The determinants of trade in the Central African Economic and Monetary Union

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ABSTRACT

Bilateral trade between the economies of the Central African Monetary and Economic Union is low relative to trade in other economic unions in Africa. Understanding what actually determines trade in the CEMAC regions can offer useful insights for policies that promote trade. This study uses a modified gravity model of trade on panel data for the six member states of CEMAC and fourteen trading partners to investigate the relationship between trade and its determinants. Panel data unlike cross-section and time series analysis allow us to control for unobservable individual specific characteristics that affect trade. The results of the study show that membership of CEMAC did not increase trade among member states during the period from 1998-2008. The results highlight the importance of distance and being landlocked as obstacles to trade within the region and between CEMAC economies and overseas trading partners.

Keywords: gravity model, economic and monetary union, pooled model, fixed effects, random effects, Haussmann-Taylor

INTRODUCTION

The recent emergence of economic blocs has been attributed to economic and political motives (Baldwin 1997). The formation of trade blocs, a form of economic union, has been undertaken in attempts to create incentives for political cooperation and stability. Schiff and Winters (1997) in particular, hold that by grouping their economies, countries tend to avoid conflicts and security threats. Another reason for the creation of trade blocs is that reaching multilateral agreements on trade liberalization under the General Agreement on Tariff and Trade and the World Trade Organization is often more daunting than is the case within trade blocs where countries are fewer and negotiation is easier. From the economic perspective, the formation of economic blocs is motivated by the allocation effect and the growth effect arising from free trade within an economic bloc (Baldwin 1997).

The allocation effect requires that in a competitive economic system resources are allocated for the production of goods based on peoples' demand for those good. Thus demand acts as a signal for interaction between consumers and producers. When tariffs and non-tariff barriers interfere with this signal, it becomes necessary to clear such barriers through regional integration (UNCTAD 2009). A consequence of the allocation effect according to Baldwin (1997) is the scale and variety effects. Regional integration could also lead to the creation of large markets which would allow access to small firms thus enabling them to reach optimal sizes lowering costs and prices for the consumers. As concerns the variety effect, economic integration creates a wider market allowing consumers to choose from a variety of products at lower prices. At the level of the firm, this creates an incentive for more efficient use of its inputs and could increase productivity.

As regards the growth effect, economic integration expands regional markets, attract more suppliers to these markets and this gives firms the opportunity to specialize which in turn reduces average costs of production within the trade bloc. This has the tendency of increasing the return to physical and non-physical factor accumulation. Regional integration accounts for an increase in the mobility of human capital, technological spillovers, an increase in productivity and the reduction of production costs which help to attract more investment and capital accumulation. The location decision of foreign firms can be significantly influenced by the formation of trade blocs. Krugman (1991) has pointed out based on the new economic geography school that market size, the cost of production, the availability of relevant production factors and market access are the key location variables.

Although regional integration has many positive effects on trade, supporters of free trade argue that regional trade limits rather than promote trade (Schiff, 1997; World Bank 2000). The argument advanced in support of this opinion is that trade blocs raise tariffs and non-tariff barriers thus inhibiting substantial inflows of productive resources from non-members. This may result in inefficient resource allocation and production which may diminish welfare gains from competition.

In Africa, regional integration was pursued to enhance political unity at Pan African level and as a means to foster economic growth and development (UNCTAD 2009). With the desire to promote economic integration and in some cases monetary integration, there has been a multiplicity of regional and sub-regional economic groupings across the continent (Nnanna, 2006). Compared to other regions of the world, Africa's trade costs are the highest and this tends to discourage foreign investment and also place limits on bilateral trade. The expansion of the market through regional integration can significantly relax this constraint. Thus free movement

of factors of production as envisioned in trade agreements can help to keep production costs at low levels, attract investments and increase competition and efficiency. This is even more significant considering that population wise African countries are typically small with over 70 percent of them having a population of less than or equal to fifteen million people including some with as low as three million or less. In terms of purchasing power, African countries are also small, given that thirty-one out of the forty-six least developed countries in the world, as classified by income level, are found in Africa (UNECA, 2010).

