 2014). Also, a relatively important conclusion is that the direction of asymmetry can shift between the short and long run. For example, a positive shock may have a larger absolute effect in the short run while a negative shock may have a larger absolute effect in the long run (or vice versa). For example, Shin et al. (2014) developed the non-linear autoregressive distributed lag (NARDL) model, which has significant advantages over existing methodologies by

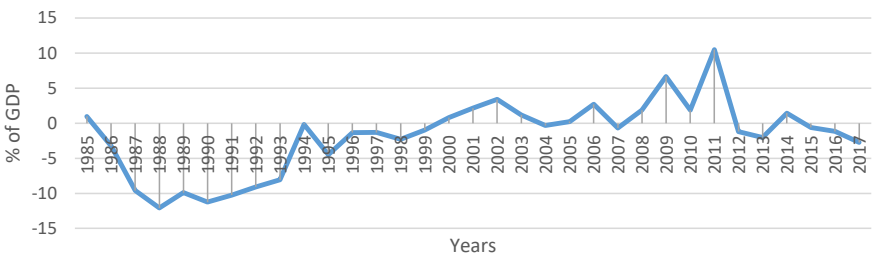

Figure 1. Evolution of the current account balance (% of GDP) of Côte d'Ivoire. Source: Author based on WDI from World Bank (2020b) and World Debt Statistics data from World Bank (2020a).

Table 1. Tests prior to estimates.

Augmented Dickey-Fuller test		
Variables	in Level	in Difference
Exports	-0.504 (0.885)	-3.448** (0.011)
Increased Imports	-0.103 (0.945)	-3.965*** (0.002)
Asymmetric Cointegration test		
F-Statistics = 8.588***	lower Bound	upper Bound
Asymptotic statistics	4.13	5
Finite sample statistics	4.358	5.393

Values in parentheses represent p-value. **(***) represents the level of significance at the 5% (1%) threshold.
Source: Author based on WDI from World Bank (2020b) and World Debt Statistics data from World Bank (2020a).

Table 2. Estimations results.

Conditional Error Correction Regression				
Variable		Coefficient	Std. Error	Probability.
EXPORT (-1)	ρ	-0.087***	0.016	0.000
IMPORT_POS(-1)	θ^+	0.067***	0.016	0.000
IMPORT_NEG	θ^-	0.026***	0.016	0.000
D (EXPORT(-1))	γ_j	0.891	0.046	0.105
D (IMPORT_POS)	ϕ_j^+	0.415***	0.086	0.000
D (IMPORT_POS(-1))	ϕ_j^+	-0.307***	0.084	0.000
Long run regression				
IMPORT_POS	β_1	0.776***	0.064	0.000
IMPORT_NEG	β_2	0.300**	0.150	0.048
CONSTANT TERM	β_0	9.439***	0.012	0.000
Error Correction Term		-0.087***	0.014	0.000

**(***) represents the level of significance at the 5% (1%) threshold.
Source: Author based on WDI from World Bank (2020b) and World Debt Statistics data from World Bank (2020a).

allowing asymmetries and cointegration dynamics to be modelled jointly in a single step, thus improving the cointegration test performance on small samples. They derive asymmetric cumulative dynamic multipliers that allow to plot asymmetric adjustment profiles from positive and negative shocks to regressors. In addition, their model provides flexibility by relaxing the hypotheses of the Error Correction Method regarding the time series properties of the variables into which they are to be integrated of the same order. Based on the fact that Eq. (6) can be specified as an asymmetric equation, we have the following:

$$X_t = \beta_0 + \beta_1 M_t^{*+} + \beta_2 M_t^{*-} + \varepsilon_t \tag{9}$$

With $(\beta_0, \beta_1, \beta_2)$ the parameters of the cointegrating vector, X the exports, M_t^{*+}, M_t^{*-} which represent the partial sums of the positive and negative variations of the increased imports of which:

$$M_t^{*+} = \sum_{i=1}^{t} \Delta M_t^{*+} = \sum_{i=1}^{t} \max\left(\Delta M_t^*, 0\right) \tag{10}$$

$$M_t^{*-} = \sum_{i=1}^{t} \Delta M_t^{*-} = \sum_{i=1}^{t} \min\left(\Delta M_t^*, 0\right) \tag{11}$$

