Potential Impacts of the Proposed West African Monetary Zone on Cowpea Trade in West and Central Africa

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Abstract

Member countries of the Economic Community of West African States (ECOWAS) are expected to form a West African Monetary Zone (WAMZ) by 2004 whereby member countries would use a common currency in an attempt to promote regional integration. Evidence suggests that reduction in transaction cost as a result of a decrease or complete elimination of non-tariff barriers (NTBs) and a decrease in real interest rates in response to elimination of exchange rate differentials positively influence trade. The objective of this study is to quantify the effects of (a) a 7% real interest rate on capital and (b) zero NTBs within ECOWAS countries on cowpea trade in West and Central Africa in order to provide a measure of the potential impacts of a common monetary policy. The study applied a spatial and temporal price equilibrium (SPE) formulated as a four-period mixed complementary programming (MCP) in GAMS and solved using GAMS/PATH solver focusing on cowpea (*Vigna unguiculata* (*L.*) *Walp*) trade in the Nigerian Cowpea Grainshed (NCG) comprising Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, and Togo in ECOWAS, and Cameroon, Chad, and Gabon in Central African Economic and Monetary Cooperation (CAEMC) using 1999/2000 as base marketing year.

The results showed that if WAMZ results in reduced real interest rates within ECOWAS, the larger of the two monetary unions, consumers in the relatively larger coastal economies and producers in the smaller Sahelian economies would benefit while all others lose. However, net social welfare would increase by 0.19% over the base case of US$6.3 billion. Removing NTBs among countries in the larger trading bloc may alter the pattern of cowpea flows with total trade volume increasing by 3%, but inter-bloc trade decreases by about 8%. The net total regional social welfare would increase by 0.14%, or US$15 million, benefiting only consumers in importing countries and producers in exporting countries. The results emphasize the importance of specialization based on regional comparative advantage, but also draw attention to the need to devise ways to ensure acceptable welfare distribution among producers and consumers in line with policy objectives of the individual countries within the proposed WAMZ. Finally, this paper contributes to the literature on the application of spatial and temporal models incorporating both *ad valorem* tariffs and differential interest rates in developing economies.

Introduction

The Economic Community of West African States (ECOWAS) was established in 1975 by 16 West African countries (Figure 1). It was intended as a common market with the eventual elimination of customs duties and quantitative and administrative restrictions on trade among its members, common customs duties and commercial policy toward non-members of ECOWAS, and free factor mobility among its members in the same fashion as found within the European Community (EC) at the time (Gambari, 1991). In pursuance of their objectives, ECOWAS removed tariffs on agricultural imports yet transaction costs remain high due to non-tariff barriers, such as inefficient transportation services, different currencies, numerous road checkpoints, and unofficial taxes limiting trade within ECOWAS (Knowles, 1990, Obadan, 1984; Gambari, 1991; Henink and Owusu, 1998). For instance, railway lines connecting individual countries within ECOWAS are sparse, making large-scale shipments difficult. There is a common currency, CFA franc (*Communauté Financière Africaine*) within the West African Economic and Monetary Union (WAEMU) established by the Francophone ECOWAS member countries (Figure 1) but that area and ECOWAS are not coincident. Member countries in a parallel monetary union, the Central African Economic and Monetary Cooperation (CAEMC) formed by six Central African Countries (Figure 1) also use CFA (*Cooperation Financière en Afrique)* franc which is equivalent to the WAEMU CFA franc in the sense that both were linked to the French Franc and now to the Euro. All non-WAEMU ECOWAS countries use different currencies of variable stability.

With the currently small fragmented monetary systems, there are substantial inefficiencies in the financial sector and they have a limited ability to act as a shock absorber (Honohan and Lane, 2000). Furthermore, economies of scale are unexploited because of the small sizes of the system components including financial intermediaries, minting of currencies, bank supervision and securities exchanges. To reduce risk through better international diversification of loan portfolios and minimization of the vulnerability of financial crisis, ECOWAS intends to regionalize its banking system through the formation of the West African Monetary Zone (WAMZ) by 2004, the statutes of the West African Monetary Institute which started in January 2001 (ECOWAS, 2001; Masson and Pattillo, 2001). Member countries would use a common currency and monetary policies managed by the West Africa Central Bank. It is envisaged that an ECOWAS Free Trade Zone would be established alongside the WAMZ (Masson and Pattillo, 2001). Formation of a monetary union (MU) eliminates exchange rate uncertainties with implications for reduction in trade transaction costs. MU can also potentially reduce or eliminate checkpoints and other non-tariff barriers thus promoting trade as has been shown in the European Monetary Union (EMU) (Rose, 2000; Persson, 2001; Micco et al., 2002; Takata, 2002; Frankel, 2002; Frankel and Rose, 2002). Although the EMU may be said to be an inappropriate yardstick for the WAMZ, evidence from WAEMU and CAEMC suggest improvement in intra-union trade (IMF, 2000; 2001). This means that WAMZ can have substantial beneficial impacts on trade within ECOWAS, especially the countries in which the share of trade in GDP is large (Frankel, 2002).

The objective of this study is to quantify the impacts of real interest rates and non-tariff barriers on grain trade in West and Central Africa in order to provide an indication of the potential impacts of WAMZ on regional grain trade. The study applied a spatial and temporal equilibrium model focusing on cowpea (*Vigna unguiculata* (*L.*) *Walp*) trade in the Nigerian Cowpea Grainshed (NCG) comprising Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, and Togo in ECOWAS, and Cameroon, Chad, and Gabon in CAEMC (Langyintuo et al., forthcoming). Cowpea is the most economically important African legume produced in most parts of West and Central Africa but production is concentrated in the lower rainfall Sahelian and Sudanian zones (Figure 2) while demand is growing in the densely populated coastal areas. All countries within the NCG (Figure 1) except Gabon produce cowpea, accounting for 90% of cowpea trade in West and Central Africa. An estimated 3.6 million tonnes of cowpea valued at US$1.9 billion are produced and consumed within the NCG, with Nigeria being the largest producer and importer (Langyintuo et al., forthcoming). Unlike traditional trade which is largely external (Yeats, 1999) cowpea trade is within Africa and thus provides a unique opportunity for examining the potential impacts of the WAMZ on grain trade. Furthermore, cowpea has hitherto been neglected in marketing research in Africa (van der Laan, 1999) notwithstanding its economic importance within the region.

