Impact assessment of the multilateral agricultural trade negotiations on CEMAC countries

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Abstract

Using the Agricultural Trade Policy Simulations Model (ATPSM), this paper shows that the modalities of improving market access being negotiated within the World Trade Organisation (WTO) would deteriorate the welfare of the population of the Central African Economic and Monetary Community (CEMAC) countries. To mitigate these negative effects, they should plead for the suppression/reduction of subsidies and domestic supports and insist that revenue saved be oriented towards technical assistance in diversifying their exports and restructuring their economies in order to promote their competitiveness. Despite the differentiated impacts of the modalities on the countries, the ongoing regionalism process should be consolidated and used as a framework for increasing the negotiation power and look-in of national reforms.

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1. Introduction

The increasing opening of national economies to the rest of the world would gradually introduce agricultural products into multilateral negotiations. As such, agricultural trade shall be subject to very strict multilateral rules and commitments comprising: reduction of subsidies with distortion effects on trade; greater reduction of tariff barriers and increase the tariff binding coverage, etc. The World Trade Organisation (WTO) Doha Ministerial Conference held in Qatar in November 2001 launched a new round of agricultural negotiations, aimed to put in place an...
equitable and pro-market agricultural trade system. Parallel to the WTO negotiations, the European Union (EU) launched negotiations on Economic Partnership Agreements (EPA) with African, Caribbean and Pacific (ACP) countries. Prior preparation of the agenda would be necessary for African countries to actively participate in these negotiations. This paper helps in this preparation by identifying priorities for CEMAC countries and formulating recommendations and policy options of the sub-region in the WTO agricultural negotiations thanks to an analysis of the major agricultural issues under discussion and their impact on production and agricultural trade, government revenue and the welfare of the population.

The rest of the paper is divided into four sections. The first provides the background of CEMAC countries. The second reviews the WTO agricultural negotiations framework. The third presents the methodological frame and analyses the simulation results. And finally, the fourth groups the conclusion and policy recommendations.

2. CEMAC economic background

The implementation of agreements and their impact depends on the development level of countries. Contrary to developed countries, developing countries (DCs) and less developed countries (LDCs) are granted some preferential treatment. Also, the impact of agreements on the performance of signatory countries is closely determined by the volume of trade, factor endowments, fiscal system etc., specific to each country. This section presents CEMAC countries according to these preoccupations.

CEMAC constitutes six countries (Cameroon, Chad, Central African Republic (CAR), Congo Republic, Equatorial Guinea and Gabon). According to the human development index (HDI) of the United Nations Development Programme (UNDP), the best classified country ranks 116 out of 175. Three among them (Equatorial Guinea, CAR and Chad) are considered as LDCs and the other three (Cameroon, Congo and Gabon) as DCs (see Table 1). Thus, they are all granted a special and differential treatment (SDT) within WTO.

Despite the predominance of the petroleum sector, the agricultural sector still plays an important role. It accounts for more than 18% of total production and more than 20% of non-petroleum production (BEAC, 2004). Fiscal and customs revenue from international trade represents a substantial share of the budgetary revenues of member states (IMF, 1999). Any modification of the fiscal system stands therefore to affect public revenue and by extension, the growth and development of these countries, considering the determinant role of the budget in LDCs (Fozzard, 2001; Gankou, Bamou, & Ekpo, 2003; IMF–World Bank Development Committee, 1999; Sahn, 2001). In spite of the efforts deployed as part of the structural adjustment programme (SAP), the tax ratio of agricultural products, which evolves between 17% and 25%, remains quite high and should as a result be subject to the tariff reduction advocated by WTO (Hoekman, Mattoo, & English, 2002).