According to Shin et al. (2014), Eq. (7) can be put into the form of an error-correction model as follows:

$$\Delta X_t = \alpha + \sum_{j=1}^{p} \varphi_j X_{t-j} + \sum_{j=0}^{q} \left(\theta_j^+ M_{t-j}^{*+} + \theta_j^- M_{t-j}^{*-}\right) + \varepsilon_t \tag{12}$$

Where φ_j is the autoregressive parameter, $\theta_j^+ and\ \theta_j^-$ are the asymmetric parameters of distributed lags, ε_t is an iid process with zero mean and constant variance. According to Pesaran et al. (2001), the representation of the error-correction model becomes:

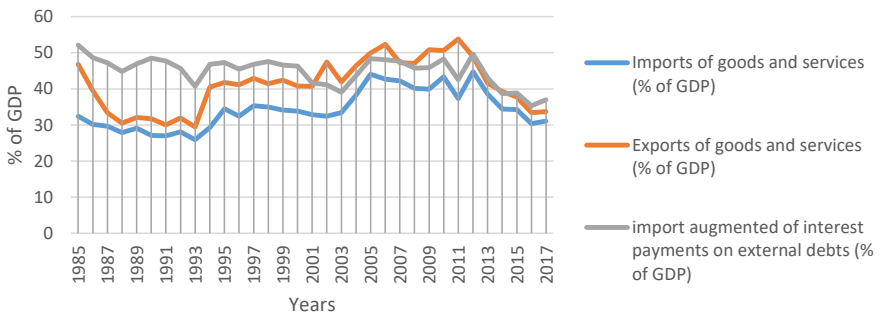

Figure 2. Evolution of Côte d'Ivoire's international trade (% of GDP). Source: Author based on WDI from World Bank (2020b) and World Debt Statistics data from World Bank (2020a).

$$\Delta X_t = \alpha + \rho X_{t-1} + \theta^+ M^+_{t-1} + \theta^- M^-_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta X_{t-j} + \sum_{j=0}^{q-1} \left(\phi_j^+ \Delta M^+_{t-j} + \phi_j^- \Delta M^-_{t-j} \right) + \varepsilon_t \quad (13)$$

Where $\beta_1 = -\frac{\theta^+}{\rho}$ *and* $\beta_2 = -\frac{\theta^-}{\rho}$ represent the long-run effects of increased and reduced imports on exports respectively.

Ordinary Least Squares (OLS) estimation of Eq. (13) requires that the variables are first integrated of an order less than 2 and cointegrated. For this purpose, we use Augmented Dickey-Fuller tests as a unit root test. However, it is important to note that in the case where the long run response is symmetric ($\theta^+ = \theta^-$) and the short term adjustment is also symmetric ($\phi_j^+ = \phi_j^-$ for any j from 0 to q), NARDL is reduced to its linear form i.e. to the autoregressive distributed lag (ARDL) model.

In case the above restrictions are rejected, the cumulative positive and negative multipliers corresponding to the unit changes of M^{*+} *and* M^{*-} are obtained by:

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial X_{t+j}}{\partial M_j^{*+}} \text{ and } m_h^- = \sum_{j=0}^{h} \frac{\partial X_{t+j}}{\partial M_j^{*-}}, \text{ With } h = 0,\ 1,\ 2,\ \ldots \quad (14)$$

Thus, when h tends towards infinity, m_h^+ and m_h^- tend respectively towards their asymmetric coefficients $\beta_1 = -\frac{\theta^+}{\rho}$ *and* $\beta_2 = -\frac{\theta^-}{\rho}$.

The power of NARDL lies in the fact that it allows the simultaneous analysis of short- and long-run asymmetries while highlighting the transition between short-run imbalance and long-run equilibrium (Shin et al., 2014).

6. Results and discussion

Examination of Table 1 shows that our different variables are integrated of order 1, thus confirming the absence of a variable integrated of a higher order that would invalidate the use of an ARDL model. The cointegration analysis indicates that the calculated value of the F-statistic of the bounds cointegration test is higher than the theoretical value of its upper bound at the 1% threshold, thus confirming the existence of asymmetric cointegration between exports and increased imports.