Specification of the West and Central Africa Cowpea Spatial and Temporal Price Equilibrium Model (WECACSTEM)

The theoretical framework for the analysis of spatial price equilibrium (SPE) is based on the seminal paper of Samuelson (1952) and subsequent conceptual and algorithmic advances by Takayama and Judge (1964, 1971). The traditional SPE model assumes that each possible pair of regions is separated by a transportation cost per physical unit which is independent of volume, there are no legal restrictions to limit the actions of the profit-seeking traders in each region, and the functions which relate local production and local use to local price, are known; consequently, the magnitude of exports or imports at each local price is also known (Takayama and Judge, 1971; Harker, 1986). The model can be expressed as an optimization problem and solved for (a) the price in each region, (b) the quantity of exports or imports for each region, and (c) the volume and direction of trade between each possible pair of regions.

The application of SPE models is very diverse because it has properties that can serve as a foundation to a host of other models (Labys and Yang, 1997). Peeters (1990) used a multi-commodity SPE model to examine price and quantity impacts of price support and taxes on major imported cereal substitutes in the European Community (EC) feed grain sector. He showed that inter-commodity substitution effects in animal feeding were very important and price cut rather than tax on grain substitutes was far more effective in restoring market balance in the EC. Yang and Page (1993) showed that the impact of an *ad valorem* tax on demand prices is the same for all interrelated spatial regions regardless of their price elasticities. Minot and Goletti (1998) simulated the effect of rice-market policy options on income, prices, production, and consumption in each region of Vietnam and examined options such as relaxing the export quota, replacing the quota with export taxes, and removing restrictions on the internal movement of rice. Their results suggested that although rice export liberalization raised food prices and exacerbated regional inequality, it increased average real income and reduced (slightly) the incidence and severity of poverty. They suggested a slow liberalization of the export market gradually replacing quotas with export taxes. Arndt et al., (2001) used an optic developed by Benirschka and Binkley (1995) to model seasonal flow reversals (or backward transport) under market regimes where storage costs in rural production zones are high. They observed that high storage costs in rural zones induced farmers to sell immediately post-harvest and repurchase late in the marketing season in order to benefit from more efficient storage elsewhere.

In general, empirical models dealing with both *ad valorem* tariffs and differential interest rates are virtually absent. Incorporating a specific tariff in the static SPE model does not violate the integrability of the model nor does a constant discount factor in the dynamic model. In contrast, *ad valorem* tariffs or differential interest rates through space typically violate integrability of the traditional SPE model. The model can no longer be formulated as a single optimization problem. As indicated by Rutherford (1995) re-formulation of the model in a mixed complementary programming (MCP) framework is the most straightforward manner to solve problems of this type. An MCP model consists of a set of simultaneous (linear or non-linear) equations that are a mix of strict equalities and inequalities with each inequality linked to a bounded variable in a complementary slackness condition (Rutherford, 1995). The Kuhn-Tucker optimality conditions define an MCP with the necessary conditions for a local optimum for economic linear and non-linear optimality problems. In this study, an MCP formulation was adopted because countries within the study area exhibit large differences in interest rates (potentially related to the stability of their economies) and the NTBS between countries were thought to be best expressed in terms of their *ad valorem* tariffs equivalents.

The MCP model is motivated here by first building an integrable SPE model with a constant discount rate through space and time and a specific tariff. The first order conditions with respect to the spatial and temporal arbitrage conditions are then modified to incorporate differential discount rates and *ad valorem* tariffs, respectively. The following notation is important in setting up a two-country spatial and temporal equilibrium model.

Sets

R set of regions (note that region and country are interchangeable)

R^s set of producing regions

R^d set of consuming regions

T set of time periods

T^n set of non-harvest time periods (subset of T)

W set of origin-destination pairs

Functions

Φ_{rt} inverse demand function

ψ_{rt} inverse supply function

Variables

S_{rt} quantity supplied

D_{rt} quantity demanded

$T_{(ijt)}$ quantity transported between countries *i* and *j*; $(i \in N)$, $(j \in M)$

K_{rt} quantity stored

P_{rt} demand price

Parameters

$c_{(ijt)}$ transport cost between countries *i* and *j*

$\gamma_{(ijt)}$ unit specific tariff between countries *i* and *j*

$\tau_{(ijt)}$ unit *ad valerom* tariff between countries *i* and *j*

k_{rt} unit storage cost

δ discount factor: $\delta = (1+i)^t$

ϕ storage loss factor (in percent)

Assuming a constant interest rate across space and a specific tariff, the social welfare function that needs to be maximized in the two-country model is:

$$\underset{(D_{rt}, S_{rt}, T_{(ijt)}, K_{rt})}{Max:} \sum_{t=1}^{T} 1/(1+i)^t \left(\begin{array}{l} \sum_{r \in R^d} \int_0^{D_{rt}} \Phi_{rt}(\vartheta) d\vartheta - \sum_{r \in R^s} \int_0^{S_{rt}} \psi_{rt}(\xi) d\xi - \sum_{(ij) \in W} \int_0^{T_{(ijt)}} (c_{ijt} + \gamma_{ijt})(\varpi) d\varpi \\ -\sum_{r \in R} \int_0^{K_{rt}} k_{rt}(\omega) d\omega \end{array} \right) \quad \text{... (1)}$$

s.t.

$$K_{rt+1} \le \phi K_{rt} + S_{rt} + \sum_{j \in R^s} T_{jrt} - (D_{rt} + \sum_{j \in R^d} T_{rjt}) \quad \forall r \in R;\ t \in T \qquad \text{… (2a)}$$

$$D_{rt}, S_{rt}, T_{(ijt)}, K_{rt},\ all \ge 0 \quad \forall r \in R;\ t \in T, (ij) \in W \qquad \text{… (2b)}$$

$$S_{rt} = 0 \quad \forall r \in R^d;\ t \in T \qquad \text{… (2c)}$$

$$S_{rt} = 0 \quad \forall r \in R^s;\ t \in T^n \qquad \text{… (2d)}$$

$$K_{r1} = 0 \quad \forall r \in R \qquad \text{… (2e)}$$

$$T_{(rjt)}, T_{(jrt)}\ both \ge 0\ \forall r \in R^s;\ t \in T \qquad \text{… (2f)}$$

Constraint (2a) requires that any quantity of cowpeas stored in period t+1 must be less than or equal to the previous quantity stored adjusted by any storage losses plus any new supply plus any shipment into the region less demand and shipment out of the region. Non-negative consumption (D_{rt}), supply (S_{rt}), shipment ($T_{(ijt)}$), and storage (K_{rt}) are controlled by (2b). Constraint (2c) states that demand regions do not supply any cowpeas while (2d), implies that supply regions have no supplies during non-harvest periods. Constraint (2e) suggests that at the initial period (t = 1), no grains are in storage while (2f) states that shipment in and out of a supply region that also imports is non-zero.