The implementation of the previous multilateral trade agreements varied from one CEMAC country to another. In 2002 for instance, Cameroon, Congo and Chad barely bound 17% of their agricultural tariff lines while CAR bound theirs at 62.5% (Mattoo & Subramanian, 2004). The gaps between bound and applied tariffs are also much different: more than 50% for Cameroon and Chad, 39% for Gabon and less than 10% for Congo and CAR (Hoekman et al., 2002). Despite market access preferences granted to these countries, certain potential agricultural products are still subjected to fairly high most favoured nation (MFN) rates on the traditional (Europeans) and non-traditional markets. CEMAC countries must normally put pressure on developed countries to liberalise their markets and vice versa.
Considering the fragility of the economies of the sub-region, their priority is to promote a rapid and sustainable economic growth, closely related to poverty reduction towards which they are all engaged (ILEAP, 2004). As an integral component of this objective, their interests in the agricultural trade negotiations are to strengthen rules and specific commitments on support and protection and to address distortions in agricultural markets, while retaining appropriate measures of protection for their own economies (ILEAP, 2003). All said and done, they should grant priority to measures aimed to promote exports, diversify exports and their markets by eliminating or reducing external access barriers and domestic exports supply constraints.

3. WTO agricultural trade negotiations overview

The WTO agricultural negotiation modalities are grouped under Appendix A of the Decision of the Ministerial Conference of 1 August 2004. The primary objective of these negotiations, outlined in the Doha Treaty of 14 November 2001, is to substantially improve market access of agricultural products, reduce all forms of export subsidies, and considerably reduce domestic supports with distortion trade effects and Special and Differential Treatment of DCs.
4. Market access

Tariffs tend to restrict trade, decrease world prices and increase price volatility, whose negative effects on revenue and poverty in DCs and LDCs are very well documented (Watkins, 2004). Agricultural products are exclusively protected by tariffs, since the other obstacles had been relatively eliminated or transformed into tariffs during the Uruguay Round. However, the equivalent tariffs are still too high to really favour imports. Improvement in this area are suggested under the Decision of 1 August 2004 through a tiered formula that cut higher tariffs proportionately more than lower ones. Except LDCs, all Members are expected to make some cuts. Those cuts will apply to each product. Sensitive and special products will however be accorded distinct treatment which is still to be negotiated. Special products (SPs) are products selected on the basis of the food security, livelihood and rural development needs of each country. Sensitive products are those with higher tariffs and potential for increasing market access. The two categories are distinct and the relationship between them needs to be clarified.

The bound tariff rates would be used for the cuts. In a case where tariff is not already bound, it is suggested that the base of the cut be twice the applied rate. Many DCs are however opposed to this figure because they believe it would result in bindings on some products that are too low to afford the desirable degree of flexibility arising from the gap between bound and applied rates. An alternative option is the use of a floor that would determine a minimum level of binding. All these issues are still to be negotiated.

Many formulae were on the table, each having advocates and critics. In this regard, the WTO Secretariat elaborated an arbitration formula, summarised in Table 2, that tallies well with the spirit of the tariff reduction agreed under the August 1 Decision. That formula aimed to address tariff escalation and simplification. The improvement of market access is also expected from some tariff quota commitments and renegotiation of the existing special agricultural safeguard (SSG). Reductions of in-quota tariffs are required and tariff quota administration has to be improved.

In relation to the SDT granted in paragraph 39 of the August 1 Decision to DCs, less tariff reduction or tariff quota expansion commitments are required for these countries. They will also have access to a special safeguard mechanism (SSM), distinct from the SSG under negotiation. The parameters of the SSM remain to be negotiated, along with the relationship with the SSG. The issue of preference erosion is also to be addressed.

<table>
<thead>
<tr>
<th>Tariff bands</th>
<th>Average reduction</th>
<th>Minimal reduction for all tariff lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed countries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+from 90</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>15–90</td>
<td>50</td>
<td>35</td>
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<td>0–15</td>
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<td>25</td>
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<tr>
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<td>60–120</td>
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<td>20–60</td>
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<td>0–20</td>
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</tr>
<tr>
<td>Special products</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

5. Export subsidies

Export subsidies affect the economies of countries not practising them in a significant manner. They spur export increase in countries that subsidise. This increase in turn contributes to the decline in world prices and consequently, to the decline in the revenue of exporting countries that do not subsidise. *OECD (2003)* estimates at US$ 3.6 billion, the global yearly revenue increase generated by the full elimination of agricultural export subsidies. Though the taxpayers of EU countries constitute the first beneficiaries of this elimination, net exporting DCs and producers in net importing countries shall however benefit from the increased world prices that should reflect in their revenue. Meanwhile, the elimination of subsidies can also increase the cost of imports in net importing countries and thereby deteriorate their welfare (*Vatalis, 2004; Watkins, 2004*). These effects are examined within CEMAC through a simulation of their negotiation modalities.