However, in view of the five possibilities offered by the ARDL model, the choice was made for the model referring to Case II, i.e. the model with constant constraint but without trend. As for the choice of the optimal number of lags, Schwartz's Bayesian criterion allowed to retain a maximum number of lags equal to 2 as recommended by Pesaran et al. (1999).

Before analysing the estimates result, it should be recalled that various diagnostic statistics (post-estimation) have made it possible to judge the adequacy of the dynamic specification (see appendix, Table A3). These include residue validation tests, model stability and justification of asymmetric effects. In this respect, the Breusch-Pagan-Godfrey and Jarque-Bera tests show that the residuals are homoscedastic and normal. The CUSUM-square test indicates a high stability of the model. As for the validity of the asymmetric representation of the effect of positive and negative partial sums of increased imports on exports, the Wald test rejects the null hypothesis of the symmetric effect of increased imports on exports in the long run. Furthermore, the error-correction coefficient, which is the restoring force to long-run equilibrium, is negative and significant at the 5% threshold, indicating that the NARDL representation is valid (Table 2). However, a coefficient of -0.087 indicates a low speed of convergence towards long-run equilibrium. This implies that short-run deviations from the long-run equilibrium of the current account balance are corrected by 8.7% per year by feedback effect.

However, the estimated coefficients of the long-run effects of positive and negative changes in increased imports are 0.77 and 0.30 respectively. These results are in line with the Hakkio and Rush (1991) proposal which states that if exports and increased imports are non-stationary variables in level, a value between 0 and 1 of the estimated coefficients of imports on exports is a sufficient condition for the budget constraint to be respected in the weak sense. However, we look at how exports adjust to positive and negative shocks on increased imports. The dynamic multiplier of asymmetric effects associated with the response of exports to one-unit changes in the positive and negative partial sum of increased imports shows a rapid response of exports to the positive shock. In the case of the negative shock, the response is slower (Figure 3) with a slower return to equilibrium.

As with any economy, exports are of paramount importance to the country as they generate not only jobs, but also the foreign exchange needed to finance imports; in particular, the import of equipment needed for growth. Indeed, Côte d'Ivoire is heavily dependent on certain imported goods, including capital and intermediate goods, petroleum products, food products and other everyday consumer goods. In return, its external assets depend for the most part on the marketing of agricultural products with low added value, since the country is specialised in the production and export of raw materials.

Since exports generally have a high raw material content, the terms of trade are the primary source of external shocks since this variable is highly sensitive to price fluctuations on international markets. Thus, the widening of the current account deficit is caused by several factors, including commodity price volatility and deteriorating terms of trade.

Also, Côte d'Ivoire faces a weak mobilisation of internal resources, mainly tax revenues. This situation, which is likely to penalise the country's financing capacity, is a major cause of the budget deficit. An increase in the budget deficit tends to increase domestic absorption and, as a result, deteriorate the current account (Khan and Knight, 1983). Indeed, the budget deficit is usually accompanied by a corresponding increase in liquidity which, in turn, increases nominal private demand and reinforces the negative impact on current operations. Moreover, according to Feldstein (1992), the financing of the budget deficit affects

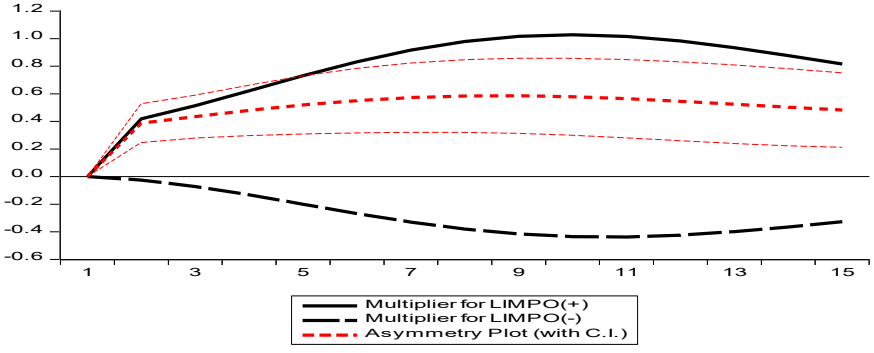

Figure 3. Cumulative multipliers of positive and negative shocks. Source: Author based on WDI from World Bank (2020b) and World Debt Statistics data from World Bank (2020a).

the level of real interest rates and is likely to crowd out private investment and net exports, which is worsening the trade deficit and thus of the current account.