To derive the necessary conditions for the maximum of (1) subject to (2a), we define L as a Lagrange function with λ as the Lagrange multiplier for the storage constraint. The partial Kuhn-Tucker necessary conditions for optimality for the spatial and temporal components are[1]:

$$\frac{\partial L}{\partial T_{(ijt)}} = -(c_{ijt} + \gamma_{ijt}) + \lambda_{jt}(1+i)^t - \lambda_{it}(1+i)^t \le 0 \qquad and \qquad \left(\frac{\partial L}{\partial T_{(ijt)}}\right) T_{(ijt)} = 0 \qquad \text{… (3a)}$$

$$\frac{\partial L}{\partial K_{rt}} = -k_{rt} + (\phi\lambda_{rt} - \lambda_{rt-1})(1+i)^t \le 0 \qquad and \qquad \left(\frac{\partial L}{\partial K_{rt}}\right) K_{rt} = 0 \qquad \text{… (3b)}$$

[1] The derivatives with respect to all components are presented in Langyintuo (2003).

By interpreting the Lagrangean λ as the optimal price for cowpea in each region, the following economic interpretation can be given to (3a): when the optimal flow $T_{(ij)}$ is positive, the market price in region *j*, $\lambda_{jt}(1+i)^t$, must exceed the market price in region *i*, $\lambda_{it}(1+i)^t$, by the unit transportation cost adjusted by the specific tariff, $(c_{(ijt)}+\gamma_{(ijt)})$, and if $T_{(itj)}$ = 0, the market price in region *j*, $\lambda_{jt}(1+i)^t$, does not exceed the market price in region *i*, $\lambda_{it}(1+i)^t$, by the unit transportation cost adjusted by the specific tariff, $(c_{ijt}+\gamma_{ijt})$. Condition (3b) states that, at the optimum, when positive quantities are stored, $K_{rt,}$ it must be that the future market price, $\lambda_{rt+1}(1+i)^t$, must be greater than the current price adjusted by storage loss factor, $\phi\lambda_{rt}(1+i)^t$, by the storage cost, $k_{rt}(K_{rt})$, and if K_{rt} = 0, then the discounted future market price, $\lambda_{rt+1}(1+i)^t$, is not greater than current price, $\phi\lambda_{rt}(1+i)^t$, adjusted by the storage cost, $k_{rt}(K_{rt})$. Notice that the specific tariff and the constant discount factor still allow the SPE model to be formulated as an optimization problem. Therefore, the first order conditions of the complete setup (See Langyintuo, 2003) could thus be solved for demand, supply, storage, prices, volume and direction of cowpea shipment. The traditional SPE set up, however, needs to be modified to account for differential interest rates and *ad valorem* tariffs (equivalents of NTBs).

Assume a positive, *ad valorem* tariff (the tariff-equivalents of the NTBs) applied to imports from market *i* in time *t* by market *j*. When the optimal flow $T_{(ij)}$ is positive, the market price in region *j*, p_{jt}, must exceed the market price in region *i* plus the unit transportation cost all adjusted by the *ad valorem* tariff, $(p_{it}+c_{ijt})(1+\tau_{ijt})$. This would destroy the integrability of the SPE but can be accommodated by modifying the first order conditions with respect to the inter-spatial arbitrage condition (3a) as follows:

$(p_{it} + c_{ijt})(1 + \tau_{ijt}) \geq p_{jt}$ … (3a')

Similarly, real interest rates differentiated through space would destroy the integrability of the traditional SPE. This could be visualized as similar to an *ad valorem* tariff through time. Differential interest rates may be accounted for by adjusting the inter-temporal arbitrage condition (3b) as:

$-k_{rt} + (\phi\lambda_{rt} - \lambda_{rt-1})(1 + i_r)^t \leq 0$ … (3b')

By letting $P_{rt} = \lambda_{rt}(1 + i_r)^t$, (3b') can be expressed as $\phi p_{rt} \leq p_{rt-1} + k_r$. This states that, at the optimum, when positive quantities are stored, K_r, it must be that the future market price discounted by the region specific discount rate, $\lambda_{rt+1}(1 + i_r)^t$, must be greater than the sum of the loss factor-adjusted current price and storage cost all adjusted by the region specific discount rate, $(\phi\lambda_{rt} + k_r)(1 + i_r)^{t+1}$.

Because differential interest rates or *ad valorem* tariffs violate the integrability of the traditional SPE model, an equilibrium could be computed by solving a sequence of non-linear program. However, as indicated earlier, the solution is more tractable and more transparent if formulated in a mixed complementary programming (MCP) framework consisting of a set of simultaneous equations that are a mix of strict equalities and inequalities with each inequality linked to a bounded variable in a complementary slackness condition (Rutherford, 1995). Consequently, in this analysis, the model was formulated as a four-period MCP in the General Algebraic Modeling System (GAMS) and solved using MCP/PATH solver (Brooke et al., 1992; Dirkse and Ferris, 1995). A one-year model was considered because inter-annual storage volumes of cowpea tend to be negligible (Langyintuo, 2003). WECACSTEM thus consisted of five blocks of equations and five sets of endogenous variables for each of the 11 countries.

