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Explanatory factors for the balance of current transactions in the CEMAC zone

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Abstract
Most of the countries in Central Africa have recorded current account deficits since the coronavirus pandemic in 2020. The aim of this article is to identify the main factors explaining the behavior of the current account balances of CEMAC member countries. Using a dynamic panel autoregressive distributed lag (ARDL) model, we use annual data for the period 1970-2018. The results indicate that there is a long-run relationship between the current account balance of the CEMAC countries and the explanatory variables (real exchange rate, terms of trade, domestic savings, GDP growth rate, domestic investment, inflation rate, oil price). We also show that domestic investment boosts the competitiveness of the countries concerned, that domestic savings are directed towards the consumption of foreign goods, that oil revenues do not fuel productive investment, and that there is a structural difference between the CEMAC countries; thus, the terms of trade have an asymmetrical effect on their current accounts. The results of this study lead to recommendations to the effect that diversifying the productive base of CEMAC countries is the most effective way of enabling them to rebalance their current account balances in the long term and reduce their vulnerability to external shocks.

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INTRODUCTION

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A current account imbalance occurs when a country buys more abroad than it sells itself. The trade balance, like the balance of payments, are economic indicators that measure the value of trade between a country and its external partners. It represents the difference between the value of exports and imports of goods and services.

Generally speaking, the deficit is seen as a symptom of poor economic health. The remedy would be to promote exports and curb imports in order to reduce the imbalance. This policy would lead, according to its supporters, to an improvement in the health of the economy. The role of the state and the central bank would then be to impose policies aimed at orienting the economy towards a more „favorable" balance of the current account. The whole problem is whether this reasoning is rational.

The economic literature suggests several theoretical and empirical analyzes to demonstrate that any country can be faced with the problem of the sustainability of its current account deficits (Opoku-Afari, 2007; Osakwe and Verick, 2007; Adedeji and Handa, 2008; Searly and Mama, 2010; Ichu, Tebba et El Hiri, 2019 ; Zongo, Ndong Ntah et Gankou, 2020).

On the theoretical level, the causes of trade deficits put the classical and Keynesian conceptions in opposition. If the classical current is based on the flexibility of prices for an automatic adjustment of the imbalances of the balance of current payments (Taussig, 1927; Angell, 1966), the Keynesian current shows, in turn, that the slowness in the adjustment of prices makes the self-regulatory mechanisms of the market non-operational. In other words, the current account cannot balance

automatically. Corrective measures that may lead to a rebalancing of the current account balance must necessarily be implemented.

It then becomes very interesting to know the fundamental determinants of the current account deficits. But the views are far from agreeing. Sometimes, the causes of the current account imbalance are to be found in the real sector of the economy, for the Keynesians (Robinson, 1947; Alexander, 1952); sometimes in the monetary sector, for the supporters of the monetary approach. (Polack, 1957). On an empirical level, the scale and persistence of trade deficits are of interest to both industrialized and emerging countries. Indeed, the American trade deficit reached its highest level in 2018 in more than ten years, an annual increase of 12.5% to stand at $621 billion (Mulikani L., 2019). This deficit seems to be the consequence of the budgetary policy pursued by the Trump administration which, by deciding to sharply reduce taxes in 2017, mechanically increased Americans' capacity to consume and caused an increase in imports (Le Billon V., 2022). Such a decision, concomitant with the rise of the dollar amplified by the increase in rates by the American Federal Reserve, made American products more expensive (Boussour L., 2021).

And since the start of the coronavirus health crisis, there have been significant deficit rates in France with a 12.6% deterioration in the trade balance after one year, from 57.9 billion euros in 2019 to 65.2 billion euros in 2020 (see Le Monde with AFP of August 7, 2020). In Japan, the external deficit is nearly 14 billion euros and the outlook for 2020 does not seem more promising (AFT, 2022). This situation is rather unprecedented since at the same time as exports fell by 5.6%, imports also fell by 5%. In China, despite a 10.3% reduction in its trade deficit in 2019, it remains very high at around 204 billion dollars.

African countries south of the Sahara are not to be outdone. And if we go by the statistics provided by the ECOFIN agency (2020), the deficit of the whole of Africa vis-à-vis China, the main trading partner, will amount to 17.7 billion US dollars in 2020. This is more than three times the deficit recorded in 2018. In fact, out of 55 African countries, 40 have significant trade deficits with China. If we look only at the Central African countries, the current account deficit in the CEMAC zone looks significant at 7.3% of the zone's GDP in 2020. In Cameroon, the trade balance is structurally negative. According to the WTO (2021), Cameroon recorded a trade deficit of $533 million in 2018. In Congo, the trade surplus fell sharply in 2019 to 1,796 billion CFA francs. Gabon's trade balance fell from CFA 1,857 billion

in 2018 to CFA 1,679 billion in 2019. These three main economies in the zone are all victims of restrictions to combat the Covid-19 pandemic.

In light of these alarming Fig.s, the objective of this article is to analyze the main factors likely to explain the current account deficits of the CEMAC countries.

The interest of such an approach is twofold:

1. Empirically, the countries in the sample are small, largely open economies. Their exports and imports are an important component of their aggregate demand. It is therefore important to verify what influence the selected explanatory variables (real exchange rate, domestic income, terms of trade, national savings, domestic investment, inflation rate and oil price) may have on the current account balance of the countries concerned. The use of an autoregressive model with staggered lags (ARDL) under a dynamic panel makes it possible to show that domestic investment favors the competitiveness of the CEMAC countries, that domestic savings are directed towards the consumption of foreign goods, that oil rents do not fuel productive investment, and that there is a structural difference between the CEMAC countries; thus, the terms of trade act asymmetrically on their current account. Specifically, the results reveal that, in the long term, domestic savings and the price of oil have a negative impact on the current account balance of CEMAC countries, that investment and GDP have a positive impact on the current account, and that the terms of trade and the real exchange rate have contradictory effects (sometimes positive, sometimes negative) on the current account balance in the CEMAC zone. This reveals the asymmetric nature of the shocks on the economies concerned.
2. In terms of economic policy, the current account balance appears to be inelastic to both demand and price factors, with exports being the most sensitive component of foreign trade. The results also reveal the vital nature of imports of foreign products. Therefore, it seems that diversification of the production base is the most effective way of achieving a lasting rebalancing of the current account and reducing the vulnerability of these economies to external shocks.

To this end, our reflection is organized as follows: the second section provides a review of the literature on the factors that explain the balance of the current transactions in the CEMAC zone; the structure of the model and its results are presented in the third section; the fourth section is devoted to economic policy recommendations. This study concludes with the fifth section.

1. LITERATURE REVIEW ON THE DETERMINANTS OF THE CURRENT ACCOUNT BALANCE

This section highlights the theoretical and empirical foundations of the explanatory factors of the current account balance.

1.1 Theoretical foundations of the determinants of the current account balance

Three types of conceptions furnish the economic literature on the determinants of the current account balance: the traditional approaches to the balance of payments, the Mundell-Fleming model and the intertemporal solvency approach.

As for the traditional approaches, they cover the critical elasticities theorem, the absorption approach as well as the monetary conception of the balance of payments.

The critical elasticities theorem considers that the exchange rate has three different effects on the economy's current account: a terms of trade effect, a volume effect, and a capital effect (Robinson, 1947) (1). The terms of trade effect results from the fact that, other things being equal, the devaluation or depreciation of the exchange rate changes the price of imports (exports).

The volume effect is reflected in the increase in the volume of exports resulting from the fall in their prices, on the one hand; and the decrease in the volume of imports, due to the rise in their prices, on the other hand. The increase in the volume of exports and the reduction in the volume of imports are helping to improve the current account.

