

Determinants of International Trade in CEMAC: Granger causality test for heterogenous Panel

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ABSTRACT: The literature in general assumes two channels of exports. In the one hand, the New Export channel with the Domestic Demand as the main driven force of Exports. In the other hand, the Old Export channel with the conventional Real Exchange Rate. The recent contribution on international trade reveals the difficulty to identify the determinants of international trade with the classical channel of exports dynamics. In fact, the parameters estimate of the exports dynamics equation, as well as with the latest econometric techniques as the ARDL Modelling than the conventional one as the Single Equation Approach, reveals that sometimes the parameters estimates are with the wrong sign while significant. Then the aim of this paper is to overcome this issue with the use of an relevant framework able to identify the determinants of international trade. To done this we employ the Granger causality test for heterogenous panel data Models. Globally Speaking, according to the Results in accordance to the standard theoretical framework coming from the Old and the New Export channel the domestic demand as well as the Real Exchange Rate are determinants of international trade. Once more there is a Reverse causation from exports dynamics to domestic demand.

KEYWORDS: Exports, Real Exchange Rate, Domestic Demand, Causality tests, Panel

I. INTRODUCTION

There are currently two frameworks for assessing on Exports Dynamics. In the one hand the Export Market share Model (Esteves and Rua, 2013 ; Bobeica et al, 2015 ; Esteves and Prades, 2016) and in the other hand the Capacity Constraints Model of Belke et al (2014, 2013). From these Models a number of policy implications have been designed. In a recent contribution, Kuikeu (2026f) resumes all of these one and according to the obtained results in this last study the Major Event as the asian crisis should have exert an effect on exports dynamics of CEMAC¹ countries. Evidence suggesting thus that the international trade determinants have to be examined. Then to done this exercise we employ and we Compute the Granger causality test for panel data put forward by Dumitrescu and Hurlin (2012). In the test, all the coefficients are allowed to vary across cross-sections in the panel. The test is computed by running standard Granger causality regressions for each cross-section. This kind of issue is relevant as he shapes the causes of the slowdown in trade performance of this area. Indeed, in 2016, according to Bikai and Afomongono (2017, p.7), trade in this area represents only 8 % of his total exports and 6.4 % of its total imports.

In constructing the panel data asymmetric causality tests the pioneering paper of Abdunnasser Hatemi (2020) reveals that the theoretical papers on the Granger causality testing within a panel system are implicitly based on the supposition that the causal impact of positive shocks is of the same magnitude as the causal impact of negative shocks in the absolute terms. In other words, no asymmetry is allowed in the causality testing of panel data. The Asymmetric causality tests suggests to assess the causal impact of positive shocks and negative shocks.

Nevertheless this supposition is not too restrictive since despite that in the reality people react differently to negative shocks compared to the positive ones, this tends to not be the case in a potential situation when we assess Granger causality testing that

¹ CEMAC is the monetary union of the six central African countries (Cameroon, Central African Republic, Chad, Congo Republic, Equatorial Guinea and Gabon) which have in common the sharing of the CFA franc as a common currency, issued by BEAC (Bank of Central African States) and pegged by a fixed parity to the French franc, at the rate of 1 French franc per 100 CFA franc since the devaluation of 1994 or since 1st January 2002, with the advent of the euro, at the rate of 1 euro for 655.957 CFA francs, or 1 euro for 6.55957 French francs.

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doesn't involve only positive shocks or negative shocks. In fact, the magnitude of an Asymmetric shock is not the same in the absolute terms when we envisage causality testing that involves just Asymmetric shocks (ie positive shocks and negative shocks) as this is the case when allowing for potential asymmetry in panel data causality testing made by the author (Abdulnasser Hatemi, 2020). While this is not the case here with panel causality testing that does not involve just symmetric shocks. Then the using of the conventional Dumitrescu and Hurlin (2012) –Dumitrescu-Hurlin (DH) panel causality tests to infer on international trade determinants.