Data Sources

Data on cowpea production and prices were obtained from the statistical service departments of the respective countries. In general, supply prices were lower than demand prices and prices in surplus producing countries were lower than those in deficit countries. As is often the case, demand patterns and elasticity of demand are less known. Using per capita consumption and population, the benchmark demand data were estimated while supply and demand elasticities were obtained from literature. The most difficult data to collect for model validation were the import and export data. Data from country pairs were compared and the highest of the two taken. There is no reason to believe that import and/or export figures were overstated. Rather, the tendency for understatement simply due to omissions or deliberate under-invoicing to avoid taxes (where applicable) was probable. A 1% transportation loss was assumed to occur with each shipment and a 15% storage loss factor assumed for a quarter following Golob et al., (1996).

Equally a challenge was the appropriate discount factor to use. Traders rely on the informal rather than the formal financial sector for credit despite the relatively higher interest rates in the former compared with the latter (Lowenberg-DeBoer, et al., 1994; Evers and Mehmet, 1994; Basu, 1997; Warning and Sadoulet, 1998; Bose, 1998). Reasons for this include traders simply not considered credit worthy (Bose, 1998) and rationing of credit to traders (Kochar, 1997; Chakrabarty and Chaudhuri, 2001). Even when traders obtain credit from formal financial institutions, the effective interest rates are often as high as informal sector rates because of delays in disbursement or bribes/fees that have to be paid to ensure timely delivery (Chaudhuri and Gupta, 1996). These problems made it difficult to obtain quality data on real interest rates hence the reliance on commercial bank rates and employing sensitivity analysis to determine their stability in influencing model results.

Distances between major wholesale markets in national capitals were computed from digital maps. The cost of transporting commodities from source to destination market is the upper limit on the price differentials between the markets unless there are barriers to trade. Trade barriers reduce the flow of goods thereby increasing the supply in the surplus region reducing prices, while decreasing supply in the deficit region, thus increasing prices. The net effect is to increase the price differential between the two regions. Information on the degree of restrictions on non-traditional international trade barriers are difficult to obtain. If tolls and other fees are collected by local authorities, it is more difficult to estimate the size of those costs. Similarly, data on the costs associated with delays due to road blocks and bureaucratic obstacles are not easy to collect. Following Minot and Goletti, (1998), the implicit costs related to restrictions on trade were estimated by comparing the observed price differentials between source and destination markets with the actual cost of transportation. The difference between the two measured in percent of demand price is an aggregate measure of the costs associated with restrictions on trade. Data on official specific tariffs such as value added taxes (VATs) were obtained directly from country statistics.

Base model results

The WECACSTEM results simulate cowpea trade in 1999/2000 marketing year in terms of supply, demand, imports and exports of cowpea given existing policies. Using linear demand and supply functions. The base scenario predicted 3.6 million t of cowpea produced, about 9% higher than the benchmark figure while demand was about 4% less (Table 1). ECOWAS countries accounted for 98% of total predicted supply as in the benchmark case. The largest percentage deviations between predicted and observed supply were in Burkina Faso (11%), Ghana (10%) and Nigeria (11%) while the lowest in Cameroon (0.16%) and Chad (1.42%). An estimated 2.8 million t were held in storage initially (62% in Nigeria and 24% in Niger) and released subsequently. The direction and volume of cowpea flow were consistent with reality (Table 2). An estimated 540,000 t of cowpea was shipped to Nigeria (75.8%), Ghana (12.7%), Cote d'Ivoire (9.6%), Togo (1.3%) and Gabon (0.6%). Ninety five percent of Nigeria's imports originated from Niger accounting for 98% of the latter's marketable surplus.

The interest rate differential and *ad valerom* tariffs complicated the estimation of welfare in the MCP formulation. In this analysis, welfare was estimated from the Judge and Takayama measure which would have prevailed if an iterative non-linear programming optimization scheme had been employed. In the base scenario, cowpea trade generated a net social welfare of US$6.3 billion to producers (60%) and consumers (40%) (Table 3). In terms of regional distribution, Nigeria accounted for 63%, Niger 20% and the remaining 17% was distributed among the other countries, with Chad and Gabon accounting for the least. Whereas in Nigeria benefits were shared almost equally between producers and consumers, in Niger and Mali, over 90% of the total surplus went to producers. The loss in welfare to producers and consumers through non-tariff barriers was equivalent to about US$12 million, or 0.2% of net social welfare. Total surplus per capita ranged from US$2 in Gabon to US$117 in Niger (Table 3). Nigeria with the largest proportion of total surplus is third after Mali in per capita terms. Similarly, in terms of producer surplus per person in the farming population, Niger is first with US$208 followed by Mali with US$83 and third by Nigeria and Benin with US$26 each. Cote d'Ivoire is the least with only US$2.4.

In summary, the WECACSTEM base model sufficiently replicated the base year price, supply, and demand figures as well as trade flows and was thus used in three counterfactual policy analyses: (a) 7% real interest rate on capital in ECOWAS, (b) zero non-tariff barriers (NTBs) among ECOWAS countries to simulate a free trade scenario within ECOWAS, and (c) a combination of the two scenarios (i.e., a 7% real interest rate on capital in ECOWAS and zero NTBs among ECOWAS countries).

The interest payable on investment in the storage structures and cowpea grains stored is part of the cost of storage. This means that any adjustment in real interest rates has a direct effect on cost of storage and consequently on inventory adjustments and trade. Knowing that interest rates are generally high in the region, adjusting real interest rate to 7% in ECOWAS countries in line with the existing rate in Nigeria appears realistic and attainable if the convergence criteria for the formation of the WAMZ are achieved. Each policy change was introduced into the model via parameter changes, holding all other variables at benchmark values, solving the model and comparing the resulting solution to the base case scenario.

Effects of a Change in Real Interest Rate on Cowpea Trade in West and Central Africa

A 7% real interest rate on capital within ECOWAS resulted in an increase in cowpea inventories post harvest in all ECOWAS countries because of relatively cheaper storage financing cost, except in Nigeria where storage financing cost was not affected by the policy. Since Nigeria no longer exhibited substantially lower storage financing costs relative to other countries in the region, post harvest exports to Nigeria for the purpose of storage declined. Grain shipment within ECOWAS decreased in the third and fourth quarters of the year (during and immediately after harvesting) by 25% and 10%, respectively, but increased by 10% in the second quarter. In response to the inventory adjustments average prices increased from July through March and decreased the rest of the year. The relative increase was more than the decrease consequently leading to relatively higher average annual prices in all ECOWAS member countries except in Nigeria (Table 4). Prices in Nigeria were consistently lower compared with the base case because stocks were not accumulated (traders reduced inventories in anticipation of cheaper imports). As expected, countries with lower prices experienced decreased domestic demand but higher supply and vice versa (Table 4).