The capital attraction effect occurs when a devaluation is announced. This leads speculators to withdraw their capital from the money market concerned to place it on a foreign money market before repatriating it after the devaluation. This operation allows them to cash a "devaluation premium". The capital attraction effect is generally favorable since it positively influences the current account balance.

Despite its explanatory power, the critical elasticities theorem remains limited. Two reasons can be cited in this regard:

1. the phenomenon of the J-curve which is explained by the late reaction of consumers to change in domestic and foreign prices. In other words, the improvement

of the current account situation by the devaluation of the exchange rate is not immediate (Masera, 1974) (2);

2. the existence of other factors internal to the economy would explain the positive influence of the exchange rate on the current account balance.

The absorption approach then (Alexander, 1952). It is based on the macroeconomic balance between aggregate supply and demand in an open economy. It indicates that the exchange rate has two effects on the current account: a direct effect through the change in absorption and an indirect effect through the change in national income. One implication of this approach is that policymakers need to lower absorption or increase national income if they are to reduce current account deficits (3).

Finally, the monetary approach to the balance of payments. It places money at the heart of the process of rebalancing the current account balance in a context of fixed exchange rates (Coiteux, 1996) (4).

In the monetary approach, the balance of payments corresponds to the change in foreign exchange reserves which is equal to the difference between the demand for and the supply of money (Polak, 1957). In this regard, the imbalance is the result of an excess of money supply which can be absorbed through a reduction of credit to the State or to the economy via the rise in interest rates or the introduction of credit quotas.

The main limitation of the latter approach is that it has difficulty explaining balance of payments imbalances through monetary factors, which only make sense in the long term.

Regarding the model developed by Fleming (1962) and Mundell (1963), he analyzes the impact, in the short term, of economic policies on the current account of a small open economy having no effect on the rate of international interest (5). This model starts from two assumptions, perfect mobility of capital, on the one hand; and imperfect mobility of capital, on the other hand.

In the event of perfect capital mobility, the exchange rate regime is either flexible or fixed. When the exchange rate regime is flexible, monetary policy is effective in reducing current account imbalances. But fiscal policy is ineffective (6). In turn, when the exchange rate regime is fixed, monetary policy seems ineffective while fiscal policy is effective.

The ineffectiveness of monetary policy stems from the fact that the scale of capital movements deprives the authorities of any possibility of conducting an autonomous monetary policy. But fiscal policy is effective, since the monetary authorities react to avoid any appreciation of the national currency by increasing the money supply in order to keep the interest rate at its initial level with a higher level of production.

In the event of imperfect capital mobility, monetary policy is effective in flexible exchange and inefficient in fixed exchange as well as in perfect capital mobility. As for fiscal policy, it is effective in both fixed and flexible exchange rates (7).

The main limitation of the Mundell-Fleming model is that it only analyzes the short-term effects of economic policies on the current account balance. It is therefore unable to verify the impact of these policies in the long term.

Regarding the intertemporal solvency approach, it explains the imbalances of the current account of the long-term balance of payments from the intertemporal decisions of investment and savings.

A small economy that is very open to the outside is subject to fluctuations in intertemporal factors such as the global interest rate and the life cycle of individuals. These factors are generally the cause of fluctuations in the output relative to its long-term level, and therefore of current account imbalances (8).

The comparison by Sachs (1981) between the current level of variables (GDP, household consumption and public expenditure) and their permanent or long-term level, reveals that low current consumption compared to long-term consumption leads agents economic to maintain their consumption, which leads to a significant absorption, and therefore a current deficit.

In turn, current imbalances can be explained by real interest rates (Obstfeld and Rogoff, 1996 and Obstfeld, 2000). Indeed, for these authors, an increase in the money supply by the monetary authorities translates into a decrease in the real interest rate. The fall in the real interest rate leads to an increase in current consumption, as the opportunity cost of present consumption decreases, while that of future consumption increases. Increasing current consumption increases absorption, and causes imbalances in the current account.

1.2 Review of empirical literature on the determinants of the current account

Empirical work on the dynamics of the current account balance can be divided into two categories: that which focuses on industrialized countries, and that which can be confined to developing countries.

Several studies of industrialized countries examine the sustainability of current account deficits. Freund (2005) examines the current account adjustment dynamics of the main OECD countries and asks whether there is a deficit threshold beyond which a deficit becomes unsustainable. She was able to identify 25 episodes between 1980 and 1997, during which adjustments made it possible to improve the current account following a deficit. For her, a turnaround in the current account situation occurs when the current account deficit is around 5% of gross domestic product (GDP). In short, Freund concludes that current account reversals are linked to the economic cycle in industrialized countries. In the same spirit, Gruber and Kamin (2007) explore the possibility of explaining the major current account deficits recorded in the United States and the large surpluses in the Asian economies. Using a panel regression approach, as formalized by Chinn and Prasad (2003), they find that the Asian surpluses are better explained by a model that incorporates, in addition to the standard determinants, the effect of financial crises on the current account. However, they fail to provide a clear explanation for the United States' worrying targets, despite taking account of the quality of its institutions.

A little later, Janko (2020) examined the link between the current account and its determinants using Canadian quarterly data from 1981 to 2018. Using the Auroregressive Distributed Lag (ARDL) model, he finds that there is a long-run relationship between the current account and its determinants, notably the budget balance. This relationship is positive in both the short and long term. In particular, a one percentage point increase in the fiscal balance to GDP ratio leads to a 0.43 percentage point increase in the current account to GDP ratio. Furthermore, Fourkan (2021), in an attempt to measure the impact of net lending and borrowing by general government and the current account balance on the GDP growth rate for developed countries (the United Kingdom, the United States, Canada and France) over the period from 1980 to 2020, found that the current account balance has an insignificant negative effect on the GDP growth rate in the fixed effects model, whereas this result appears significant in the random effects model. Similarly, Afonso and Opoku (2022) re-examine the link between the budget balance

and the current account balance for 18 OECD countries using quarterly data for the period 1995-2018. Using the panel vector autoregression (VAR) method, they find that an increase in the budget balance of one percentage point of GDP leads to an improvement in the current account balance of around 0.1 to 0.3 percentage points of GDP. In turn, an increase in real public consumption leads to a deterioration in the current account balance. The impact of the real effective exchange rate does not appear to be statistically significant. The results also confirm that there is a long-term relationship between the budget balance and the current account balance.

A number of studies on developing countries have looked at the determinants of the balance of payments current account balance. Khan and Knight (1983) were the first authors to examine the external and internal factors explaining the current account of the balance of payments. Working on a sample of 32 non-oil developing countries over the period 1973-81, using estimates based on pooled data, they showed that an improvement in the terms of trade led to an increase in the current account ratio, while a rise in the real foreign interest rate resulted in a fall in the ratio of the current account to exports. In addition, an appreciation of the real effective exchange rate could lead to a decrease in the current account ratio, and a rise in the budget deficit as a percentage of GDP was accompanied by an increase in the current account deficit as a percentage of exports.

Eita and Gaomab II (2012) also looked at the specific case of a country like Namibia to analyze, through a VAR approach over the period 1999-2009, the macroeconomic determinants of the current account balance of this country. It then appeared that the budget balance, GDP and the interest rate are the main determinants of the current account in this country. Specifically, the increase in GDP, the budget balance and the interest rate improved Namibia's current account. This investigation focused on a limited number of variables and did not allow us to know, for example, the role of external debt or the quality of institutions in the explanation of the current account.

The work of Oshota and Badejo (2015) made it possible to assess the determinants of the current account balance of West African countries over the period 1980-2012, through an autoregressive model with staggered lags (ARDL) in panel. They concluded that per capita GDP, investment, financial deepening and the dependency ratio had a positive effect on the long-term current account in West Africa. But the real effective exchange rate exerted a negative influence on the current account. This latter result was confirmed by that of Ibrahim et al. (2017). These

authors focused on the singular case of the real effective exchange rate to explain the current account deficits in Nigeria over the period 1970-2012. Using an error correction model, they concluded that the real exchange rate had a negative influence on Nigeria's current account.