These reasons were the cause of the economic and financial crisis of the 1980s and even of several other periods characterised by excessive current account deficits. Moreover, through the implementation of structural adjustment measures, the country has always strived to improve the business climate, with a view to increasing financing opportunities for the agricultural and industrial sectors and encouraging a greater inflow of foreign capital. Thus, between 2002 and 2012, with the improvement in the terms of trade and political instability leading to a relative decline in external debt, the country recorded positive current account balances except in 2007. But with the subsequent cancellation of the country's debt, following the return of economic, political and social stability, the country has regained investor confidence, resulting in a reduction in uncertainty and an increase in investments of all kinds and growth. However, given the surge in food and energy prices over the period, the current account balance returned to a deficit. Thus, the Ivorian current account balance is the result of a multitude of policies implemented to ensure its sustainability. However, efforts are still needed to ensure that this sustainability is strong.

7. Conclusion

Against the background of the strong growth experienced by Côte d'Ivoire in recent years and the evolution of its current account balance, it was important to investigate the degree of sustainability of the current account in order to propose appropriate economic policy measures to ensure that the country maintains sustainable macroeconomic indicators. Thus, the present study sought to examine the degree of sustainability of its current account. Beyond this, the study looked at the resilience of the economy to external shocks by looking at how exports behave following an asymmetric shock on imports plus interest on external borrowing. To this end, the model developed by Shin et al. (2014) was applied to the intertemporal approach to current account sustainability using quarterly macroeconomic data from 1985q1 to 2017q4. The study found that Côte d'Ivoire's current account balance is sustainable. However, this sustainability is weak in the sense of Hakkio and Rush (1991), thus leading to a high risk of government failure in this respect. Also, the study shows that exports react differently to asymmetric shocks on increased imports, with a return to equilibrium often very slow.

In view of these results, economic policy implications should be highlighted. These include continuing efforts to strengthen and consolidate the stability of the socio-political environment. Implementing a process of diversification of the economy so as to reduce the dependence of export earnings on certain products and minimise the vulnerability of the economy to external shocks. Strengthen and consolidate public finance management through sound mobilisation of domestic resources and rationalisation of expenditure for a better reduction of the country's budget deficit and debt levels.

Declarations

Author contribution statement

Hugues Kouassi Kouadio: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Romain Kouakou N'Guessan: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data associated with this study has been deposited online at https://databank.worldbank.org/source/world-development-indicators and https://data.worldbank.org/products/ids.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