As a result of the relatively lower prices in Nigeria, traders in the CAEMC countries reduced their exports to Nigeria (their main export market for cheap storage) because their expected loss in extra export revenue would have been greater than their extra savings in storage financing (Table 5). But, reducing exports to Nigeria resulted in excess supply over demand within the CAEMC bloc thus depressing domestic prices resulting in losses in sales revenue.

A weighted average[2] of the change in prices in the NCG showed that prices decreased by 0.11%, leading to a 0.24% increase in regional demand. Net social welfare increased by 0.19% (or US$12 million) over the base case (Table 6). Although consumers in Nigeria and CAEMC countries gained in welfare by about 0.3%, in general, consumers' welfare decreased by 6 percentage points compared with the base case while producers gained by 8 percentage points. This suggests that the policy emphasized inequalities in the distribution of gains between producers and consumers in favor of the former.

Potential Impacts of Eliminating Regional Non-Tariff Barriers to Trade

Given that NTBs are forms of tariffs passed onto importers by exporters, eliminating all NTBs within ECOWAS resulted in a reduction of prices in all importing countries except in Togo (Table 4). In contrast, prices in all exporting countries increased because eliminating NTBs

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[2] In calculating the weighted average, the proportion of total cowpea demanded by each country was used as the weight.

made shipping from one country to the next cheaper and faster motivating traders to ship out more grains raising domestic prices. The reason why prices did not decrease in Togo (an importing country) could be explained by the linkage between prices in Togo and Benin (Togo's main import market). Langyintuo (2001) noted that cowpea prices in Togo and Benin co-move. Since prices in Benin increased (by 4.6%), those in Togo also increased and the decrease resulting from the elimination of NTBs was not sufficient to counteract the price increase.

The situation appeared different in the CAEMC region. Whereas prices increased in all exporting countries within ECOWAS, CAEMC exporting countries experienced lower prices because of the reduction in exports to Nigeria, their main exporting markets due partly to low prices and partly to crowding-out of CAEMC from the ECOWAS market. Whereas CAEMC traders still faced higher barriers, their counterparts in ECOWAS shipped out their grains freely because NTBs were removed, thus capturing most of the ECOWAS cowpea market.

As expected, demand increased in countries where prices decreased and vice versa. The converse was true for supply (Table 4). The absolute deviation in demand was highest in Benin (16%) followed by Burkina Faso (9%). In Benin although supply increased by 0.96%, total grain shipment increased by 15% thereby creating a shortfall.

Removal of all NTBs significantly altered the volume and direction of cowpea shipment within ECOWAS in particular (Figure 3). Traders in Niger found it easier to redirect all their marketable surpluses to Nigeria eventually eliminating Benin from the Nigeria market. No more cowpeas were imported into Ghana from Niger. Traders in Burkina Faso exported to Ghana over and above Ghana's import demand. As a result, Ghana also exported some cowpea to Cote d'Ivoire. In addition to imports from Ghana, Cote d'Ivoire also imported from Benin and Mali.

Although total trade volume increased by 3%, inter-bloc trade decreased by about 8% suggesting increased intra-bloc trade at the expense of inter-bloc trade.

Total social welfare within ECOWAS increased by 0.14% (or US$9 million) (Table 6) but tariff revenue decreased by 86% or US$10 million. The gain in welfare would have been greater if not for losses due to transport cost (which increased by 4%) due to the increased shipment volume. Compared with the base case, revenue lost through non-tariff barriers within CAEMC was equivalent to US$2 million. With the exception of Togo and Chad, all countries experienced improvements in total social welfare. In Chad, the producer welfare loss from selling at relatively lower prices outweighed the consumer surplus gain. In Togo, on the other hand, the consumer welfare loss due to higher prices outweighed the producer welfare gain.

Potential impact of a seven percent real interest rate on capital and zero NTB in ECOWAS

The elimination of all NTBs within ECOWAS as well as reduction in real interest rates to seven percent decreased regional prices by 0.18%, more than the reduction observed with either of the policies separately. At the individual country level, changes in prices were similar in sign but of smaller magnitudes to the elimination of NTBs alone. Within ECOWAS, the reduction in cowpea prices in importing countries ranged from 0.29% in Nigeria to 1.36% in Cote d'Ivoire (Table 4). In contrast, prices in all exporting countries increased, ranging from 0.72% in Mali to 4.24% in Benin. The relatively larger proportion of price reduction in Cote d'Ivoire was as a result of a large volume of imports from Mali and Burkina Faso. The decrease in prices in all CAEMC countries was less than when interest rate was reduced to 7% but more than when all NTBs were eliminated. Removal of NTBs lowered transaction costs within ECOWAS enabling countries within the bloc to easily ship out cowpeas as against countries from CAEMC who still faced relatively higher barriers. At the same time, the relatively lower interest rates motivated traders to store more to benefit from the interest financing costs. The net effect within ECOWAS is the moderate change in prices leading to a decrease in demand and an increase in supply in exporting countries and vice versa.

Grain shipment patterns were less distorted under the current policy compared with the elimination of only NTBs because the reduction in interest rates had a mitigating effect on trade pattern changes. For example, Ghana no longer shipped to Cote d'Ivoire nor did Togo ship any cowpea to Ghana. As a result of the reduced interregional shipment, total regional welfare increased (Table 6). The observed 0.43% or US$27 million increase in net regional welfare over the base case was about 30% more than in the case of reducing interest rates to seven percent only. This indicated a tremendous positive impact on regional welfare. At the country level, however, Mali, Togo and Chad all suffered loses in welfare is NTBs were removed real interest rates reduced to at least 7%. In Chad, the producer welfare loss from selling at relatively lower prices outweighed the consumer surplus gain. In Togo and Mali, on the other hand, the consumer welfare loss due to relatively higher cowpea prices outweighed the producer welfare gain.