In addition, Ousseini et al. (2017) conducted a study examining a variety of factors that may influence the current account balance. They were thus interested in the behavior of the money supply, the real exchange rate, income, inflation, foreign direct investment and household consumption expenditure in the WAEMU countries in the period from 1980 to 2013. Using an autoregressive vector panel (VAR) model, they found that money supply and FDI negatively affect the current account, while the real exchange rate and income positively influence on the current account balance. Inflation and household consumption spending have had no effect on the current account balance. One of the limitations of their study was the failure to take into account other West African countries which had experienced similarly structural current account deficits.

More recently, some authors (Bousnina, Redzepagic and Gabsi, 2021) have attempted to analyze the empirical link between the current account balance and a set of economic variables. Using a dynamic panel model based on the generalized method of moments (GMM), they were able to identify the main determinants of current account balances in certain economies in the Middle East and North Africa (MENA) region. Using the period 1970-2018, they estimated a threshold cointegration model on a sample of 12 MENA countries to show that these countries should implement policies to reduce their current account deficits if they want to regain external stability.

Similarly, Okiemy and Mbongo (2021) analyzed the effects of the oil shock, the interest rate and the balance of payments on the sovereign debt of CEMAC member countries over the period 1998-2018. Using the non-linear autoregressive distributed lag (NARDL) method, they show that there is an asymmetric short- and long-term relationship between the sovereign debt of these countries and its determinants. This reveals a procyclical behavior of sovereign debt. In other words, a long-term shock has a positive effect on debt, while a short-term shock has a negative effect on debt servicing in these countries. The implication of economic policies suggests improving the fiscal management of these countries and, above all, diversifying their economies.

Two particularly interesting studies by Bousnina and Gabsi (2022) are based on data from countries in the MENA region. The first study analyses the non-linear relationship between total public debt and twin deficits for the period 2003-2019. A fixed-effects panel data threshold model is proposed, based on the work of Hansen (1999). The most important result here is that there is no single debt threshold applicable to all countries in the sample. Indeed, if the public debt/GDP ratio is below 36.71%, there is a negative relationship between the budget balance and the current account. But twin deficits are confirmed if this ratio is between 36.71% and 72.99%. In turn, if the ratio is higher than 72.99%, a double divergence of the ratio is observed. It is therefore important for policymakers in the countries concerned to take measures to adjust the current account deficit by lowering the public debt/GDP ratio, reducing sterile government-funded programs and taking appropriate austerity measures to mitigate the negative effects of the financial crisis.

In the second study, the authors examined the relationship between the current account and financial development. This time, they took institutional quality into account and found that most financial development indices have a positive impact on the current account, even if the coefficients of the interaction term are negative. In short, this reflects the fact that institutional quality attenuates the positive effect of financial development on the current account. They therefore conclude that in the presence of a high level of corruption, the current account deficit tends to worsen despite appreciable financial development.

A more recent study concerning developing countries was carried out by a group of authors in 2023 (Çetin, Sarıgül, Isik, Avci, Ahmad & Alvarado, 2023). The authors wanted to verify the causal link between natural resources, economic growth, savings, the current account balance and financial development for 33 developing countries. Using cross-sectional augmentation ARDL modelling (CS-ARDL) combined with Dumitrescu-Hurlin panel causality tests, their results indicate that the variables selected were cointegrated, and that natural resources, economic growth and the current account balance all have a negative impact on financial development. Savings, on the contrary, stimulate financial development. Causality appears to be bidirectional between all the explanatory variables and financial development.

We must remember that since the financial crisis of 2007-2008, the trade of African countries has been disrupted by the instability of the prices of their raw materials. Indeed, the latter have lost half of their value (OECD, 2010). This caused the fall in the foreign exchange reserves of oil-exporting countries and their export earnings,

negatively impacting their budget balances and their GDP. In 2009, the IMF estimated the decrease in oil export earnings at 40%, causing the surplus position of the current account to decline from 11.75% to less than 10% between 2004 and 2008 (IMF, 2009). Some authors thus believe that the decline in import demand from industrialized countries and the low price of raw materials are explanatory factors for the deterioration in the current account of most African countries (Hugon, 2009; Kasekende, Brixova and Ndikumana, 2010).

2. PRESENTATION OF THE MODEL

The presentation of the model for determining the current account balance consists in specifying it first before specifying the variables used.

2.1 Specification of the model and presentation of the variables

Our study is based on the theoretical model of Chinn and Prasad (2003) because of its great ability to relate the current account to the main macroeconomic variables. This model is formulated as follows:

$$\left(\frac{CB}{GDP}\right)_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where:

i = 1,…, 6; t = 1970, ..., 2018 (i is the number of countries in the area: 6, and t represents the number of years: 49);

CB represents the current balance;

GDP, the gross domestic product;

α, a constant;

ε, the error term and;

X, a vector of explanatory variables including in particular the budget balance, relative income, the dependency ratio, the degree of openness and the terms of trade.

The specific context of the Economic and Monetary Community of Central Africa (CEMAC) leads us to adapt the above model to take into account the economic reality of this area. That is, all of these countries are commodity exporters. In this

regard, their current account balance is likely to be explained by the real exchange rate (RRC), domestic income (GDP), terms of trade (TT), national savings (NS), domestic investment (INV), the inflation rate (INFL) and the price of oil (PP). Taking these variables into account in the theoretical model gives the following functional presentation:

$$CAB_{it} = \alpha + \beta_1 RER_{it} + \beta_2 GDP_{it} + \beta_3 TT_{it} + \beta_4 NS_{it} + \beta_5 INV_{it} + \beta_6 INFL_{it} + \beta_7 PP_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

with

CAB, the current account balance and μ_i the specific effects.

The current account balance (CAB) is the dependent variable. Drawing on the work of Kahn and Knight (1983), this variable is expressed as a percentage of exports. This allows us to make comparisons between countries easily, while at the same time putting the weight of each country's balance into perspective.

Measured by the real effective exchange rate, the real exchange rate (*RER*) reflects the country's competitiveness vis-à-vis its external trading partners. Listed in uncertainty, its increase (decrease) corresponds to a depreciation (appreciation). We expect a positive sign for the coefficient associated with this variable.

Gross Domestic Product (*GDP*) represents real domestic income per capita. When it increases, it bodes well for an improvement in the current account balance through increased domestic production which absorbs part of imports. Thus, the expected sign of the coefficient associated with this variable is positive.

The terms of trade (*TT*) are defined as the ratio of the export price index to the import price index. Their increase implies an improvement in the current account, while their decrease results in a deterioration of the current account balance. From this point of view, its expected sign must be positive.

The national savings variable (*NS*) is taken as a constant value. The expected sign of the parameter associated with it is positive.

Domestic investment (*INV*), taken in constant value, its increase leads to an increase in imports in the short term. But their positive effect on exports takes some time,

it is possible that in the medium or long term, the effect of domestic investment will lead to an improvement in the current account situation.

The inflation rate (*INFL*) is defined as the growth rate of the consumer price index. A rise in the rate of inflation discourages domestic consumption, and stimulates imports. Therefore, the expected sign of the parameter relating to this variable is negative.

The price of oil (*PP*) is included as a variable in the model used because in five out of six CEMAC countries, oil is exploited. This variable therefore has a different impact on countries depending on whether you are an exporter or importer of hydrocarbons. So, for oil-exporting countries, the fall in the price of oil is bad news. Indeed, the current account balance is expected to worsen significantly, increasing their fiscal vulnerability and thus hampering their growth. In turn, for hydrocarbon importing countries, a decrease in the price of oil should improve the current account balance and stimulate their growth.