In a recent paper, Kuikeu (2026f) reveals that Major Event should exerts effects on Exports dynamics in CEMAC. For example, considering the CFA franc devaluation of 1994, one of this Major Event for the area, CEMAC member's countries are a case study where external competitiveness generally taken as the Real Exchange Rate have limited Role on Exports since they sharing the same comparative advantage in natural resources especially Oil (see Appendix) while the price of these raw material products result from the law of supply and demand given by the international market and the nominal exchange rate have limited fluctuations on the market as in the one hand the currency is the same among us and a system of fixed parity against euro is used. In the same vein the Gabonese experience seems to confirm the preceding deelopment of the limited Role of Real Exchange Rate on Exports dynamics in CEMAC. In fact, Gabonese economy was at this time full member of OPEC (The Organization of Petroleum Exporting Countries) so that the raise of it's exports around the period coinciding with the major event of 1994 with the *peg* devaluation (Kuikeu, 2025a, p. 22) is not necessary an result of this monetary arrangement. Recall that OPEC is a dominant producer in the world crude oil where regulation of oil price affects world oil demand and supply.

To explain this realize that while a depreciation of the real exchange rate is one of the main result of an major event as the currency crisis in 1994 into the area the literature develops the idea according to which the mechanical chain of national exports stimulation from a depreciation of the real exchange rate seems unlikely to occur in the context of Sub-Saharan Africa (SSA) resulting from the price inelasticity of their imports concentrated in basic products (manufactured goods, capital goods, etc.) necessary for the manufacture of local inputs but few substitutable to local products due in particular to the content in technological progress of these imported products not yet acquired by these economies (Kamin, 1988 ; Rose, 1991 ; Ghei and Pritchett, 1999).

Our main hypothesis is the following: Since Kuikeu (2026a, 2026b, 2026d) reveal the evidence of the New Export channel but not of the Old Export channel while in panel data Kuikeu (2026c, 2026e) reveal the evidence of the Old Export channel but not of the New Export channe lis the panel data causality testing a suitable framework to suggest evidence of New than Old Export channel ?

This study will be organized as follow, in the next section (section 2) we present the Method, in section 3 the Results, and finally in section 4 as concluding Remarks a summary of the main results.

II. RESEARCH METHODOLOGY

Expressed in an Error Correction Model we have for annual data and respectively for Export Market share Model and Capacity Constraints Model (Kuikeu, 2025b) the following Equation (1) and (2):

$$\Delta X_{it} - \Delta D_{it} = \alpha_i + \beta(\Delta X_{it-1} - \Delta D_{it-1}) + \sum_{k=0}^1 \varphi_k \Delta REER_{it-k} + \sum_{l=0}^1 \omega_l \Delta DD_{it-l} + \sum_{m=0}^1 \omega_m^C \Delta DD_{it-m} \cdot CI_{it-m} + \theta(X_{t-1} - D_{t-1}) + \lambda REER_{t-1} + \varphi t \quad (1)^2$$

Where Δ is the first difference operator. The exports dynamics result from the export market share (the difference between the exports of goods and services X and the foreign demand D). The determinants of exports dynamics are in the one hand the Real Effective Exchange Rate $REER$ for the Old Export channel and in the other hand the Domestic Demand DD for the New Export channel. CI_{it} accounts for the export concentration index in goods. As an additional issue that was raised in the previous literature is the hypothesis that a high product concentration of exports will reduce this trade-off between sales to domestic and foreign markets the model uses the interaction with the concentration indicator ($\Delta DD_t \cdot CI_t$). The Model considers all the variables except the trend measured in log allowing for a maximum of one lag. The interpretation of the time trend is not straightforward as it can capture the long-run effects of the so-called non-price competitiveness factors.

$$\Delta X_{it} - \Delta Y_{it} = \alpha_i + \beta(\Delta X_{it-1} - \Delta Y_{it-1}) + \sum_{k=0}^1 \varphi_k \Delta REER_{it-k} + \sum_{l=0}^1 \omega_l YGAP_{it-l} + \theta(X_{t-1} - Y_{t-1}) + \lambda REER_{t-1} + \varphi t \quad (2)$$

Where Δ is the first difference operator. The exports dynamics result from the the “production potential” defines as the difference between the home economy's exports and the domestic production Y (Kuikeu, 2025b, p. 45). The determinants of exports dynamics are in the one hand the Real Effective Exchange Rate $REER$ for the Old Export channel and in the other hand the capacity constraints Models of Belke et al (2014, 2013) present an alternative explanation to the Domestic Demand given by the output gap $YGAP$ which is more relevant because in the one hand this allows to not use the foreing demand variable an serie who

² The Complementary issue of Berman et al (2011) is investigating by adding the domestic demand (DD) in the long term relationship (Kuikeu, 2025d).