One of the advance commitments of the August 1 Decision is the elimination of export subsidies, despite the fact that the date is still to be decided. The commitment covers all other export-related measures with equivalent effects like export credit guarantees and insurance programmes, trade-distorting practices of state-trading enterprises and food aid. In compliance with SDT provisions, DCs are accorded longer implementation periods to comply with these commitments.

The most popular export subsidies elimination modalities is that of Harbinson, who proposes for a series of products, an initial 50% reduction and later on, reduction to zero at the end of 5 years for developed countries and 10 years for DCs and nine and 12 years for the rest of the products. This proposal shall be simulated in our case. Note should be taken that the reduction/suppression of subsidies is complementary to the tariff reduction.

6. Domestic support

The net impact of domestic support policies is a production increase. The surplus generated is generally sold or distributed as food aid. This supplementary supply contributes to reduce prices to the disfavour of other exporting countries not supporting their agricultural sector. These supports also disintegrate agricultural product markets. Consumers and producers no longer react in conformity with the realities of information conveyed by the prices. Their capacity to adjust to external shocks is reduced, with aggravation of price volatility as immediate consequence. OECD countries pay close to US$ 229 billion each year to their farmers, representing more than four times what they spend in terms of aid to development in DCs. This support constitutes 32% of the revenue of these farmers (*Vatalis, 2004*).

The August 1 Decision commits Members to substantially reduce trade-distorting domestic supports. The reduction commitments are measured by the final bound total aggregate measure of support (AMS), adjusted for de minimis support levels and levels of support agreed for the less trade-distorting Blue Box payments. A tiered reduction formula will be applied in order to reduce higher levels of support proportionately more than lower ones. In the first year of implementation of the agreement, a reduction of at least 20% will be made in the final bound total AMS plus permitted de minimis and Blue Box payments.

In order to prevent members from shunting domestic support between different supports categories, product-specific levels of AMS will be capped at their respective average levels. De minimis levels of support will be subject to reduction targets, below the product and non-product specific thresholds of 5% and 10% agreed for developed and developing countries respectively in the Uruguay Round. Blue Box support is to be capped at 5% of a member’s average total production level during a historical period to be determined. Some flexibility is available for
members with exceptionally high levels of trade-distorting support in the Blue Box. The Green Box, containing support measures exempted from reductions because they have no, or very minimal, trade-distorting effects or effects on production, will be reviewed (Low, 2004).

Provisions on SDT in this area are limited to trade-distorting domestic support. Longer implementation periods and lower reduction coefficients are foreseen. In the case of reductions in de minimis support, an exemption is granted to DCs that allocate almost all de minimis support for subsistence and resource-poor farmers.

In general, CEMAC countries are only remotely concerned by domestic support and export subsidies, in terms of impact of these issues on their economies. As part of the unilateral liberalisation engaged within the frame of SAPs, these countries have practically abolished their domestic support policies. Also, export subsidies do not exist and ‘de minimis’ supports are not applied because of their low revenue and the disinvestiture of governments from productive sectors. The low agricultural production shows that these countries would not even be able to use the Blue Box measures in the years ahead. See Bamou, Njinkeu, and Douya (2003) for further information on the liberalisation process of the agricultural sector in Cameroon.