2.2 The estimation of the model

The model estimate is based on a panel of 6 CEMAC countries (Cameroon, Congo, Gabon, Equatorial Guinea, CAR, Chad) for the period from 1970 to 2018, i.e., 294 observations. Most of the data used are secondary and come from different sources (the WEO database of the IMF, that of the World Bank (WDI), that of the IMF, or that of International Financial Statistics). Due to the presence of missing data, we had to complete them by the method of moving averages.

Some preliminary tests are considered necessary for the quality of the results. To this end, we successively carry out the individual dependence test before checking the stationarity of the chosen variables.

2.2.1 Preliminary tests

Due to the superiority of the time dimension (49 years) over the individual dimension (6 countries), we rely on the Breusch and Pagan test (1980) to analyze the dependence between the individuals in the panel. The results of this test are presented in Table 1 (see appendix 1).

It emerges from Table 1 that the P-value associated with the Chi2 statistic is less than 5% whatever the variable considered except for the price of oil (PP). In this regard, the null hypothesis cannot be rejected at this level. To demonstrate the independence between the endogenous variable and the exogenous variables, we consider the tests of Levin et al. (2002), the results of which are shown in Table 2 (see appendix 1).

Examination of Table 2 reveals that four variables (NS, INFL, CAB and TT) are stationary at level; and the other four (GDP, RER, INV and PP), not stationary at level, became so after their transformation into first difference. Also, the absence of dependence between individuals and the presence of integrated series of order 1 lead us to proceed to the Westerlund test (2007) to verify if there is at least one cointegration relationship between the variables selected.

This test consists in opposing the null hypothesis of the absence of a cointegrating relation to the alternative hypothesis of the presence of cointegrating. This method combines four simultaneous tests, the first two of which, Gt and Ga, relate to the interindividual dimension; and the last two, Pt and Pa, relate to the intra-individual dimension. The results of the cointegration tests are listed in Table 3 (appendix 1).

The results of this Table 3 indicate that all statistics (P-value) of the test are less than 0.05 (0.000). The null hypothesis of the absence of cointegration between the variables is therefore rejected. In other words, there is at least one long-term relationship between the explanatory variables and the explained variable. We can therefore consider that the ARDL model estimated under a dynamic panel is appropriate. Its main advantage is that it gives convergent estimators even if the variables are integrated of different orders (Pesaran et al., 2001). It also allows robust results to be obtained with small sample sizes, at the same time as it allows analysis of short-term dynamics and long-term equilibrium.

But the optimal ARDL model is obtained by determining the number of necessary lags of the variables. However, the selection criterion for the number of delays is determined through different methods, the most common of which in the literature are the Akaike information criterion (AIC) and the Schwarz information criterion (SIC). Given the relatively limited number of variables in our model, the Schwarz information criterion seems more appropriate to us. Table 4 (appendix1) summarizes the delays for all CEMAC countries.

The Table 4 indicates that the optimal model is ARDL (0 1 0 1 1 1 0 0).

We will rely on the following basic model proposed by Pesaran et al. (1999):

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

with y_{it} the endogenous variable; x_{it}, a vector of explanatory variables; μ_i the fixed effects; the λ_{ij} are scalars; δ_{ij}, a set of coefficients, p the maximum delay of the dependent variable; and q the optimum delay of the explanatory variables.

The parameterization of the above model in the form of an error correction equation gives the following relation [4]:

$$\Delta y_{it} = \emptyset_i y_{i,t-1} + \beta_i' x_{it} + \sum_{j=1}^{p-1} \lambda_{ji}^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*} \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (4)$$

where

$$\emptyset_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right), \ \beta_i = \sum_{j=0}^{q} \delta_{ij}, \ \lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im} \text{ et } \delta_{ij}^{*} = -\sum_{m=j+1}^{p} \delta_{im}$$

On the basis of this development, the empirical model that we propose can be rewritten as follows:

$$\begin{aligned} \Delta CAB_{it} = {} & \alpha + \emptyset_i CAB_{it-1} + \beta_1 RER_{it} + \beta_2 GDP_{it} + \beta_3 TT_{it} + \beta_4 NS_{it} + \beta_5 INV_{it} + \\ & + \beta_6 INFL_{it} + \beta_7 PP_{it} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta CAB_{it-j} + \sum_{j=0}^{q-1} \alpha_{1j} \Delta RER_{it-j} + \\ & + \sum_{j=0}^{q-1} \alpha_{2j} \Delta GDP_{it-j} + \sum_{j=0}^{q-1} \alpha_{5j} \Delta INV_{it-j} + \sum_{j=0}^{q-1} \alpha_{6j} \Delta INFL_{it-j} + \\ & \sum_{j=0}^{q-1} \alpha_{7j} \Delta PP_{it-j} + \mu_i + \varepsilon_{it}. \end{aligned} \quad (5)$$

Where j represents the number of delays; Δ, the first difference operator; and $\emptyset_i$, the restoring force towards equilibrium. This coefficient must be negative and significant. The coefficients of β_1 to β_7 denote the long-term elasticities, those of α_1 to α_7 describe the short-term dynamics of the explanatory variables, and the coefficient λ_{ij} describes the short-term dynamics of the explained variable.

Choice of estimation method

Recall that the estimation of the ARDL panel model is generally done using three methods developed by Pesaran et al. (1999):

- The Pooled Mean Group (PMG) method, which is based on the assumption of the heterogeneity of the short-term coefficients and the homogeneity of the long-term coefficients;
- The Mean Group (MG) method, which considers heterogeneity of the short-term and long-term coefficients; and
- The Dynamic Fixed Effect (DFE) method, which assumes homogeneity of the short-term and long-term coefficients.

The use of the Hausman (1978) test allows us to choose the best method for estimating the panel ARDL model. Using the three methods (PMG, MG, DFE) developed by Pesaran et al (1999), we arrive at the result that, on the one hand, between the random effect model and the fixed effect model, the fixed effect relationship is better. On the other hand, the test of the PMG against the MG shows a P-value of less than 5%, implying that the PMG should be rejected. For the CEMAC countries, the probability associated with Chi-2 being less than 0.05 (ChI-2 = 0.0001), we only retain the estimate of the long-term relationship country by country (10). Table 5 (appendix1) presents the results of the estimations of the model.

The results of Table 5 show that the restoring force (ECT) is negative and significantly different from zero for all the EMCCA countries. The current account balance of Central African countries members of the Monetary Union therefore always returns to its long-term equilibrium value. Thus, the model specified as an error correction relationship is validated.

The column representing the national savings variable (NS) indicates that the coefficient of this variable is significant at 5% for Cameroon and the CAR. It acts negatively on the current account balance of all the countries in the sample except for Chad. In other words, apart from Chad, domestic savings have a negative influence on the current account of Cameroon, Congo, Gabon, Equatorial Guinea and CAR. This reflects the fact that, when it increases, it is mechanically used for the consumption of foreign goods and services, increasing imports and thus worsening the current account balance. This result contradicts those of Calderon et al. (2000), for whom an increase in the savings rate improves the current account balance.

High inflation indicates that domestic prices are rising rapidly, and this may mean that domestic production is becoming less competitive compared to imported goods and services, since it is becoming relatively more expensive compared to imports. The coefficient linked to the inflation rate (INFL) is significant at 5% for Cameroon, Congo, CAR and Chad, while it is significant at 10% for Gabon and Equatorial Guinea. Furthermore, while its sign is positive for Cameroon, Gabon, Equatorial Guinea and Chad, revealing compliance with the theoretical intuition that a rise in the inflation rate discourages domestic consumption and stimulates imports into these countries. However, for Congo and CAR, inflation has a negative impact on the current account balance.