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is at the same time costly to compute and scare, secondly because the output gap is more available. the Domestic Demand DD for the New Export channel. The model considers all the variables except the trend and the output gap measured in log allowing for a maximum of one lag. The interpretation of the time trend is not straightforward as it can capture the long-run effects of the so-called non-price competitiveness factors.

It is important to assess whether the substitution effect between domestic sales and exports is an effect which appears only during economic downturns or during growth periods. In order to investigate this, we introduce non linearity by testing for the existence of an Asymmetric relationship between in the one hand exports and domestic demand for the Export Market share Model in the other hand exports and output gap for the Capacity constraints Model. This is done by splitting domestic demand and output gap in two different variables, as this have been done into the literature for the domestic demand (Esteves and Rua, 2013 ; Bobeica et al., 2015 ; Esteves and Prades, 2016) depending of its change being positive ($\Delta DD+$ for the Domestic Demand and $YGAP+$ for the output gap) or negative ($\Delta DD-$ and $YGAP-$). Then the estimate equation becomes:

$$\Delta X_t - \Delta D_t = \alpha + \beta(\Delta X_{t-1} - \Delta D_{t-1}) + \sum_{k=0}^1 \varphi_k \Delta REER_{t-k} + \sum_{s=0}^1 \omega_s \Delta DD_{t-s}^+ + \sum_{p=0}^1 \omega_p \Delta DD_{t-p}^- + \sum_{u=0}^1 \omega_u^{CI} \Delta DD_{t-u}^+ \cdot CI_{t-u} + \sum_{v=0}^1 \omega_v^{CI} \Delta DD_{t-v}^- \cdot CI_{t-v} + \lambda REER_{t-1} + \theta(X_{t-1} - D_{t-1}) \quad (3)$$

$$\Delta X_{it} - \Delta Y_{it} = \alpha_i + \beta(\Delta X_{it-1} - \Delta Y_{it-1}) + \sum_{k=0}^1 \varphi_k \Delta REER_{it-k} + \sum_{s=0}^1 \omega_s YGAP_{it-s}^+ + \sum_{p=0}^1 \omega_p YGAP_{it-p}^- + \lambda REER_{t-1} + \theta(X_{t-1} - Y_{t-1}) + \varphi t \quad (4)$$

A. Method

We Compute the Granger causality test for panel data put forward by Dumitrescu and Hurlin (2012) –Dumitrescu-Hurlin (DH) panel causality tests. In the test, all the coefficients are allowed to vary across cross-sections in the panel. The test is computed by running standard Granger causality regressions for each cross-section, taking the average of the test statistics ($\bar{W}$) and standardizing it ($\bar{Z}$). $\bar{Z}$ -bar follows a standard normal distribution. The number of lags in the Granger causality regression, K , and the number of time-periods in each cross-sectional unit i , T_i , must satisfy the following condition:

$$T > 5 + 2 \cdot K$$

If the condition is not met, the function returns the number of (one of) the unit where the condition fails. A row vector containing $\bar{Z}$ -bar is available for assignment on return.

B. Data Set

The macroeconomic data set for the CEMAC area covers 1974 to 2021 in annual frequency thus 48 observations measured in real terms. The time frame is bounded by the availability of real exchange rates series where the data is available between 1973-2021. It were able to use the data coming from the World Bank but in this case this would be done at the cost of missing two countries namely Chad and Congo.

Table 1 presents the list of variables.

Table 1. List of Variables

Variables	Definition	Units	Abbreviation	Source
The exportations of goods and services	The value of all goods and other markets services provided to the rest of the world.	\$ US constant of 2015	X	World Bank, WDI
The foreign demand	The imports of goods and services of the main trading partners.	\$ US constant of 2015	D	World Bank, WDI
The real effective exchange rate	The price/cost competitiveness indicator of the home economy compare to the foreign partner.	Base 100=2010	$REER$	Cepii, EQCHANGE
The real gross domestic product	The home production for CEMAC countries	\$ US constant of 2015	Y	World Bank, WDI
The GDP gap as	The output gap	% of potential	$YGAP$	

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percent of potential GDP	computed using the Hodrick-Prescott ³ filter with the smoothing parameter set to 100	output		World Bank, WDI
The domestic demand	The final demand including private and public consumption and gross fixed capital formation ⁴ .	\$ US constant of 2015	<i>DD</i>	World Bank, WDI
The concentration index for goods		It is normalized in order to obtain values between 0 (zero concentration) and 1 (maximum concentration).	<i>CI</i>	UNCTAD

Source: Author

III.RESULTS

These results were grouped according to the Model of exports dynamics. We begin first with the Export Market share Model (equation 1) and following with the Capacity Constraints Model (equation 2). Given the annual periodicity, as in Esteves and Prades (2016) it is assumed that the substitution effect between domestic and foreign markets sales occurs contemporaneously.