Conclusion and policy implications

The WECACSTEM base model sufficiently replicated the base year equilibrium prices, supplies, demands and direction of grain flows thus justifying its use in counterfactual simulations. Adjusting real interest rates to 7% within ECOWAS increased inventories and hence prices in smaller economies within the ECOWAS bloc to the benefit of producers but to the disadvantage of consumers in such economies. Nigerian consumers, however, benefited because they consumed more at relatively lower prices. Producers within the bloc (except in

Nigeria) benefited but those in Nigeria and CAEMC lost because they sold less at relatively lower prices. In general, net social welfare increased but the distributional effects were uneven. Consumers in large economies and producers in small ones benefited while others lost. The intuition behind the results is that given the high cost of capital in the study area, the savings made on storage financing costs as a result of the relatively lower interest rate was sufficient for traders to accommodate the loss in revenue caused by a reduction in demand prices. This is important to policy makers when WAMZ is adopted that ensures re-alignment of interest rates among member countries.

Removing trade barriers has the effect of decreasing demand prices in importing countries thereby increasing demand and consumer welfare at the expense of producers who sell less at lower prices. In contrast, producers in exporting countries benefited from the policy as they sold more cowpea and hence enjoyed an improvement in welfare. Trade diversionary impacts are potentially important suggesting the development of efficient transportation systems to ensure the maximization of societal benefits. Without a corresponding elimination of barriers between the ECOWAS and CAEMC blocs, inter-bloc trade is reduced while increasing intra-bloc trade although total trade volume expanded. The full benefits of lifting all trade barriers would be realized if specialization based on regional comparative advantage is emphasized but the unequal distribution of regional welfare must be recognized and addressed appropriately.

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Table 1: Base model results on supply, demand, and prices using linear functions

	Supply		Quarterly demand		Demand price	
	('000 t)	% deviation from benchmark	('000 t)	% deviation from benchmark	(US$/t)	% deviation from benchmark
			ECOWAS Countries			
Benin	78.46	3.36	13.34	-3.05	534	7.48
Burkina Faso	135.27	10.91	6.48	-15.84	527	31.91
Cote d'Ivoire	18.76	5.49	20.79	-6.14	602	16.89
Ghana	77.53	10.00	41.00	-3.00	565	7.33
Mali	113.09	2.12	16.06	-4.08	529	16.10
Niger	681.44	5.66	8.45	-8.03	533	40.63
Nigeria	2,346.34	10.62	654.99	-3.88	591	14.60
Togo	33.43	4.47	10.15	-2.37	555	6.90
			CAEMC Countries			
Cameroon	51.45	0.16	9.33	1.64	404	-7.43
Chad	18.29	1.42	2.81	-0.11	429	-0.31
Gabon	-	-	0.53	16.78	458	-47.96
Total/average	3,554.06	8.90	783.93	-3.94	-	-

Table 2: Optimal interregional cowpea shipment in the base case ('000 t)

Exporter	Importer	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun
	ECOWAS Exporting Countries				
Benin	Nigeria	-	-	-	7.63
Benin	Togo	-	-	-	6.75
Burkina Faso	Cote d'Ivoire	-	-	4.27	13.85
Burkina Faso	Ghana	-	6.17	33.37	19.15
Mali	Cote d'Ivoire	2.06	19.05	12.41	-
Niger	Ghana	-	-	-	9.16
Niger	Nigeria	-	-	-	385.83
	CAEMC Exporting Countries				
Cameroon	Nigeria	4.90	-	-	-
Cameroon	Gabon	0.54	1.73	-	-
Chad	Nigeria	8.14	-	-	-

Table 3: Surplus measures in the base case scenario (US$ million)

	Consumer surplus	Producer surplus	Total surplus	Producer surplus per farmer	Total surplus capita^{-1}
	(US$ millions)			(US$)	
	ECOWAS Countries				
Benin	19.95	101.36	106.14	25.96	17.40
Burkina Faso	4.80	136.69	111.61	10.11	2.67
Cote d'Ivoire	39.31	32.19	70.24	2.41	4.53
Ghana	86.80	63.35	144.56	4.32	7.69
Mali	40.74	376.31	400.27	82.56	37.76
Niger	23.57	1,403.99	1 ,229.38	208.93	117.08
Nigeria	2,086.89	2 ,217.02	3,980.02	25.56	32.12
Togo	22.21	34.05	52.36	8.92	11.38
	CAEMC Countries				
Cameroon	35.49	113.65	142.86	25.26	2.06
Chad	2.42	27.66	29.39	4.26	7.59
Gabon	2.73	-	2.47	-	19.05
Total	2,364.91	4,506.27	6,269.31	27.94	

Note: *Tariffs and tariff-equivalents of non-tariff barriers
- No value

Table 4: Change in supply, demand and price for given policy change (%)

	Seven percent real interest rate on capital in ECOWAS countries only			Zero NTBs within ECOWAS countries only			Zero NTBs and seven percent real interest rate on capital in ECOWAS countries only		
	Price	Supply	Demand	Price	Supply	Demand	Price	Supply	Demand
				ECOWAS Countries					
Benin	0.68	0.36	-1.33	4.63	0.96	-16.32	4.24	1.10	-13.83
Burkina Faso	1.52	0.98	-4.23	1.20	0.32	-9.24	0.82	0.80	1.10
Cote d'Ivoire	1.52	0.66	-2.90	-1.74	-0.46	4.93	-1.36	0.08	5.81
Ghana	1.48	1.55	-2.32	-0.84	-0.29	2.25	-0.80	0.87	4.07
Mali	1.62	0.33	-2.10	0.43	0.03	-0.91	0.72	0.26	-0.21
Niger	0.68	0.22	-0.84	1.90	0.25	-3.67	2.87	0.51	-5.06
Nigeria	-0.34	-0.11	0.64	-0.20	-0.06	0.38	-0.29	-0.09	0.54
Togo	0.86	0.54	-1.43	2.53	0.69	-6.39	2.15	0.88	-4.77
				CAEMC Countries					
Cameroon	-0.38	-0.04	0.44	-0.23	-0.02	0.26	-0.32	-0.03	0.37
Chad	-0.38	-0.05	2.08	-0.22	-0.03	1.24	-0.32	-0.05	1.76
Gabon	-0.36	-	0.34	-0.21	-	0.20	-0.30		0.29