The parameter associated with the price of oil (PP) is only significant at 10% for three countries in the sample (Cameroon, Congo, CAR) and is significant at 5% for the other countries (Gabon, Equatorial Guinea and Chad). Its long-term positive sign shows that the rise in the price of oil is boosting export growth in the four countries of Cameroon, Congo, CAR and Chad. If this result is opposed to the analysis of Kasekende, Brixova and Ndikumana (2010) which states that the low price of raw materials due to the decrease in import demand from industrialized countries reduces by more than 50% the revenues of export. Which leads to the deterioration of the current account. Said analysis is rather consistent with the results for Gabon and Equatorial Guinea for which this variable acts negatively. It is thus confirmed that in these two countries, a long-term increase in the price of the barrel favors imports.

The gross domestic product (GDP) has a significant coefficient at 5% for four countries (Gabon, Equatorial Guinea, CAR and Chad) and at 10% for the other two countries (Cameroon and Congo). This variable acts negatively on the current account balance of Equatorial Guinea, CAR and Chad. This suggests that the economic growth of these countries is rather "impoverishing". That is, it benefits more the external trading partners of those countries whose products are more competitive. This result runs counter to that of Eita and Gaomad (2012) who found that in Namibia, increased GDP improves the current account. In turn, the GDP acts positively on the three most important economies of the zone, bringing in conformity the results of the study of Eita and Gaomoad. In other words, economic growth is favorable to their current account by increasing exports more than imports. This result is highlighted with the absorption approach (Alexander, 1952), according to which policy makers in these countries can increase their national income if they wish to reduce their current account deficits.

The parameter associated with the domestic investment variable (INV) is only significant for four countries (Cameroon, Gabon, Chad at 10% and CAR at 5%). It is not significant for Congo and Equatorial Guinea. Its positive sign, which confirms the result of Oshota and Badejo (2015) in West Africa, indicates that domestic investment promotes the competitiveness of the countries concerned (Cameroon, Congo, Gabon, Chad), stimulating their exports. In turn, for countries such as Equatorial Guinea and CAR, domestic investment leads to impoverishing growth, insofar as this investment is mainly directed towards the purchase abroad of intermediate goods needed for certain activities, and certain machines useful for domestic production. All of which leads to an increase in imports. However, this result can be compared with the work of Ousseini et al. (2017), according to which investment has a negative impact on the current account in WAEMU countries.

The terms of trade (TT) influence the current account balance of the sample countries over the long term. They act positively on this balance in three countries (Cameroon, Congo, Chad) and negatively on the other three (Gabon, Equatorial Guinea, CAR). Thus, following an improvement in the terms of trade, the current account balance increases in the long term in Cameroon, Congo and Chad, while it deteriorates in Gabon, Equatorial Guinea and CAR. This result is indicative of the structural difference between the CEMAC economies. Gabon, Equatorial Guinea and CAR appear to be smaller in size than their counterparts (Cameroon, Congo and Chad) due to the limited absorption capacity of their internal market. Moreover, the content of their exports being basic products of which they have little control over the evolution of prices, there is often a sharp reduction in external demand for these products and an increase in demand for goods imported. These results are to be compared to Mundell-Fleming's theoretical intuition about small countries open to the outside world.

The coefficient associated with the real exchange rate (RER) is significant in the long term in four countries (Gabon, Equatorial Guinea, CAR and Chad). It is positive for Congo, Gabon, Equatorial Guinea and Chad, confirming our theoretical intuition. This may mean that with a quotation in doubt, an increase in the TCR (depreciation) would help encourage exports to these countries, in particular through the fall in the price of goods exported in terms of foreign currency. In contrast, in Cameroon and CAR, the negative sign of the coefficient indicates that a decrease (appreciation) of the TCR would cause a deterioration in the current account. That is, a contraction of exports in favor of imports. This contraction is the result of the increase in the price of imports in national currency. This result is supported by

that of Bahmani-Oskooee and Harvey (2018) for the case of the United States. It is confirmed by that of Oshota and Badejo (2015) for the case of West African countries.

2.2.2 Robustness of the results

The model presented in this study being an ARDL model, we verify its robustness through the autocorrelation test of the residuals. Indeed, this type of model is generally subject to the problem of autocorrelation with regard to the presence of the lagged dependent variable among the explanatory variables.

To detect autocorrelation of errors, we use the Breusch-Godfrey test (1978), as it is able to detect the presence or absence of autocorrelation of order greater than or equal to unity (11). He opposes two hypotheses to this end: the null hypothesis of the absence of autocorrelation of the residuals and the alternative hypothesis of the presence of autocorrelation. When the probability associated with the test is greater than 5%, the null hypothesis of the absence of autocorrelation cannot be rejected. The results of the test are presented in Table 5 in the appendix.

They show that the null hypothesis of the absence of autocorrelation of errors cannot be rejected at the 5% level. In other words, the results obtained in this paper do not suffer from an autocorrelation problem of the residuals.

3. IMPLICATIONS

The countries of the Economic and Monetary Community of Central Africa are very small economically and very open to the outside world. Their current account is therefore dependent on fluctuations in the prices of raw materials which constitute the bulk of their exports. Three main recommendations can be made in relation to their economic policies. Reducing tariff barriers, diversifying their productive base and integrating into global value chains.

With regard to the reduction of tariff barriers, this trade policy measure is generally instituted for the protection of a domestic industry. However, the industrial landscape is almost non-existent in the CEMAC countries. In other words, support for pseudo-national industries unnecessarily burdens the already very burdened public

finances of these countries. Customs duties must therefore be reduced, if not eliminated, in order to hope to expand the productive base in the countries in the sample.

As for diversification, it can be done within the framework of the mobilization of the main productions linked to the specific sectors found there (Ndo Ndong, 2020a). Indeed, several sectors can contribute to the reduction of the risks linked to the poor exploitation of basic products. These are the wood, agriculture, livestock, agro-industry, fishing and aquaculture sectors.

By only retaining the timber sector, it can allow CEMAC countries to distinguish their products and distinguish them from those of the competition (Ndo Ndong, 2020b). This would allow them to fit into the intra-industry exchange. They will thus be able to differentiate their product (wooden furniture of all kinds) and target a regular clientele. Whether this differentiation strategy focuses on products or customers, it allows the producer to increase market share and improve profitability. This provides the financial means for its future growth.

Regarding integration into value chains, it would allow these countries to put in place effective mechanisms to meet the needs of consumers to adapt more quickly to shocks (for example that of Covid-19) and to changes in the market environment. It also helps to eliminate unnecessary costs and waste. Finally, it helps increase added value all along the chain.

CONCLUSION

This study reveals a structural disparity in the CEMAC economies in the sense that the factors that determine the current account balance have different effects depending on the country on this variable. Therefore, an improvement in the terms of trade will deteriorate the current account of commodity-exporting countries, while it will improve the current account balance of countries with a less extroverted productive structure. It is therefore important that Community policies take this diversity into account in order to avoid too great an asymmetry in their consequences for these economies.