A. Export Market share Model

The following Table 2 resumes the causality tests for the Export Market share Model:

Table 2. Results of Dumitrescu-Hurlin (DH) panel causality tests for the Export Market share Model

Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it} - \Delta D_{it}$ $X = REER$ $K = 1$			
X does not homogeneously Granger-cause Y	1.8368	0.7217	0.4705
Y does not homogeneously Granger-cause X	1.4605	0.2840	0.7764
$Y = \Delta X_{it} - \Delta D_{it}$ $X = \Delta REER$ $K = 1$			
X does not homogeneously Granger-cause Y	0.1052	-1.2929	0.1961
Y does not homogeneously Granger-cause X	1.4971	0.3265	0.7440
$Y = \Delta X_{it} - \Delta D_{it}$ $X = \Delta DD$ $K = 1$			
X does not homogeneously Granger-cause Y	4.3717	3.6195	0.0003

³ Hodrick and Prescott (1997).

⁴ Esteves and Rua (2013, p. 15).

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Y does not homogeneously Granger-cause X	2.2122	1.1358	0.2560
$Y = \Delta X_{it} - \Delta D_{it} \quad X = D \quad K = 1$			
X does not homogeneously Granger-cause Y	0.7858	-0.5010	0.6163
Y does not homogeneously Granger-cause X	0.9805	-0.2745	0.7837
$Y = \Delta X_{it} - \Delta D_{it} \quad X = \Delta DD_t \cdot CI_t \quad K = 1$			
X does not homogeneously Granger-cause Y	3.1429	2.1869	0.0288
Y does not homogeneously Granger-cause X	2.0063	0.8871	0.3750

According to these results the standard formulation for the New Export channel holds in the Export Market share Model since there exist a causality from domestic demand change to Export Market share ($\Delta DD \rightarrow \Delta X_{it} - \Delta D_{it}$). The complementary issue of Berman et al (2011) is tested at the end of the Table and it's proved that this issue don't hold. Then we now proceed to the Asymmetric causality test.

Table 3. Results of Dumitrescu-Hurlin (DH) Asymmetric panel causality tests for the Export Market share Model

Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = \Delta DD_t^+ \cdot CI_t \quad K = 1$			
X does not homogeneously Granger-cause Y	2,3017	1,2336	0,2174
Y does not homogeneously Granger-cause X	2,0005	0,8879	0,3746
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = \Delta DD_t^- \cdot CI_t \quad K = 1$			
X does not homogeneously Granger-cause Y			
Y does not homogeneously Granger-cause X			
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = \Delta DD_t^- \quad K = 1$			
X does not homogeneously			

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Granger-cause Y			
Y does not homogeneously Granger-cause X			
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = \Delta DD_t^+ \quad K = 1$			
X does not homogeneously Granger-cause Y	4.2096	3.4331	0.0006
Y does not homogeneously Granger-cause X	2.1487	1.0627	0.2879

Then according to these results just the assumption that only the positive changes in domestic demand variable seems to hold has we reject the null hypothesis that the positive changes in domestic demand does not Granger cause the Exports dynamics.

B. Capacity Constraints Model

The following Table 4 resumes the causality tests for the Capacity Constraints Model :

Table 4. Results of Dumitrescu-Hurlin (DH) panel causality tests for the Capacity Constraints Model

Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = REER \quad K = 1$			
X does not homogeneously Granger- cause Y	1.9490	1.0773	0,2813
Y does not homogeneously Granger- cause X	0.8507	-0.3830	0,7017
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = \Delta REER \quad K = 1$			
X does not homogeneously Granger- cause Y	0,5225	-0,8194	0,4125
Y does not homogeneously Granger- cause X	0,4518	-0,9135	0,3610
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = YGAP \quad K = 1$			
X does not homogeneously Granger- cause Y	0.9871	-0.2016	0,8402
Y does not homogeneously Granger- cause X	0.3040	-1.1100	0.2670

Then we now proceed with the Asymmetric causality test.