Table 5: Cowpea grain shipment between countries for given policy change in West and Central Africa ('000 t)

		Seven percent real interest rate on capital in ECOWAS countries				Zero NTBs within ECOWAS countries only			
Exporter	Importer	Jul - Sep	Oct – Dec	Jan – Mar	Apr – Jun	Jul - Sep	Oct – Dec	Jan – Mar	Apr – Jun
ECOWAS Exporting Countries									
Benin	Cote d'Ivoire	-	-	-	-	-	-	-	10.06
Benin	Nigeria	-	-	-	2.17	-	-	-	-
Benin	Togo	-	-	(6.18)	7.25	-	-	-	6.16
Burkina Faso	Cote d'Ivoire	-	-	3.07	13.96	-	-	-	-
Burkina Faso	Ghana	-	-	29.86	28.51	-	17.86	33.57	28.55
Ghana	Cote d'Ivoire	-	-	-	-	13.06	-	-	-
Mali	Cote d'Ivoire	1.57	18.79	13.51	-	-	10.18	16.90	3.99
Niger	Nigeria	-	-	-	395.96	-	-	-	396.24
Togo	Ghana	-	4.24	(3.33)	-				
CAEMC Exporting Countries									
Cameroon	Nigeria	4.83		-	-	4.86	-	-	-
Cameroon	Gabon	0.54	1.73	-	-	0.54	1.73	-	-
Chad	Nigeria	8.08		-	-	8.10	-	-	-

Note: In parenthesis are grains transhipped between locations. For example, Benin shipped 6,180 t of cowpea to Togo between Jan-Mar 3,330 t of which was transhipped to Ghana during same period.

Table 6: Changes in surplus measures for given policy changes

	Seven percent real interest rate on capital in ECOWAS countries only			Zero NTBs within ECOWAS countries only			Zero NTBs and seven percent real interest rate on capital in ECOWAS countries only		
	Consumer	Producers	Total	Consumer	Producers	Total	Consumer	Producers	Total
				ECOWAS Countries					
Benin	-1.00	0.71	0.43	-6.97	1.93	0.47	-6.36	2.22	3.21
Burkina Faso	-4.39	1.98	1.76	-3.04	0.63	0.51	-2.61	1.60	0.73
Cote d'Ivoire	-1.98	1.33	-0.49	2.41	-0.92	0.91	2.03	0.16	2.41
Ghana	-1.61	3.12	0.39	1.02	-0.58	0.35	1.20	1.74	2.24
Mali	-1.38	0.67	0.47	-0.42	0.07	0.02	-0.51	0.52	-0.33
Niger	-0.53	0.45	0.43	-1.72	0.50	0.46	-2.50	1.03	0.63
Nigeria	0.30	-0.22	0.04	0.18	-0.13	0.02	0.26	-0.18	0.28
Togo	-0.91	1.07	0.29	-2.90	1.39	-0.31	-2.41	1.76	-0.12
				CAEMC Countries					
Cameroon	0.21	-0.07	0.00	0.13	-0.04	0.00	0.18	-0.06	0.01
Chad	0.74	-0.11	-0.04	0.44	-0.06	-0.02	0.63	-0.09	-0.05
Gabon	0.17	-	0.17	0.10	-	0.10	0.14	-	0.18
Total net social welfare			0.19			0.14			0.43

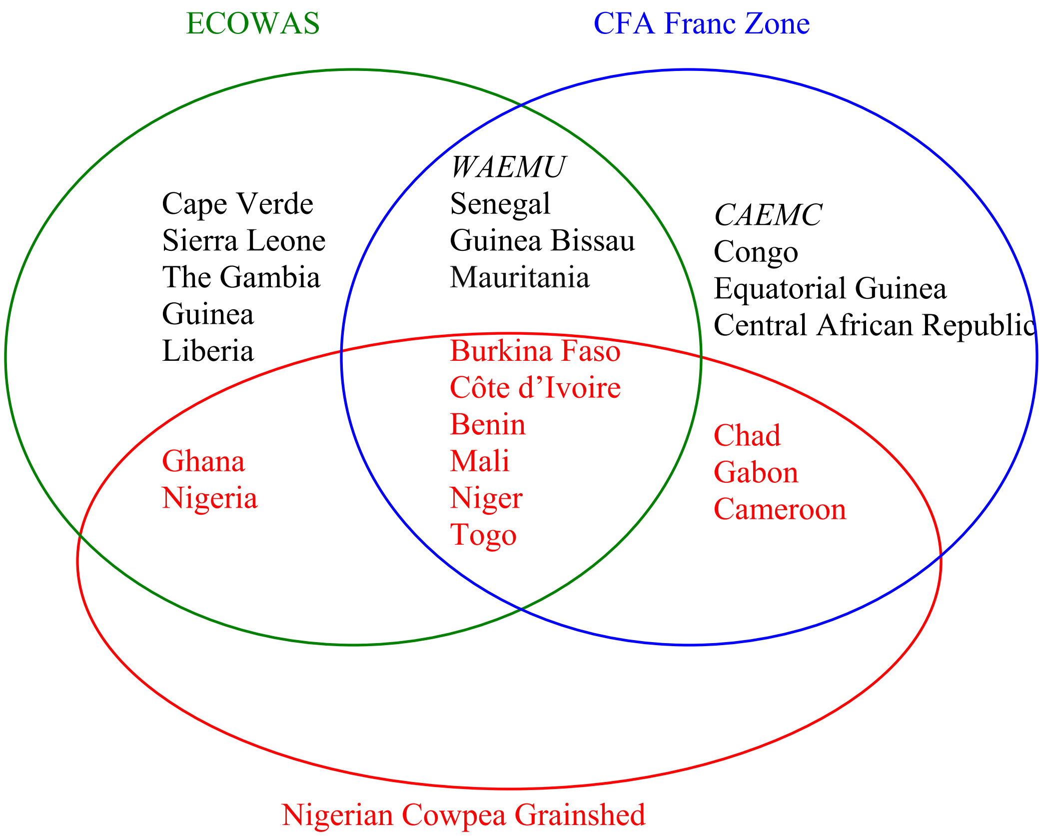

Figure 1: Membership of ECOWAS, CFA Franc Zone and Nigerian Cowpea Grainshed

Notes: [1]ECOWAS was formed in 1975 and Cape Verde joined in 1976.
[2]WAEMU replaced the West African Economic Community (CEAO) of which Mauritania was a member but opted out of WAEMU. [3]Guinea Bissau joined in 1997, three years after WAEMU was established.