Despite the proliferation of regional economic groups in Africa, intra-regional trade between African countries and especially between members of the same economic unions is limited. Countries belonging to various economic blocs have taken limited measures in fully reducing tariffs and eliminating non-tariff barriers, and in adopting common economic policies that promote growth and these tend to impede meaningful economic integration that foster trade between member states. While the problems faced by regional economic communities are generally similar, the kinds of arrangements remain varied. This study focuses on the Central African Economic and Monetary union (CEMAC). CEMAC effectively replaced the Customs and Economic Union of Central African States (UDEAC) in 1999. What is particular about this union is that it was created both as an economic and monetary union with the member countries sharing a common currency, the franc CFA (Coopération financière en Afrique Centrale).

Free trade agreements between countries of this sub-regional group require among other arrangements that members substantially reduce or eliminate all forms of tariffs and non-tariff barriers to trade for greater market integration and increase in production and volume of trade flows (Freund and Ornelas, 2009). The currency union as in the case of CEMAC is a multilateral arrangement with far reaching economic and political implications as even barriers to labor and capital flows are removed and individual countries give up both their fiscal and monetary autonomy. In particular, the implementation of policies in the currency union has implications on regional trade. A currency union enhances trade by eliminating exchange rate volatility among member countries thereby reducing the transaction costs that hinder trade flows between countries and regions. Celine (2003) suggests that trade creation effects mostly result from a common currency arrangement.

Various studies carried out in the last decade show a general consensus that economic and monetary unions enhance trade between member countries (Rose and Stanley 2005; Frankel and Rose, 2000 Rose, 2000; Alejandro et al, 2003). In the case of Africa, however, no such consensus was found. While some studies found positive and large as well as small effects, a few others have found zero or negative effects. The Central African Economic and Monetary Union is one of Africa's economic blocs that raise some concern. The level of intra-regional trade between member states of the sub-region is low. Intra-regional trade among economies of the Economic Community of Central African Countries (ECCAS) where CEMAC countries are also members accounts for only 2 percent or less of total trade and apparently has the lowest intra-regional trade share of all regional economic communities in Africa (UNCTAD, 2009).This raises questions on the effectiveness of economic and monetary unions as an instrument that promotes stability and trade among member states. This study uses the gravity model to investigate the determinants of bilateral trade between CEMAC economies and between these economies and their major trading partners to have a clear understanding of the extent to which economic and monetary integration contributes to the expansion of bilateral trade. Investigating the determinants of bilateral trade in the CEMAC region is crucial in understanding why intra-

regional trade within the region is limited despite the global positive view of regional integration on both regional and international trade.

THE CENTRAL AFRICAN ECONOMIC AND MONETARY UNIONS

A total of six countries make up the Central African Economic and Monetary Union including Cameroon, Central Africa Republic, Chad, Republic of Congo, Equatorial Guinea and Gabon. These countries are also member states of the Economic Community of Central African States (ECCAS). The regional central bank of the six countries of CEMAC is the Banque des Etats de l'Afrique Centrale (BEAC). The common currency used by CEMAC countries is the Franc CFA which was pegged to the French franc at a fixed exchange rate of 50 franc CFA per French franc for 45 years. In its whole history, the franc CFA was devalued once in 1994 from the 50 franc CFA per French franc to CFA 100 per French franc. The changes require a unanimous agreement by member states of the Union Monétaireet Economique Ouest Africaine (UEMOA), member states of the CEMAC and France. The monetary rules put in place since 1973 require that the central banks of CEMAC and UEMOA each deposit 65 % of its foreign exchange holdings into the French Treasury while maintaining 20% foreign exchange for sight liabilities coverage each. This in practice is intended to limit an open-ended access to the operation accounts that the banks maintain with the French Treasury.