Table 5. Results of Dumitrescu-Hurlin (DH) Asymmetric panel causality tests for the Capacity Constraints Model

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Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = YGAP^+ \quad K = 1$			
X does not homogeneously Granger-cause Y	0,5271	1.0773	0,2813
Y does not homogeneously Granger-cause X	0,4539	-0,9113	0,3621
$Y = \Delta X_{it} - \Delta Y_{it} \quad X = YGAP^- \quad K = 1$			
X does not homogeneously Granger-cause Y	0,5022	-0,8474	0,3968
Y does not homogeneously Granger-cause X	0,3838	-1,0043	0,3152

C. New Results

Then these results raise the question of an adequate specification for exports dynamics. For this purpose, we avoid the assumption of unitary elasticity for the foreign demand in the Export Market share Model and for the real output in the Capacity Constraints Model (Kuikeu, 2025a) so that the change in export becomes the main measure of exports dynamics. The results are compiled in the following Table 6 for the Export Market share Model and Table 7 for the capacity constraints Model.

Table 6. New Results of Dumitrescu-Hurlin (DH) panel causality tests for the Export Market share Model

Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it} \quad X = D \quad K = 1$			
X does not homogeneously Granger-cause Y	2.6761	1.7445	0.0811
Y does not homogeneously Granger-cause X	0.8493	-0.4243	0.6714
$Y = \Delta X_{it} \quad X = REER \quad K = 1$			
X does not homogeneously Granger-cause Y	2.4086	1.6904	0.0910
Y does not homogeneously Granger-cause X	1.8287	0.9187	0.3582
$Y = \Delta X_{it} \quad X = \Delta REER \quad K = 1$			
X does not homogeneously Granger-cause Y	0.5644	-0.7634	0.4452
Y does not homogeneously Granger-cause X	1.7181	0.7716	0.4404

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$Y = \Delta X_{it}$ $X = \Delta DD$ $K = 1$			
X does not homogeneously Granger-cause Y	1.7434	0.7749	0.4384
Y does not homogeneously Granger-cause X	1.3983	0.3244	0.7456
$Y = \Delta X_{it}$ $X = D$ $K = 1$			
X does not homogeneously Granger-cause Y	2,6761	1,7445	0,0811
Y does not homogeneously Granger-cause X	0,8493	-0,4243	0,6714

According to these results the standard formulation for the Old Export channel holds since there exists a causality from foreign demand to exports change ($D \rightarrow \Delta X_{it}$) and from Real Exchange Rate to exports change ($REER \rightarrow \Delta X_{it}$). As precedly the complementary issue of Berman et al (2011) is tested at the end of the Table and it's proved to hold in this case ($DD \rightarrow \Delta X_{it}$)

Table 7. New Results of Dumitrescu-Hurlin (DH) panel causality tests for the Capacity constraints Model

Null hypothesis	W-bar	Z-bar	p-value
$Y = \Delta X_{it}$ $X = D$ $K = 1$			
X does not homogeneously Granger-cause Y	2.6761	1.7445	0.0811
Y does not homogeneously Granger-cause X	0.8493	-0.4243	0.6714
$Y = \Delta X_{it}$ $X = REER$ $K = 1$			
X does not homogeneously Granger-cause Y	2.4086	1.6904	0.0910
Y does not homogeneously Granger-cause X	1.8287	0.9187	0.3582
$Y = \Delta X_{it}$ $X = \Delta REER$ $K = 1$			
X does not homogeneously Granger-cause Y	0.5644	-0.7634	0.4452
Y does not homogeneously Granger-cause X	1.7181	0.7716	0.4404
$Y = \Delta X_{it}$ $X = YGAP$ $K = 1$			
X does not homogeneously Granger-	1.9084	1.0247	0.3055

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cause Y			
Y does not homogeneously Granger-cause X	2.7722	2.1742	0.0297

According to these results there is a Reverse causation from exports change to output gap ($\Delta X_{it} \rightarrow YGAP$).

IV. CONCLUSIONS

According to the standard frameworks for assessing exports dynamics the traditional determinants of international trade are the level of Real Exchange Rate, the Real Exchange Rate change, the domestic demand and the domestic demand change. In accordance to the standard frameworks, the Granger causality tests for panel data reveals that these are effectively determinants of international trade. Once more there is effectively a Reverse causation (Kuikeu, 2025c) This analysis confirms with those of Fontagne et al (1998) according to which the economy's standard of living a good proxy to the domestic demand is an favorable determinant to the international trade with the cost to trade a good proxy to the Real Exchange Rate.

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