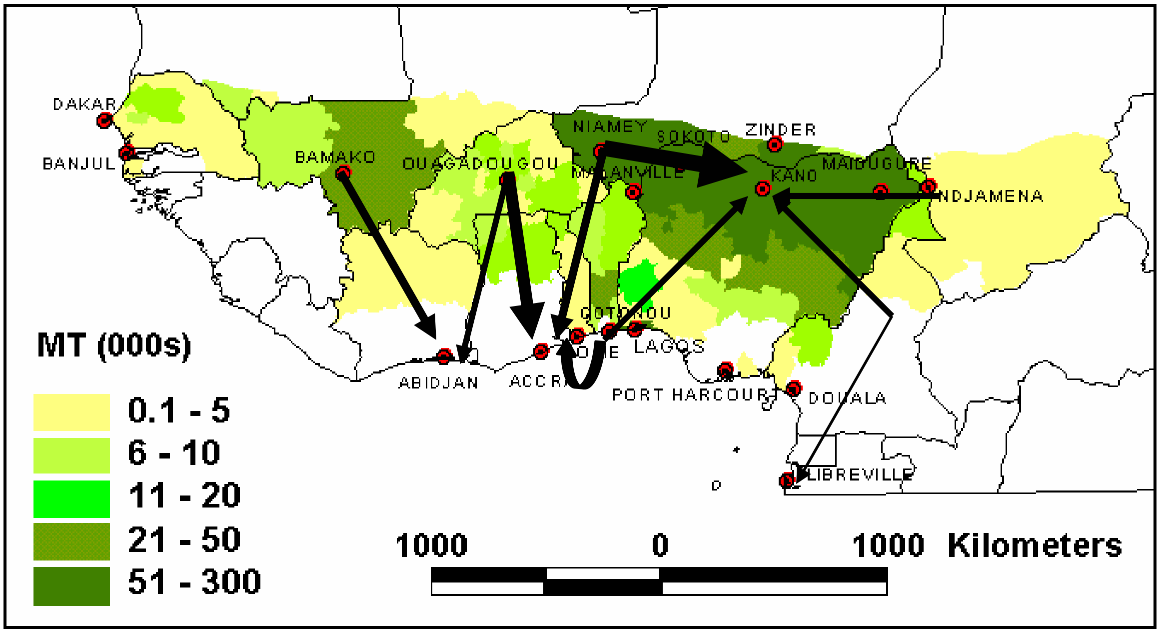

Figure 2: Map of principal cowpea production areas in West and Central Africa, with arrows showing the principal trade flows in the base WECACSTEM simulation

Sources: Langyintuo et al. (forthcoming) ; Model Results

Note : The widths of the arrows approximately reflect the quantity of cowpea shipped.

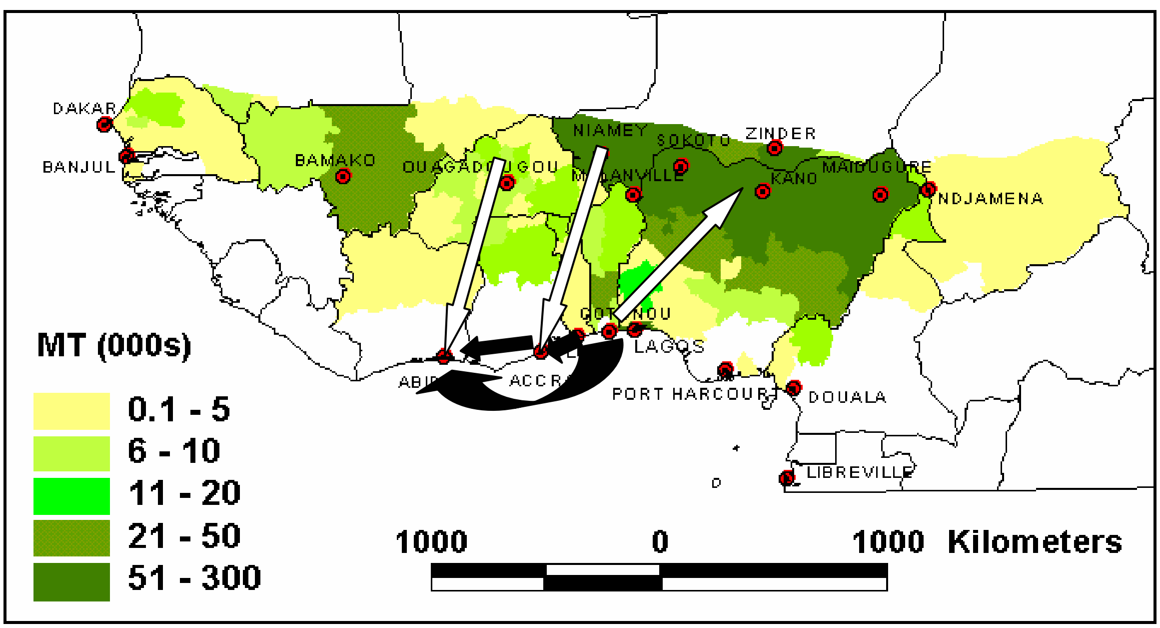

Figure 3: Map of principal cowpea production areas in West and Central Africa, with arrows showing changes in direction of cowpea flow given a removal of NTBs within ECOWAS

Sources: Langyintuo et al. (forthcoming) ; Model results

Note: For clarity, old trade routes (shown in Figure 2) that have not changed after the policy are not shown. Only changes are shown as follows:

Old trade route discontinued

New trade route created