Following the formation of the European economic and monetary union, the CFA franc became pegged to the Euro with the support of the French Treasury-budgetary arrangement at an exchange rate of 1 euro = 655.957 francs CFA. Following this arrangement, the franc CFA is guaranteed by the European Central Bank and there are no monetary implications for the latter. Each of the central banks issuing the franc CFA maintains an operation account with the French Treasury and the French Treasury guarantees the convertibility of the franc CFA into Euros. How this affects the CFA franc countries in the future depends on CFA franc countries keeping up with their efforts and commitment to better economic management. This indeed implies that these countries have to adhere to very strict monetary and fiscal discipline imposed by the European Central Bank.

It appears since the new arrangement that the advantages from this anchor to the euro overshadow the potential risks in principle. In the medium to long run, the principal risks would be linked to how strong the euro is with respect to other major currencies (pound, dollar, yen, and Swiss franc). The CFA franc zone produces and exports a limited number of basic products whose prices are quoted in dollars. Although CFA franc countries carry out more than 50 % of their trade with the European Union members, the trade is denominated in dollars.

The benefits of monetary and economic union are assessed in terms of macroeconomic stability and economic integration among member countries in the form of expanded trade and free movement of capital within the union. Macroeconomic stability requires that member countries agree to improve on price stability, reduce exchange rate variability, save resources from pooling of foreign exchange reserves and the centralisation of monetary policy. A full monetary union would ensure and support an open trading regime. When countries join monetary unions, they lose their monetary independence so that the costs of a monetary union are measured in terms of the loss of the exchange rate as an instrument for adjustment among members and also the loss of seigniorage and inflation tax revenue.

Economic performance in the CEMAC zone has been quite impressive relative to that in other economic groupings. Between 1997 and 2005, the region grew at the rate of 7.6 percent

making it the highest performer among all the regional groupings (Nnanna 2006). It also outpaced Africa's growth rate of 3.8 percent during the period. However, intra-regional trade for the bloc was only 1.3 percent representing the lowest in the continent. The average inflation rate was low and estimated at 3.1 percent making it the second best after that of UEMOA and was 7.4 percent lower than the African average. The countries of the union also had a fiscal surplus of 2.1 percent of GDP making the bloc the best performer relative to other groupings which suffered from deficits of different sizes.

The overall performance of the franc CFA countries before the devaluation of the franc CFA in 1994 was a dismal one in spite of the strict budgetary discipline and low inflation compared to other African countries (Devarajan and Milo 1987). One of the main constraints faced by these unions is the lack of and difficulty in adjusting to the external environment which led to exchange rate misalignment and economic problems of the late 1980s and early 1990s (Devarajan and Milo 1991). An important benefit from economic integration is the ability of the union to promote growth in exports and cross-border trade and investment among member countries. Yet intra-regional trade in the CEMAC region accounts for only a small percentage of the overall trade in the region. While intra-regional trade in economic unions such as UEMOA has been quite impressive, in the CEMAC, the percentage of intra-regional trade fell from 4.9 percent in 1970 to barely 1.6 percent in 1980. The ratio rose to 2.3 percent in 1995 and fell to 2.1 by 2000. The overall average has been maintained at below 1.5 percent and in value terms, it has remained consistently below US$85.0 million although when the time frame is modified to between 1995 and 2004, the average value rises above US$100.0 million. The trade estimates are from official sources and do not include informal trade between these countries which can be very significant.

THE GRAVITY MODEL OF TRADE

This study employs the gravity model to analyze bilateral trade flows within the CEMAC region. It examines factors that contribute to variations in the volume of trade between these countries and trade with major trading partners. The gravity model of international trade was first developed by Tinbergen (1962) to explain bilateral trade flows and between two countries. The model considered both countries as organic bodies that attract each other in proportion to their levels of economic activity and income, and the extent of the impediment to trade. The latter include transport costs, trade policies, uncertainty, cultural differences, and various bottlenecks. While these factors may well determine the volume of trade flows in sub-Saharan African countries, the high cost of transport in addition to poor transport infrastructure are important barriers to trade.