NOTES

1. Indeed, this tends to rise (decrease) in national (foreign) currency, while the price of exports (imports) in national (foreign) currency remains constant.
2. Despite the verification of the Marshall-Lerner theorem, a devaluation can have negative effects on the current account balance. In other words, the current account generally deteriorates in the short term. But its improvement, following the devaluation, is only noticeable later, in the medium and long term.
3. Reducing domestic absorption means reducing public spending, social benefits or, at the very least, the amount of money in circulation in the economy. Anything that can discourage consumption and investment. The decrease in the amount of money in circulation is usually achieved through an increase in the interest rate, an increase in reserve requirements or the imposition of credit quotas.
4. This approach was one of the theoretical foundations of the SAPs advocated by the Washington consensus to help developing countries faced with problems of internal and external imbalance in the 1980s and 1990s.
5. This analysis is based on the nature of the exchange rate regime and the international mobility of capital.
6. The decrease in the interest rate following the increase in the money supply results in an increase in investment and aggregate demand in the market for goods and services. There are capital outflows, leading to a depreciation of the national currency in favor of foreign currencies. In turn, the rise in the interest rate, following an expansionary fiscal policy leads to an increase in demand for the national currency which appreciates causing a loss of competitiveness of the economy. Hence the decline in exports in favor of imports and therefore deterioration of the current account.
7. The increase in imports due to the implementation of the expansionary monetary policy, increases the supply of national currency which exerts pressure to depreciate the exchange rate. In fixed exchange, the intervention of the Central Bank is done through the purchase of the national currency. This translates into a higher interest rate and thus lower investment and aggregate demand which reduces imports and improves the current account. In a floating exchange rate, the currency simply depreciates while helping to improve the current account situation.
8. For Buiter (1981), a positive demographic growth rate for such an economy increases its level of consumption if its economic agents have a preference for the present. Thus, in the first period of their life, current account deficits occur permanently. In other words, the preference for present consumption over future consumption on the part of households favors imbalances.

9. The author also shows that a rate of preference for present consumption higher than the real interest rate tends to raise current consumption above its permanent level, and thus to generate a deficit in the balance of payments currents. Likewise, the importance of public spending in relation to its long-term level is favorable to the current account deficit.
10. Two reasons can justify this choice: the first is theoretical. According to the intertemporal approach of Corden (1991), the current account is deduced from the long--term decisions of economic agents. In other words, a deficit in the current account balance is not particularly worrying since it results from optimizing behavior of economic agents. The latter end up adapting their consumption plan according to new information in order to generate the resources necessary for intertemporal balance. The second reason is empirical. No variable retained is significant in the short term. However, the principle of the cointegration model is precisely to consider only the long-term equilibrium relationship, insofar as any short-term imbalance is corrected by the restoring force leading to the long-term equilibrium.
11. The most common test is the Durbin and Watson (1950) test, but in this case it does not make sense, rather Durbin's h test should be used.

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APPENDICES

Appendix 1

Table 1: Descriptive statistics

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. sum SCC TCR PIB TE EN INV INFL pp
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Variable	Obs	Mean	Std. Dev.	Min	Max
SCC	306	.2552294	1.058873	-5.141	2.923
TCR	306	110.6053	37.34068	57.097	223.676
PIB	306	5.668868	10.35627	.0030635	74.18318
TE	306	112.356	50.47333	11.16	271.91
EN	306	27.67612	21.41383	-40.815	83.287
INV	306	1128772	1.97e+07	.0061459	3.45e+08
INFL	306	3.768091	7.082261	-17.64	42.44
pp	306	15.07255	15.51105	0	82.7769

Table 2: Dependence test between the exogenous and the endogenous variable SCC

CAB	RER	TT	INV	GDP	PP	INFL	NS
Stat. Chi2	27,2124	101,9872	56,8133	59,8359	10,4186	32,2982	160,459
P-value	0,001	0,00	0,00	0,00	0,318	0,00	0,00

Source: author's calculation

Table 3: Results of the stationarity tests

GDP	GDP at level		GDP at 1st difference	
	Statistic	P-Value	Statistic	P-Value
Test de Im-Pesaran-Shin				
t-bar	-1,991		-6,8562	
t-tilde-bar	-0,2015		-4,7830	
z-t-tilde-bar	3,8584	0,9999	-10,0328	0,000
NS	NS at level			
	Statistic	P-Value		
Test de Im-Pesaran-Shin				
t-bar	-2,9867			
t-tilde-bar	-2,7480			
z-t-tilde-bar	-3,8532	0,0000		
PP	PP at level		PP at 1st difference	
	Statistic	P-Value	Statistic	P-Value
Test de Im-Pesaran-Shin				
t-bar	-1,4217		-6,9357	
t-tilde-bar	-1,4060		-4,4944	
z-t-tilde-bar	0,2093	0,5029	-9,1578	0,000
INFL	INFL at level			
	Statistic	P-Value		
Test de Im-Pesaran-Shin				
t-bar	-5,2980			
t-tilde-bar	-4,1395			
z-t-tilde-bar	-8,0669	0,0000		
INV	INV at level		INV at 1st difference	
	Statistic	P-Value	Statistic	P-Value
Test de Im-Pesaran-Shin				
t-bar	-1,5489		-7,5185	
t-tilde-bar	-1,3624		-4,8920	
z-t-tilde-bar	0,3429	0,6342	-10,3632	0,000
TT	TT at level			
	Statistic	P-Value		
Test de Im-Pesaran-Shin				
t-bar	-2,9272			
t-tilde-bar	-2,6887			
z-t-tilde-bar	-3,6734	0,0001		
CAB	CAB at level			
	Statistic	P-Value		
Test de Im-Pesaran-Shin				
t-bar	-3,2133			
t-tilde-bar	-2,8904			
z-t-tilde-bar	-4,2842	0,0000		
RER	RER at level		RER at 1st difference	
	Statistic	P-Value	Statistic	P-Value

Test de Im-Pesaran-Shin				
t-bar	-1,8457		-6,8436	
t-tilde-bar	-1,7832		-4,8213	
z-t-tilde-bar	-0,9316	0,1758	-10,1490	0,000

Source: author's calculation

Table 4: Westerlund tests results

	RER			TT			INV			GDP			PP		
Stat	Value	Z-value	P-value	Value	Z-value	P-value	Value	Z-value	P-value	Value	Z-value	P-value	Value	Z-value	P-value
Gt	-3.6	-3.8	0.00	-3.3	-3.03	0.00	-3.9	-4.9	0.00	-3.8	-4.5	0.00	-3.7	-4.2	0.00
Ga	-22	-3.7	0.00	-22.4	-3.8	0.00	-23.6	-4.3	0.00	-22.3	-3.8	0.00	-21.5	-3.5	0.00
Pt	-7	-2.7	0.00	-6.7	-1.8	0.00	-9.3	-4.7	0.00	-8.9	-4.3	0.00	-7.7	-3.02	0.00
Pa	-19	-4.3	0.00	-19.9	-4.5	0.00	-19.8	-4.5	0.00	-19.2	-4.2	0.00	-17.1	-3.3	0.00

	INFL			NS		
Stat	Value	Z-value	P-value	Value	Z-value	P-value
Gt	-3.6	-3.9	0.00	-3.5	-3.5	0.00
Ga	-21.8	-3.6	0.00	-21.7	-3.6	0.00
Pt	-7.5	-2.7	0.00	-5.9	-0.8	0.00
Pa	-19.5	-4.3	0.00	-16.6	-3.16	0.00

Source: author's calculation

Table 5: Optimal number of delays Variables

Variables	CAB	RER	TT	INV	GDP	PP	INFL	NS
Retards	0	1	0	1	1	1	0	0

Source: author's calculation

Table 6: the results of long-term dynamics.