7. Model features, simulations and results

The Agricultural Trade Policy Simulation Model (ATPSM), jointly developed by the United Nations Conference on Trade and Development (UNCTAD) and the World Food Organisation (FAO) is used to simulate the impact of negotiation modalities described above on CEMAC economies. ATPSM is a comparative static partial equilibrium model with the following main features:

(i) An equation system for all countries, rendering incidences of supply, demand, export and import volume responses to world market price changes, giving a set of price support changes, price transmission mechanisms and market structures.
(ii) Derivation by country (or group of countries) and commodity (or group of commodities) of the volume, trade revenue and welfare effects of the policy changes.
(iii) Estimation of the size and distribution of tariff revenues and tariff quota rents among countries.
(iv) Presentation of estimation results in various dimensions, such as by country (group of countries or regions), commodity, policy scenario and economic variable (UNCTAD/FAO, 2003).

The principal characteristic of the model is that domestic prices are all determined by world market prices and border protection or special domestic support measures. Thus, no data is provided about the domestic prices and no transaction costs (such as wholesale and retail margins) are taken into account. All protection measures are expressed in tariff rate equivalents. See detailed equations in Appendix A.

Thanks to Harbinson’s proposal, the following modalities are simulated:

(i) Average reduction of bound tariff rates of the EU, USA, Canada and Japan by the three proposed bands (60% for tariff bound at more than 90%, 50% for those between 15% and 90% and 40% for less than 15%), 40% for other developed countries, 35% for Cameroon and 25% for Congo and Gabon in conformity with their binding rates and 25% for the rest of DCs (Simulation 1).
(ii) Minimal reduction of the bound tariff rates of the EU, USA, Canada and Japan by the proposed three bands (45% for tariff bound at more than 90%, 35% for those between 15% and 90% and 25% for less than 15%), 25% for other developed countries, 25% for Cameroon and 15% for Congo and Gabon in conformity with their binding rates and 15% for the rest of DCs (Simulation 2).

(iii) Addition to simulation 1 of a 10% reduction of the rates of special products (SPs) of CEMAC countries (Simulation 3). The list of SPs is borrowed from ILEAP (2003).

(iv) Addition to Simulation 2 of a 5% reduction of the rates of SPs of CEMAC countries (Simulation 4).

(v) Addition to Simulation 4 of a 50% reduction of export subsidies by all countries (Simulation 5).

(vi) Addition to Simulation 5 of a 30% reduction of domestic supports by developed countries and 10% by DCs (Simulation 6).

(vii) Addition to Simulation 6 of a suppression of quotas by the European Union (Simulation 7).

The quantitative impacts of these simulations on prices and certain macroeconomic indicators are respectively given in Tables 3 and 4. As theoretically predicted, consumers are the greatest losers and producers the greatest winners. Governments also lose tax revenue. The deterioration of the total welfare of the population indicates that losses by consumer and Governments are unfortunately greater than gains of producers. Note that for a majority of developed countries, tariffs are almost bound at their applied level. The reduction of bound tariffs is then comparable to a reduction of domestic prices, which is theoretically accompanied by a rise in world demand. An increase in the volume of exports and production in the sub-region is then engendered. Excess world demand would later on exert pressure on international prices, which would then increase. This increase not only improve producer export revenue whose surplus increases, but also slowdown the growth of imports in low income countries like those of CEMAC. Thus, the low imports increase in value and volume recorded in this sub-region. The combination of the high export propensity with the low increase in imports would engender on the one hand, an amelioration of the balance of trade surplus, and on the other, a decline in the volumes consumed, which is reflected by a deterioration of the consumer’s surplus. The decline in fiscal revenue following the tariff cuts could not be compensated by the low increase in the value of imports.

With the exception of Congo, the impacts of these simulations are almost the same on the other four countries, though at varying scales. Due to its economic importance within the sub-region, Cameroon registered scales similar to those of the entire community. Gabon and CAR, which export very little, recorded very strong export variations. Congo registered variations contrary to those of the other countries on several indicators. Contrary to the other countries, its production dropped while consumption increased. This drop in production is compensated by an increase in imports. The decline in bound tariffs in this country is sharp enough to spill over on local prices with the ensuing price competition effects.