The gravity model has been used extensively as a baseline for estimating the impact of policy issues, such as regional trading arrangements, currency unions, political blocks, and various impediments to trade (Havrylyshin and Prichett 1991; Frankel and Wei 1993; Bayoumi and Eichengreen 1997; Frankel and Wei 1998; Frankel, Stein and Wei 1998; Smith 1999; Rose 2000). The deviations from the baseline gravity model are modeled by these events and policies. Furthermore, dummy variables are used to gauge the impact of economic integration on trade. On a more aggregate level of the analysis, various macroeconomic variables such as gross domestic products, populations and geographical location have been used as powerful predictors of trade potential of nations.

Model Specification

The literature on the gravity model and key elements of the trade theory has shown that the gravity model can be derived from both the traditional and the new theory of international trade rather than just from the new theory as suggested by Helpman and Krugman (1985). Bergstrand (1985) has used microeconomic foundations to explain the gravity model by specifying the supply side of the economies. Eaton and Kortum (1997) developed a Ricardian framework while Deardorff (1998) showed that the gravity model could be derived from two extreme cases of the Heckscher-Ohlin model with and without trade impediments. Although there are various specifications of the gravity model, this study employs the following general specification of the gravity model to investigate factors that account for trade within the CEMAC countries and between these economies and overseas countries:

$$X_{ij} = \alpha_0 (Y_i)^{\alpha_1} (Y_j)^{\alpha_2} (N_i)^{\alpha_3} (N_j)^{\alpha_4} (D_{ij})^{\alpha_5} (A_{ij})^{\alpha_6} \mu_{ij} \tag{1}$$

where Xij is the value of the trade flow from country i to country j; Y_i and Y_j are the values of real gross domestic product in the exporting and importing countries respectively and represent the size of both economies. N_i and N_j represent the exporter and importer populations, D_{ij} measures the physical distance from the economic center of country i to that of country j and captures the transport costs. A_{ij} represents any other factors that contribute to or obstruct bilateral trade and μ_{ij} is the error term. The α_s are interpreted as coefficients of elasticity of exports in respect to changes in gross domestic product, population, distance and real exchange rate. The coefficients of the GDPs of the exporting and importing countries are expected to be positively related to trade. The coefficient estimates for the population may either be positive or negative depending on whether a country exports less when it has a larger population (absorption effect) or whether a larger country exports more than a smaller country (Prewo (1978) and Bergstrand (1986). The coefficient of the distance variable is expected to be negative since longer distance entail higher cost of trade. Krugman (1991) emphasized on the role of geographical proximity in the regionalization process. He showed in his analysis that a pair of countries with low transportation costs between them will tend to have a higher volume of trade than countries further apart. Higher transport costs are expected to reduce trade so that the effect of distance on trade is negative.

The generalized gravity equation is rendered estimable in the following log-linear form:

$$\ln X_{ij} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln N_i + \alpha_4 \ln N_j + \alpha_5 \ln D_{ij} + \alpha_6 A_{ij} + \mu_{ij} \tag{2}$$

We augment the gravity model shown in equation (1) in order to account for as many factors as possible that affect trade. These variables potentially account for cultural phenomenon, geographical nature of the two countries, and the historical nature of the relationship between the two countries. Further, we extend the gravity equation by considering the preferential trade policies which entails unilateral reduction in trade barriers granted by developed countries to developing countries. These are expected to stimulate exports from developing countries to the preference-giving country yielding a higher flow of trade than that which would normally be expected. We also take into account the location of the country with particular interest in whether

they are coastal countries or landlocked countries. Given the total trade flow or exports, we augment equation (2) as follows:

$$\ln X_{ij} = \alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln N_i + \alpha_4 N_j + \alpha_5 \ln Landl_{ij} + \alpha_6 \ln D_{ij} + \alpha_7 \ln A_{ij} + \mu_{ij} \quad (3)$$

where α_0 is the portion of the intercept that is common to all years and the trading countries. *Landl* is a landlocked dummy which is equal to 1 if the exporting or the importing country has a coast, and zero, otherwise. N_i and N_j are the sizes of population in both countries; A_{ij} is any other factor that either enhances or hinders trade among i and j; and u_{ij} is a normally distributed random error term with $E\ (ln\mu_{ij}) = 0$.