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References

Adamu, P., Audu, J.G., 2018. Impact of trade balance on current account of ECOWAS member countries. Int. J. Trade Econ. Finance 9 (6), 269–272.
Adedeji, O.S., 2001. The Size and Sustainability of National Current Account Deficits. IMF Working Paper 01/87. International Monetary Fund, Washington DC.
Afonso, A., Huart, F., Jalles, J.T., Stanek, P., 2019. Assessing the sustainability of external imbalances in the European Union. World Econ. 42 (2), 320–348.
Andre, C., Balcilar, M., Chang, T., Gil-Alana, L.A., Gupta, R., 2018. Current account sustainability in G7 and BRICS: evidence from a long-memory model with structural breaks. J. Int. Trade Econ. Dev. 27 (6), 638–654.
Apergis, N., Katrakilidis, K.P., Tabakis, N.M., 2000. Current account deficit sustainability: the case of Greece. Appl. Econ. Lett. 7 (9), 599–603.
Arize, A.C., 2002. Imports and exports in 50 countries: tests of cointegration and structural breaks. Int. Rev. Econ. Finance 11, 101–115.
Balke, N.S., Fomby, T.B., 1997. Threshold cointegration. Int. Econ. Rev. 38, 627–645.
BCEAO, 2013. Analyse de la viabilité et des déterminants du déficit courant des pays de l'Union Économique et Monétaire Ouest Africaine (UEMOA). Revue Économique et Monétaire Ouest Africaine, pp. 1–58.
Bohn, H., 2007. Are stationarity and Cointegration restrictions really necessary for the intertemporal budget constraint? J. Monetary Econ. 54 (7), 1837–1847.
Campbell, J.Y., Shiller, R.J., 1987. Cointegration and tests of present value models. J. Polit. Econ. 95 (5), 1062–1088.
Caner, M., Hansen, B., 2001. Threshold autoregression with a unit root. Econometrica 69 (6), 1555–1596. November, 2001.
Chen, S.-W., 2011. Current account deficits and sustainability: evidence from the OECD countries. Econ. Modell. 28 (4), 1455–1464.
Chen, S.-W., 2014. Smooth transition, non-linearity and current account sustainability: evidence from the European countries. Econ. Modell. 38, 541–554.
Chen, S.-W., Xie, Z., 2015. Testing for current account sustainability under assumptions of smooth break and nonlinearity. Int. Rev. Econ. Finance 38, 142–156.
Chortareas, G.E., Kapetanios, G., Uctum, M., 2004. An investigation of current account solvency in Latin America using non linear nonstationarity tests. Stud. Nonlinear Dynam. Econom. 8 (1).
Christopoulos, D., León-Ledesma, M.A., 2010. Current account sustainability in the U.S.: what did we really know about it? J. Int. Money Finance 29 (3), 442–459.
Clarida, R.H., Sarno, L., Taylor, M.P., Valente, G., 2006. The role of asymmetries and regime shifts in the term structure of interest rates. J. Bus. 79 (3), 1193–1224.
CNDP, 2016. *Analyse de Viabilité de la Dette de la Côte d'Ivoire.* Ministère auprès du Premier Ministre Chargé de l'Économie et des Finances. Abidjan.
Dissou, Y., Nafie, Y., 2019. Sustainability of current account deficits: evidence from Egypt using an asymmetric ARDL model. J. Econ. Asymmetries 20 (2019), 1–11.
Djeutem, E.T., Nguimkeu, P.E., 2013. On the sustainability of current account deficits in Cameroon. Int. J. Econ. Financ. Issues 3 (2), 486–495.
Egwaikhide, F.O., 1997. Effects of Budget Deficits on the Current Account Balance in Nigeria. Research Paper 70. African Economic Research Consortium, Nairobi.
Enders, W., Granger, C.W.J., 1998. Unit-root tests and asymmetric adjustment with an example using the term structure of interest rates. J. Bus. Econ. Stat. 16, 304–311.
Enders, W., Siklos, P., 2001. Cointegration and threshold adjustment. J. Bus. Econ. Stat. 19, 166–176.
Feldstein, M., 1992. The Budget and Trade Deficits Aren't Really Twins. NBR Working Paper n 3966.
Gourinchas, P.-O., Rey, H., 2007. International financial adjustment. J. Polit. Econ. 115 (4), 665–703.
Granger, C.W.J., Yoon, G., 2002. Hidden Cointegration. University of California San Diego, Mimeo.
Hakkio, C.S., Rush, M., 1991. Is the budget deficit too large? Econ. Inq. 29 (3), 429–445.