Variables Pays	***ECT***	***NS***	***INFL***	***PP***	***GDP***	***INV***	***TT***	***RER***
CAM	-0,71 (-4,24)**	-20,19 (-4,24)**	2,66 (4,68)**	2,05 (1,42)*	1,69 (0,63)*	0,69 (0,35)*	44,7 (6,29)**	-6,02 (-1,77)*
CONG	-0,32 (-2,34)**	-1,87 (-0,42)*	-2,31 (-2,08)**	2,74 (0,59)*	3,83 (0,44)*	1,05 (0,16)	9,40 (0,82)*	30,85 (1,08)*
GAB	-0,799 (-3,65)**	-3,65 (-1,21)*	0,056 (0,66)*	-5,74 (-2,92)**	10,32 (3,47)**	2,07 (1,09)*	-29,62 (-7,45)**	5,29 (2,15)**
GUIN-EQ	-0,44 (-3,54)**	-0,25 (-1,06)*	0,014 (1,42)*	-0,196 (-2,30)**	-0,146 (-3,04)**	-0,008 (-0,07)	-0,87 (-1,42)*	2,60 (5,77)**
CAR	-1,05 (-5,87)**	-0,004 (-7,51)**	-0,28 (-2,7)**	0,009 (0,24)*	-0,26 (-3,29)**	-0,41 (-5,16)**	-1,62 (-8,34)**	-1,24 (-14,32)**
CHAD	-0,87 (-4,31)**	0,015 (0,39)*	0,49 (2,49)**	8,914 (4,48)**	-22,04 (-4,78)**	0,57 (0,28)*	12,40 (2,11)**	38,9 (2,80)**

Source: author's calculation

The signs ***, **, * indicate the significance of the variables at 1%, 5% and 10% respectively. The numbers in parentheses represent Student's t.

Appendix 2

Table 7 : Fixed-effect model

```
. xtreg scc en infl pp pib inv te tcr, fe

Fixed-effects (within) regression               Number of obs      =       294
Group variable: Indices                         Number of groups   =         6

R-sq:                                           Obs per group:
     within  = 0.0406                                         min =        49
     between = 0.5464                                         avg =      49.0
     overall = 0.0031                                         max =        49

                                                F(7,281)           =      1.70
corr(u_i, Xb)  = -0.6567                        Prob > F           =    0.1094
```

scc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
en	-.0888427	.0418529	-2.12	0.035	-.1712278	-.0064577
infl	-.1751431	.1816658	-0.96	0.336	-.5327417	.1824555
pp	-3.677079	1.753195	-2.10	0.037	-7.128142	-.2260164
pib	1.568455	1.297223	1.21	0.228	-.9850529	4.121962
inv	1.027337	1.471271	0.70	0.486	-1.868774	3.923448
te	-3.908841	4.057369	-0.96	0.336	-11.89554	4.077855
tcr	-10.49962	5.177666	-2.03	0.044	-20.69155	-.3076805
_cons	28.4439	14.15314	2.01	0.045	.5842741	56.30353
sigma_u	4.6016005					
sigma_e	7.7671972					
rho	.2597996	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(5, 281) = 4.59                     Prob > F = 0.0005
```

Table 8: Random-effect model

```
. xtreg scc en infl pp pib inv te tcr, re

Random-effects GLS regression                   Number of obs      =       294
Group variable: Indices                         Number of groups   =         6

R-sq:                                           Obs per group:
     within  = 0.0110                                         min =        49
     between = 0.8245                                         avg =      49.0
     overall = 0.0816                                         max =        49

                                                Wald chi2(7)       =     25.40
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0006
```

scc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
en	-.0002864	.0281009	-0.01	0.992	-.0553632	.0547904
infl	-.0705092	.1846423	-0.38	0.703	-.4324015	.2913832
pp	-4.057956	1.730213	-2.35	0.019	-7.449111	-.6668012
pib	.2410983	1.040391	0.23	0.817	-1.79803	2.280227
inv	4.105324	1.22519	3.35	0.001	1.703995	6.506653
te	5.5453	3.091077	1.79	0.073	-.5131	11.6037
tcr	-.0681935	4.156072	-0.02	0.987	-8.213945	8.077558
_cons	-12.10398	10.20164	-1.19	0.235	-32.09884	7.890873
sigma_u	0					
sigma_e	7.7671972					
rho	0	(fraction of variance due to u_i)				

```
. est store random
```

Table 9: Fixed-effect vs random-effect

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
en	-.0888427	-.0002864	-.0885563	.0310162
infl	-.1751431	-.0705092	-.1046339	.
pp	-3.677079	-4.057956	.3808772	.2829411
pib	1.568455	.2410983	1.327357	.7748377
inv	1.027337	4.105324	-3.077987	.814583
te	-3.908841	5.5453	-9.454141	2.628209
tcr	-10.49962	-.0681935	-10.43142	3.087926

```
                b = consistent under Ho and Ha; obtained from xtreg
    B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

          chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =       31.37
        Prob>chi2 =      0.0001
        (V_b-V_B is not positive definite)
```

Table 10: random-effect vs fixed-effect

```
. hausman random fixed
```

	Coefficients (b) random	(B) fixed	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
en	-.0002864	-.0888427	.0885563	.
infl	-.0705092	-.1751431	.1046339	.0330202
pp	-4.057956	-3.677079	-.3808772	.
pib	.2410983	1.568455	-1.327357	.
inv	4.105324	1.027337	3.077987	.
te	5.5453	-3.908841	9.454141	.
tcr	-.0681935	-10.49962	10.43142	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= -31.37 chi2<0 ==> model fitted on these data fails to meet the asymptotic assumptions of the Hausman test; see suest for a generalized test

Table 11: Error correction model