   We also introduce the bilateral real exchange rate (RERji) as a proxy for relative prices. An increase in RER reflects a depreciation of the importing country's currency against that of the exporting country which should reduce imports and as a result, one would expect α_9 in equation (4) and α_{11} in equation (5) to be less than zero. The intra-union gravity equation is a restricted gravity model applicable to trade within the CEMAC custom and monetary union augmented by country pair-specific variables as follows:

$$\ln(X_{ijt}) = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 \ln N_i + \alpha_5 \ln N_j + \alpha_6 BOR_{ij}$$
$$+ \alpha_7 Landl_{ij} + \alpha_8 CCOL_{ij} + \alpha_9 \ln RER_{ijt} + \mu_{ijt} \quad (4)$$

where *BOR* is a dummy that takes the value 1 if countries i and j share a common border and 0 if otherwise, D_{ij} is the lateral distance that separate the economic (or capital) centers of countries i and j in kilometers. And $CCOL_{ij}$ is a dummy that takes the value 1 if country i and country j have a common colonizer and zero, otherwise. Equation (4) can also be augmented by including a variable that measures preferential trade agreements between countries of the CEMAC region and their major trade partners as follows:

$$\ln(X_{ijt}) = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \alpha_3 \ln D_{ij} + \alpha_4 \ln N_{ti} + \alpha_5 \ln N_{jt} + \alpha_6 P_{ij} + \alpha_7 BOR_{ij}$$
$$+ \alpha_8 Landl_{ij} + \alpha_8 CEMAC + \alpha_9 CCOL_{ij} + \alpha_{10} EU + \alpha_{11} RER_{ji} + \mu_{ijt} \quad (5)$$

where, P_{ij} is a dummy equal one if the exporting and importing country have a preferential trade agreement such as the case of the European Union and most Sub Saharan African countries and zero otherwise. EU is dummy that takes the value 1 if the country trading with a CEMAC country is a member of the European Union and 0, otherwise. $CEMAC_{ij}$ is a dummy that takes the value one if countries i and j belong to the CEMAC economic and monetary union and zero otherwise. By including CEMAC as a dummy in the specification, it enables us to investigate if belonging to the monetary and economic union is beneficial to trade or not. The arrangements require that member states put in place trade-friendly monetary policies and remove tariff and non-tariff restrictions on trade. Given that the monetary union is well structured compared to others in Africa, we expect a significant and positive effect of the CEMAC dummy on trade.

Data and Estimation Procedure

In this study, we construct a panel dataset in case of total exports. The set of importing countries consist of France, Italy, Germany, Spain, Belgium, Switzerland, Holland, Britain, USA , India, China, Morocco, Japan and Canada while the exporting countries include all CEMAC countries. These countries are listed in Appendix A. To ensure that there is sufficient coverage, we use data from 1998 to 2008. Each annual bilateral export flow is an observation. We consider only positive trade values thus dealing with the problem of zero-trade and missing values. In this analysis we use export data obtained from the International Monetary Fund Direction of Trade Statistics Yearbooks 2005 and 2009, the IMF World Economic Outlook 2009 for the population and GDP data. The geographical distance is the distance between the capital cities of two countries. Distances can be estimated by browsing on http:/www.wcrl.ars.usda.gov/cecl/java/lat-long.htm.

To successfully estimate equations (4) and (5), we employ panel data which enables us to control for unobservable factors specific to both the exporting and the importing countries that determine bilateral trade between both countries. Thus we include bilateral effects in the model to account for heterogeneity in bilateral trade relations. These effects are modeled as random effects judging that the fixed effects model is grossly inadequate since the 'within' transformation removes variables such as distance, common border, common colonizer or some other time-invariant regional dummies. Other common estimation approaches such as pooled ordinary least squares (OLS) and random effects produce coefficients that are biased when the time-variant variable is correlated with the unit fixed effects. Since unit effects are unlikely to be uncorrelated with time-variant variables and they are also unlikely to be normally distributed, estimating the gravity model by way of either pooled OLS or random effects may lead to biased results.