CEMAC countries can consequently reduce their bound tariffs to the neighbourhood of the applied rates without any important impact on their economies. This substantial reduction may be used to request more flexibility on the other issues under negotiation. From the experience of Congo, the greater opening of European markets, as advocated by the EPA, shall be accompanied by negative production and welfare effects.

Simulation 3 can be assimilated to weaker domestic tariff liberalization for SPs of CEMAC countries. As compared to Simulation 1, at the regional and country level, the domestic demand
of SPs grows less. This leads to a fairly greater deterioration of consumer surplus. Their imports also grow less thereby creating an opportunity for regional production to compensate the excess regional demand. Hence, the relatively greater increase in production. This impact is quasi the same in Simulation 4, thus the fairly greater deterioration of indicators compared to Simulation 2.

Compared to the first two simulations, it is observed that the protection effect of local production expected from the SDT of tariff reduction granted to SPs is concretised and seems more important than the expected revenue effect. Once more, producers are the main beneficiaries of this measure. The entire population would have certainly benefited from this measure if it was accompanied by greater tariff liberalization of foreign markets.

Simulation 5 is comparable to an increase in the prices of subsidised exports and by extension, international prices. This increase leads to a decrease in import volumes and a sharp increase in

<table>
<thead>
<tr>
<th></th>
<th>Sim 1</th>
<th>Sim 2</th>
<th>Sim 3</th>
<th>Sim 4</th>
<th>Sim 5</th>
<th>Sim 6</th>
<th>Sim 7</th>
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<td>1.90</td>
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<td>0.61</td>
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<td>1.65</td>
<td>2.09</td>
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<td>5.08</td>
<td>7.29</td>
<td>5.08</td>
<td>8.80</td>
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<tr>
<td>Concentrated milk</td>
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<td>4.00</td>
<td>6.63</td>
<td>6.56</td>
<td>9.19</td>
</tr>
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<td>5.11</td>
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<td>Coffee green</td>
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<td>0.25</td>
<td>0.25</td>
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<tr>
<td>Coffee roasted</td>
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<td>0.13</td>
<td>0.21</td>
<td>0.13</td>
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<td>Coffee extracts</td>
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<td>Cigarettes</td>
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<tr>
<td>Other mfr tobacco</td>
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<td>0.71</td>
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<td>0.16</td>
<td>0.27</td>
<td>0.16</td>
<td>0.16</td>
<td>0.52</td>
<td>0.52</td>
</tr>
<tr>
<td>Vegetable oils</td>
<td>0.41</td>
<td>0.24</td>
<td>0.41</td>
<td>0.24</td>
<td>0.50</td>
<td>0.50</td>
<td>0.76</td>
</tr>
</tbody>
</table>

*Note:* Sim denotes simulation. *Source:* Authors’ construction using ATPSM results file.
### Table 4
Some macroeconomic impacts of scenarios