```
Mean Group Estimation: Error Correction Form
(Estimate results saved as MG)
```

D.scc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Indices_1ECT						
en	4.191642	12.75488	0.33	0.742	-20.80747	29.19076
infl	-.0728975	.4073749	-0.18	0.858	-.8713376	.7255426
pp	7.183398	8.965649	0.80	0.423	-10.38895	24.75575
pib	-12.91205	13.54958	-0.95	0.341	-39.46875	13.64464
inv	-2.595462	8.603766	-0.30	0.763	-19.45853	14.26761
te	37.06585	18.17383	2.04	0.041	1.445802	72.68591
tcr	-6.619439	11.14372	-0.59	0.553	-28.46073	15.22185
Indices_1SR						
ECT	-.7992693	.2186862	-3.65	0.000	-1.227886	-.3706522
en						
D1.	23.93561	14.47592	1.65	0.098	-4.436677	52.30791
infl						
D1.	-.0901561	.2588459	-0.35	0.728	-.5974848	.4171726
pp						
D1.	-7.556944	9.197601	-0.82	0.411	-25.58391	10.47002
pib						
D1.	.7393333	14.0402	0.05	0.958	-26.77895	28.25762
inv						
D1.	-5.300326	4.456147	-1.19	0.234	-14.03421	3.433562
te						
D1.	6.055575	15.36755	0.39	0.694	-24.06428	36.17543
tcr						
D1.	3.757627	20.68913	0.18	0.856	-36.79232	44.30757
_cons	-37.45613	40.73429	-0.92	0.358	-117.2939	42.38161

Indices_2ECT						
en	28.4489	26.36954	1.08	0.281	-23.23444	80.13224
infl	-3.747592	3.13915	-1.19	0.233	-9.900213	2.405028
pp	-2.885398	8.035371	-0.36	0.720	-18.63443	12.86364
pib	-2.382854	15.021	-0.16	0.874	-31.82347	27.05776
inv	-.965018	11.13446	-0.09	0.931	-22.78816	20.85812
te	-62.95461	39.41297	-1.60	0.110	-140.2026	14.29339
tcr	8.475408	18.72599	0.45	0.651	-28.22685	45.17767
Indices_2SR						
ECT	-.7078638	.1803364	-3.93	0.000	-1.061317	-.354411
en						
D1.	-5.331993	17.71454	-0.30	0.763	-40.05186	29.38788
infl						
D1.	1.45866	1.355261	1.08	0.282	-1.197602	4.114922
pp						
D1.	-.5302819	7.182931	-0.07	0.941	-14.60857	13.548
pib						
D1.	-9.858258	25.24751	-0.39	0.696	-59.34246	39.62595
inv						
D1.	-2.066137	7.019032	-0.29	0.768	-15.82319	11.69091
te						
D1.	8.728417	24.88991	0.35	0.726	-40.0549	57.51174
tcr						
D1.	10.7693	33.20153	0.32	0.746	-54.30451	75.84311
_cons	45.06629	60.26036	0.75	0.455	-73.04184	163.1744

Indices_3ECT						
en	5.833075	32.42492	0.18	0.857	-57.71861	69.38476
infl	7.214811	8.080762	0.89	0.372	-8.623192	23.05281
pp	-8.565907	34.12991	-0.25	0.802	-75.4593	58.32749
pib	-11.96934	61.66322	-0.19	0.846	-132.827	108.8883
inv	-3.284499	48.4252	-0.07	0.946	-98.19615	91.62715
te	-29.35925	82.71745	-0.35	0.723	-191.4825	132.764
tcr	-96.39062	208.6235	-0.46	0.644	-505.2851	312.5039
Indices_3SR						
ECT	-.321473	.1372627	-2.34	0.019	-.590503	-.052443
en						
D1.	-3.141277	9.031794	-0.35	0.728	-20.84327	14.56071
infl						
D1.	-2.091133	1.599547	-1.31	0.191	-5.226187	1.043922
pp						
D1.	-15.25633	14.67147	-1.04	0.298	-44.01189	13.49923
pib						
D1.	-61.92199	27.28403	-2.27	0.023	-115.3977	-8.446268
inv						
D1.	16.02828	19.2357	0.83	0.405	-21.673	53.72957
te						
D1.	28.28574	18.70772	1.51	0.131	-8.380726	64.9522
tcr						
D1.	82.20048	80.30516	1.02	0.306	-75.19475	239.5957
_cons	87.23262	115.3191	0.76	0.449	-138.7887	313.2539

Indices_4ECT						
en	.5710759	1.89816	0.30	0.764	-3.14925	4.291401
infl	-.0324133	.0812411	-0.40	0.690	-.1916429	.1268163
pp	.4448547	.6825576	0.65	0.515	-.8929336	1.782643
pib	.3317436	.3850735	0.86	0.389	-.4229866	1.086474
inv	.0182022	1.056629	0.02	0.986	-2.052752	2.089157
te	1.986381	4.910629	0.40	0.686	-7.638275	11.61104
tcr	-5.911221	3.620518	-1.63	0.103	-13.00731	1.184864
Indices_4SR						
ECT	-.4424937	.1250302	-3.54	0.000	-.6875483	-.1974391
en						
D1.	-.3194	1.082579	-0.30	0.768	-2.441216	1.802416
infl						
D1.	-.0290892	.0214224	-1.36	0.175	-.0710763	.012898
pp						
D1.	.0420687	.6167248	0.07	0.946	-1.16669	1.250827
pib						
D1.	.262447	1.006113	0.26	0.794	-1.709499	2.234393
inv						
D1.	-.4324918	.7042636	-0.61	0.539	-1.812823	.9478395
te						
D1.	-1.986086	1.72119	-1.15	0.249	-5.359556	1.387383
tcr						
D1.	3.650706	1.827899	2.00	0.046	.0680899	7.233323
_cons	3.095711	4.496987	0.69	0.491	-5.718221	11.90964
Indices_5ECT						
en	.0040489	.0031522	1.28	0.199	-.0021292	.0102271
infl	.2653447	.5749448	0.46	0.644	-.8615264	1.392216
pp	-.0086449	.2317283	-0.04	0.970	-.4628241	.4455342
pib	.2482742	.4440436	0.56	0.576	-.6220352	1.118584
inv	.3857993	.4379435	0.88	0.378	-.4725543	1.244153
te	1.545662	1.092309	1.42	0.157	-.5952247	3.686549
tcr	1.180566	.4832637	2.44	0.015	.2333866	2.127746

Indices_5SR						
ECT	-1.051435	.1790553	-5.87	0.000	-1.402376	-.7004927
en						
D1.	-.0064381	.0024351	-2.64	0.008	-.0112108	-.0016654
infl						
D1.	.0071622	.488562	0.01	0.988	-.9504017	.9647261
pp						
D1.	-.1933337	.2364756	-0.82	0.414	-.6568173	.2701499
pib						
D1.	-.180069	.6577109	-0.27	0.784	-1.469159	1.109021
inv						
D1.	.2476547	.3270109	0.76	0.449	-.393275	.8885844
te						
D1.	-.4526246	.7975601	-0.57	0.570	-2.015814	1.110564
tcr						
D1.	.919331	.879213	1.05	0.296	-.8038948	2.642557
_cons	-5.029552	3.56288	-1.41	0.158	-12.01267	1.953564

```
Indices_6ECT
          en |   -.017598   .1999421    -0.09   0.930    -.4094773    .3742812
        infl |  -.5666406   .9740282    -0.58   0.561    -2.475701     1.34242
          pp |  -10.27206   9.844614    -1.04   0.297    -29.56715    9.023028
         pib |   25.39083   22.80405     1.11   0.266    -19.30429    70.08594
         inv |  -.6585782   13.68869    -0.05   0.962    -27.48793    26.17077
          te |   -14.2829   29.08534    -0.49   0.623    -71.28913    42.72332
         tcr |  -44.81956   69.30454    -0.65   0.518     -180.654    91.01485
-------------+----------------------------------------------------------------
Indices_6SR  |
         ECT |  -.8680153   .2013749    -4.31   0.000    -1.262703   -.4733277
             |
          en |
         D1. |  -.1604327   .2688864    -0.60   0.551    -.6874404     .366575
             |
        infl |
         D1. |   .0388431   .5093176     0.08   0.939     -.959401    1.037087
             |
          pp |
         D1. |  -1.851062    15.0358    -0.12   0.902     -31.3207    27.61857
             |
         pib |
         D1. |     24.978   32.84561     0.76   0.447    -39.39821    89.35421
             |
         inv |
         D1. |  -.1941973   14.98867    -0.01   0.990    -29.57146    29.18306
             |
          te |
         D1. |  -21.32424   23.83736    -0.89   0.371    -68.04461    25.39614
             |
         tcr |
         D1. |  -46.59501   76.54804    -0.61   0.543    -196.6264    103.4364
             |
       _cons |   73.63406   114.3288     0.64   0.520    -150.4462    297.7144
```

Table 12: Autocorrelation of residuals test

```
. pwcorr scc en infl pp pib inv te tcr, obs sig star(10)
```

	scc	en	infl	pp	pib	inv	te	tcr
scc	1.0000							
	294							
en	0.0582	1.0000						
	0.3203							
	294	294						
infl	0.0099	0.0803	1.0000					
	0.8664	0.1695						
	294	294	294					
pp	-0.0592	-0.0779	0.0962*	1.0000				
	0.3113	0.1829	0.0999					
	294	294	294	294				
pib	-0.0263	-0.1027*	0.1731*	0.6254*	1.0000			
	0.6534	0.0788	0.0029	0.0000				
	294	294	294	294	294			
inv	0.1892*	0.1209*	0.1190*	0.5234*	0.2898*	1.0000		
	0.0011	0.0383	0.0415	0.0000	0.0000			
	294	294	294	294	294	294		
te	0.1907*	0.1330*	0.1730*	0.1418*	0.1853*	0.4238*	1.0000	
	0.0010	0.0226	0.0029	0.0149	0.0014	0.0000		
	294	294	294	294	294	294	294	
tcr	0.0531	0.0799	0.1140*	-0.1669*	0.2519*	0.0120	0.1086*	1.0000
	0.3647	0.1720	0.0510	0.0041	0.0000	0.8375	0.0630	
	294	294	294	294	294	294	294	294

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