However both approaches may be recommended when time-invariant variables are uncorrelated with the unit fixed effects. Random effects specification performs better than pooled OLS in the presence of time-invariant variables. When time-invariant variables hinder the estimation of unit fixed effects, random effects become preferable to pooled OLS estimation. The Hausman test based on the differences between 'within' and generalized least squares estimates reveals correlation between the bilateral specific effects and the explanatory variables. Hence, this problem is overcome by way of instrumental variables estimation proposed by Hausman and Taylor (1981) which suggest the use of instruments for the variables that are likely to be correlated with the random effects. The Hausman-Taylor approach performs better than the random effects and pooled OLS when time-variant variables are correlated with unit effects.

ESTIMATION RESULTS OF THE BILATERAL TRADE MODEL

We estimate the pooled or ordinary least squares model, the fixed effects, random effects and the Hausman-Taylor models and with various tests, determine which of these models is most appropriate when estimating the flow of trade within the CEMAC region and between CEMAC economies and randomly selected trade partners.

Estimation Method and Results

A common problem encountered when modeling trade flows using panel data is that there are unobservable time invariant random variables which are difficult to be quantified and which may have influence on some explanatory variables and even the volume of trade. Ordinary least squares (OLS) or the pooled model does not allow for the heterogeneity of countries, it also fails to estimate country specific effects and assumes that all countries are homogenous. Table 1 and Table 2 show the estimation results of the two equations used in this study. In both estimated equations, the Breusch-Pagan test rejects the null hypothesis in favor of the random effect model implying that the OLS is not adequate for this study.

Table 1. Estimation Results: Intra-CEMAC Countries Trade Flows

Variables	Fixed Effects	Random Effects	Hausman-Taylor
Intercept	- 2.865 (-1.74)	9.396 (1.02)	9.680 (0.94)
RGDP exporter	-0.003 (0.01)	0.249 (1.54)	0.252 (1.13)
RGDP importer	-0.285 (-0.77)	-0.055 (-0.38)	-0.073 (-0.34)
Pop exporter	2.319 (0.83)	1.408*** (3.80)	1.4178*** (3.31)
Pop importer	0.5654 (0.19)	-0.10 (-0.25)	-0.124 (-0.33)
Distance		-2.373* (-1.87)	-2.399* (-1.73)
Border		2.848*** (2.43)	2.829*** (2.15)
landlocked		-2.340*** (-2.49)	-2.332*** (-2.62)
Common colonizer		1.1155 (1.54)	1.113 (1.05)
Number of obs	330	330	330
R-squared	0.1179	0.765	
Hausman test		3.53	
Breusch and Pagan test		978.49***	
Heteroskesdasticity test	23615.31***		
Test of over-identification (Sargan-Hasen statistic)			3.571

***, **, and * significant at 99%, 95% and 90% respectively (t-student are in brackets)

The fixed effect model allow for unobserved factors that explain the volume of trade between two countries and leads to unbiased and efficient results (Bair and Bergstrand 2005; Carrere 2006; Rose 2000). The model also assumes that there are time-invariant characteristics that are unique to the individual and should not be correlated with other individual characteristics. The fixed effect from the econometric standpoint is preferable to the random effects since it is

unlikely that the unobserved specific random effects are uncorrelated with the explanatory variables (Baier and Bergstrand 2005). The fixed effect model is no longer effective if the error terms are correlated. In this case, the random effect model provides a better method of estimating the model. The random effect assumes that the entity's error term is not correlated with the explanatory variables which allows for time-invariant variables to play a role as explanatory variables.

Table 2. Estimation Results: Bilateral flows from CEMAC Countries to Trading Partners