Husted, S., 1992. The emerging US current account deficit in the 1980s: a cointegration analysis. Rev. Econ. Stat. 159–166.
IMF, 2017. West African Economic and Monetary Union : Staff Report on Common Policies of Member Countries. Country report no1799.
Irandoust, M., Sjöö, B., 2000. The behavior of the current account in response to unobservable and observable shock. Int. Econ. J. 14 (4), 41–57.
Kapetanios, G., Shin, Y., Snell, A., 2006. Testing for cointegration in nonlinear smooth transition error correction models. Econom. Theor. 22, 279–303.
Khan, M., Knight, M., 1983. Determinants of current account balances of non-oil developing countries in the 1970s: an empirical analysis. IMF Staff Pap. 30 (4), 819–843.
Kim, B.H., Min, H.G., Hwang, Y.S., McDonald, J.A., 2009. Are Asian countries' current accounts sustainable? Deficits, even when associated with high investment, are not costless. J. Pol. Model. 31 (2), 163–179.
Kónya, L., 2009. The sustainability of the current account in the Czech Republic, Hungary and Slovenia. Empir. Econ. 36 (2), 367–384.
Kuo, C.Y., 2016. Sustainability of current accounts: evidence form the quantile unit-root test. Appl. Econ. Lett. 23 (10), 747–755.
Lane, P.R., Milesi-Ferretti, G.M., 2012. External adjustment and the global crisis. J. Int. Econ. 88 (2), 252–265.
Lardic, S., Mignon, V., 2008. Oil prices and economic activity: an asymmetric cointegration approach. Energy Econ. 30, 847–855.
Liu, P.C., Tanner, E., 1996. International intertemporal solvency in industrialized countries: evidence and implications. South. Econ. J. 739–749.
Llorca, M., 2017. External Debt Sustainability and Vulnerabilities: Evidence from a Panel of 24 Asian Countries and Prospective Analysis. ADBI (Asian Development Bank Institute). Working Paper, No: 692, Asian.
Milesi-Ferretti, G.M., Razin, A., 1996. Persistent current account deficits: a warning signal? Int. J. Finance Econ. 1 (3), 161–181.
Monastiriotis, V., Tunali, C.B., 2019. The sustainability of external imbalances in the European periphery. Open Econ. Rev. 1–22.
Obstfeld, M., Rogoff, K., 1995. The intertemporal approach to the current account. Handb. Int. Econ. 3, 1731–1799.
Ordoñez-Callamand, D., Melo-Velandia, L.F., Valencia-Arana, O.M., 2018. Asymmetric behaviour of current account sustainability in Latin America. Int. Finance 21 (1), 2–22.
Current account deficits in sub-Saharan Africa: do they matter? In: Osakwe, P., Verick, S. (Eds.), 2009. Proceedings of the African Economic Conference, Paris.
Pesaran, M.H., Shin, Y., Smith, R.J., 2001. Bounds testing approaches to the analysis of level relationships. J. Appl. Econom. 16 (3), 289–326.
Pesaran, M.H., Shin, Y., Smith, R.J., 1999. Pooled mean group estimation of dynamic heterogeneous panels. J. Am. Stat. Assoc. 94, 621–634.
Psaradakis, Z., Sola, M., Spagnolo, F., 2004. On Markov error-correction models with an application to stock prices and dividends. J. Appl. Econom. 19, 69–88.
Raybaudi, M., Sola, M., Spagnolo, F., 2004. Red signals: current account deficits and sustainability. Econ. Lett. 84 (2), 217–223.
Schild, K.-H., Schweikert, K., 2019. On the validity of tests for asymmetry in residual-based threshold cointegration models. Econometrics 7 (12), 1–13.
Schorderet, Y., 2001. Revisiting Okun's Law: an Hysteretic Perspective. Mimeo: University of California, San Diego.
Schorderet, Y., 2003. Asymmetric Cointegration. University of Geneva, Mimeo.
Shin, Y., Yu, B., Greenwood-Nimmo, M., 2014. Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In: Festschrift in Honor of Peter Schmidt. Springer, pp. 281–314.
Shuaibu, M., Oyinlola, M.A., 2017. An empirical analysis of Nigeria's current account sustainability. J. Appl. Econ. Res. 11 (1), 54–76.
Summers, L.H., 1996. The Economist. Dec. 23 1995 – Jan. 5 1996, pp. 46–48.
Summers, L.H., 2004. "The United States and the Global Adjustment Process," Speech at the Third Annual Stavros S. Niarchos Lecture, March 23. Institute for International Economics, Washington.
Taylor, A.M., 2002. A century of current account dynamics. J. Int. Money Finance 21 (6), 725–748.
Topalli, N., Dogan, I., 2016. The structure and sustainability of current account deficit: Turkish evidence from regime switching. J. Int. Trade Econ. Dev. 25 (4), 570–589.
Trehan, B., Walsh, C.E., 1991. Testing intertemporal budget constraints: theory and applications to US federal budget and current account deficits. J. Money Credit Bank. 23 (2), 206–223.
World Bank, 2019. Cote d'Ivoire Economic Update, 2. World Bank Group, Washington, D.C. (French).
World Bank, 2020a. International Debt Statistics 2019.
World Bank, 2020b. World development indicators, data. Available at: https://databank.worldbank.org/source/world-development-indicators.