Variables	Fixed Effects	Random Effects	Hausman-Taylor
Intercept	-1.527	8.236	8.706
	(-0.79)	(2.66)	(1.87)
RGDP exporter	0.942***	1.092***	1.112***
	(3.21)	(5.64)	(6.50)
RGDP importer	1.054***	0.704***	0.622**
	(3.12)	(3.88)	(2.38)
Pop exporter	1.461	0.014	0.066
	(1.22)	(0.07)	(0.19)
Pop importer	-2.232**	0.246	0.1919
	(-1.88)	(0.90)	(0.51)
Real exchange rate	-1.664***	-1.818***	-1.830***
	(-4.65)	(-7.59)	(-7.21)
Distance		-2.735***	-2.710**
		(-4.26)	(-2.49)
Preferential Trade Agreement		-0.568*	-0.742
		(1.28)	(-1.32)
CEMAC		-1.706***	-1.822*
		(-2.42)	(-1.83)
Common Language		0.311*	0.310
		(1.66)	(1.03)
Landlocked		-0.664***	-0.668**
		(-2.71)	(-2.04)
EU	0.649***	0.451**	0.555***
	(2.31)	(1.79)	(2.50)
Number of observations	1254	1254	1254
R-squared	0.027	0.540	
Hausman Test	9.43		
Breusch&Pagan test		3136.86***	
Heteroskesdasticity	832.49***		
Test of over-identification			7.731

***, **, and * significant at 99%, 95% and 90% respectively (t-student are in brackets)

We decide between fixed and random effects models by employing the Hausman (1978) test for each of the samples. The test indicates whether the specific effects are correlated or not with the explanatory variables. A high value of the Hausman test (or p-value < 0.05) indicates that the errors are correlated with the independent variables and the fixed effect model is

preferred to the random effect model. Consequently, the random effects model would be inconsistently estimated in the presence of such correlation. The absence of such correlation implies that the random model should provide consistent estimates of the coefficients. Besides, it allows for time invariant variables to play a role as explanatory variables. The results of the Hausman tests of the differences between random effects and within estimates are presented in both tables.

The test results (H=1.35 distributed as Chi2(5), with p-value = 0.9302) accepts the null hypothesis that there would be correlation between the bilateral specific effects and the explanatory variables for the intra-CEMAC sample hence the random effects model (GLS) estimator is unbiased and efficient. The result of the test for the whole sample (H=9.90, distributed as Chi2 (6), with p-value = 0.1288) equally show that the null hypothesis of no correlation is accepted and the random effect model of panel estimation is the appropriate estimation strategy. Furthermore, the fixed effect model uses only the within variance for the estimation and disregards the between variance, and does not allow the estimation of time-invariant variables so that bilateral effects are modeled as random variables (Baltigi 2001; Hsiao 2003; Wooldridge 2002).

Homoscedasticity in panel data is always assumed and needs to be tested. We use the modified Wald test for group-wise heteroskedasticity in fixed effect regression to test for heteroskedasticity. Table 1 and Table 2 report a p-value of 0.000 for both samples indicating the presence of heteroskedasticity. We control for heteroskedasticity in both the fixed and the random effects models by using the option 'robust' in the estimations.

Although the Hausman test supports the choice of the random effects over the fixed effect model, variables such as gross domestic product for the exporting and the importing countries may be correlated with bilateral specific effects. This problem can be dealt with using instrumental variables estimation such as Hausman-Taylor (1981). The Hausman-Taylor method also incorporates time-invariant variables correlated with bilateral specific effects. We performed a Hausman-Taylor test of over-identification based on the comparison of the Hausman-Taylor estimator and the fixed effect model. The results indicate the choice of the Hausman-Taylor estimator because it is more efficient, allowing for estimating time-invariant effects.

Discussion of Regression Results on Panel Data

The results discussed here are based on the Hausman-Taylor estimation presented in the fourth columns of Table (1) and Table (2). The estimated results of the intra-CEMAC equation indicate that most of the key variables specified in the traditional gravity model of trade are significant with the expected signs. The results indicate the GDP for the exporting economies is positively related to bilateral trade between CEMAC countries but is not a significant determinant. Surprisingly and contrarily to economic theory, the GDP of the importing country is negatively related to bilateral trade within the region suggesting lower imports by CEMAC countries from other members of the union. The population of the exporting country has a positive and significant effect on bilateral trade (1.42, t = 3.31) while that of the importing country is negatively related to trade as expected (-0.12, t = -0.33). The larger the population of the importing country, the more diverse is its production thus making the country more self-sufficient and it is normally expected to be negatively related to trade. The results also show that geographical distance has a negative and significant effect (-2.40, t = (-1.73)) on bilateral trade between the economies of the custom and economic union. The results also show that land

border with the expected positive coefficient is a significant determinant of bilateral trade (5 percent level). The significance of land border in explaining trade within the CEMAC region highlights one of the key concerns for trade within the region which is transport infrastructure and proximity. Bilateral trade between countries in the region tends to be higher when the country-pair share a common border than those that do not share a common border.

Another variable of key interest which is also a robust determinant of bilateral trade in the CEMAC region is landlocked. Out of the six countries that make up the membership of the economic and monetary union, two are landlocked and have access to the coast through land transit via other countries which is costly. The estimated results are robust and highly significant at 1 percent indicating the difficulties faced by landlocked countries in bilateral trade. The real exchange rate variable is significant at 10 percent and has a negative coefficient implying that real exchange rate of CEMAC countries has a significant but negative impact on trade within the region.

In estimating the second equation, variables such as the real exchange rate, the EU and CEMAC dummies, preferential trade agreements between some of major trading partners and the CEMAC economies, and common language have been added. These are all dummies which take the value 1 if the variable is observed during the period under consideration and 0 otherwise. The estimates of the whole sample in Table (2) show interesting results.

The coefficient of the GDP of the exporter countries is highly significant and has a positive sign implying that an increase in the GDP of CEMAC economies will increase their exports to trading partners. The results also indicate that an increase in the GDP of the importing country leads to an increase in imports from the CEMAC region because of the high absorbing capacity of the importing country. Like in intra-CEMAC trade, geographical distance has a negative and significant (-2.71, t = -2.49) impact on bilateral trade. Equally significant is the landlocked variable with estimated coefficient of -0.67 and t-value of -2.04. Landlocked countries have the disadvantage that their products must pass land transit via other countries to reach the nearest seaports. These products are subject to custom regulations, roadblocks, checkpoints, and fares that render trade expensive for landlocked countries.

The real exchange rates of the CEMAC countries is strongly significant with a negative sign (-1.83, t = -7.21) implying that a depreciation of the currencies of the trading partners against that of the CEMAC economies reduce exports from the region. Distance is also a significant variable that accounts for bilateral trade flows between CEMAC countries and other countries (-2.71, t = -2.49). The variable has the expected negative sign and is significant in the Hausman-Taylor estimates with elasticity of -2.70.The CEMAC dummy is a significant determinant of bilateral trade but is negative implying that belonging to CEMAC region does not increase bilateral trade for member countries and is thus not an advantage for trade. Contrarily, the EU variable is positive and also significant (0.55, t = 2.50) at 5 percent indicating that membership of European Union countries having bilateral trade with CEMAC countries has a positive impact on trade between those countries and those of the CEMAC region. The trade preference variable is only significant in the random effect model and has a negative sign in both models. This may probably explain the fact that these trade preference agreements do not actually provide any trade advantages to CEMAC countries.

CONCLUSION

We have used panel data on trade between CEMAC economies and between these economies and a set of randomly selected countries with which they trade bilaterally. The use of panel estimation methods provides acceptable results because it allows for controlling the individual heterogeneity of the countries to avoid results that are biased and inconsistent. Based on the tests for the choice of the appropriate model, we settled on the random effect model which appears convenient for our sample compared to the often appropriate fixed effect model and the Hausman-Taylor estimator which was tested to perform better than the fixed effect model. We estimated the bilateral trade model after correcting for income, country size and distance and we equally introduced dummy variables to capture effects specific to countries and to the groups.

The results show the relevance of the time invariant variable 'distance' as an important determinant of bilateral trade between CEMAC countries and between these countries and other trading partners. The results also show the significant role of variables such as GDP, common border, common language, real exchange rate and being landlocked or not in explaining bilateral trade in the CEMAC region. Surprisingly and in contrast to results obtained by Carrere (2002), regional trade agreements increase trade, the CEMAC dummy is not a significant determinant of trade between countries of the region. This finding supports the evidence that trade between these countries is the least among all regional trading groups within African (UNCTAD, 2009).

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