<table>
<thead>
<tr>
<th></th>
<th>CEMAC</th>
<th>Cameroon</th>
<th>Central Africa Republic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Production vol. (%)</strong></td>
<td>15.9</td>
<td>10.0</td>
<td>17.6</td>
</tr>
<tr>
<td><strong>Consumption vol. (%)</strong></td>
<td>-22.0</td>
<td>-13.6</td>
<td>-23.6</td>
</tr>
<tr>
<td><strong>Exports vol. (%)</strong></td>
<td>15.8</td>
<td>10.1</td>
<td>15.8</td>
</tr>
<tr>
<td><strong>Imports vol. (%)</strong></td>
<td>1.9</td>
<td>1.9</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Exports value (%)</strong></td>
<td>5.4</td>
<td>3.5</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Imports value (%)</strong></td>
<td>1.3</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Fiscal revenue</strong> (US million $)</td>
<td>-1.3</td>
<td>-0.7</td>
<td>-1.3</td>
</tr>
<tr>
<td><strong>Trade balance</strong> (US million $)</td>
<td>32.9</td>
<td>20.1</td>
<td>34.6</td>
</tr>
<tr>
<td><strong>Consumer surplus</strong> (US million $)</td>
<td>-55.7</td>
<td>-35.2</td>
<td>-57.3</td>
</tr>
<tr>
<td><strong>Producer surplus</strong> (US million $)</td>
<td>43.4</td>
<td>28.1</td>
<td>44.7</td>
</tr>
<tr>
<td><strong>Total welfare</strong> (US million $)</td>
<td>-13.5</td>
<td>-7.8</td>
<td>-13.9</td>
</tr>
</tbody>
</table>
Table 4 (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Chad</th>
<th>Congo Republic</th>
<th>Gabon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Production vol. (%)</td>
<td>11.2</td>
<td>7.5</td>
<td>11.2</td>
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<tr>
<td>Exports vol. (%)</td>
<td>118.3</td>
<td>71.9</td>
<td>118.3</td>
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<tr>
<td>Imports vol. (%)</td>
<td>-1.8</td>
<td>-1.4</td>
<td>-1.8</td>
</tr>
<tr>
<td>Exports value (%)</td>
<td>5.2</td>
<td>3.4</td>
<td>5.2</td>
</tr>
<tr>
<td>Imports value (%)</td>
<td>0.5</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Fiscal revenue (US million $)</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Trade balance (US million $)</td>
<td>7.5</td>
<td>5.0</td>
<td>7.5</td>
</tr>
<tr>
<td>Consumer surplus (US million $)</td>
<td>-14.6</td>
<td>-9.9</td>
<td>-14.6</td>
</tr>
<tr>
<td>Producer surplus (US million $)</td>
<td>14.9</td>
<td>10.1</td>
<td>14.9</td>
</tr>
<tr>
<td>Total welfare (US million $)</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
</tr>
</tbody>
</table>
values that however does not compensate for the tariff cuts, thus the drop in customs revenue. With the increase in import values, local production has become more competitive. The excess demand for local production engendered is then satisfied by a greater local production. The local consumption increase is however not sufficient to compensate the import consumption decrease due to international prices increase. There is therefore a greater deterioration of the consumer surplus and welfare of the population.

Simulation 6 adds the reduction of domestic supports to Simulation 5. Note that domestic supports affect producer revenue more and CEMAC countries do not grant them to their producers. Reduction of domestic supports then has a very low impact within the region and on international prices compared to Simulation 5. As theoretically expected, with the addition of the suppression of all quotas by the EU to Simulation 6, only revenue effects are observed. As a result, the impacts of Simulation 6 are only modified at the level of total welfare where revenue is of particular importance. These last results tend to make us believe that for CEMAC countries EPA negotiations can be considered as complementary to WTO negotiations. In this way, countries could then bind the achievements of WTO negotiations to obtain maximum added value from EPA.

8. Conclusion and policy recommendations

All CEMAC countries are DCs and LDCs, thus their main development goal is the promotion of a strong and sustainable economic growth in view of alleviating poverty. Since a majority of the population of these countries practice agriculture, its development can effectively contribute to achieve the global goal. To that end, it is necessary to reduce or eliminate external market access barriers to agricultural trade and put in place instruments to promote agricultural exports, diversification and markets, and reduce domestic exports supply constraints. It is agreed that WTO negotiations can help fulfil some of these prerequisites.

The simulation results of WTO agricultural trade negotiation modalities for a better market access indicate that despite special and differential treatment and the consideration of special products, the tariff reduction will lead to a net deterioration of the CEMAC population’s total welfare. The reduction of agricultural subsidies and domestic supports by trade partners shall further deteriorate consumer surplus and consequently undermine food security in the sub-region. The supply constraints are the main cause of this poor exploitation of market access opportunities offered by these modalities.

To mitigate the negative effects of tariff reduction on their economies, CEMAC countries should, in addition to advocating the differential reduction of tariffs between developed and developing countries, sustain a low reduction of their tariffs to compensate the unilateral efforts already deployed as part of SAP. The suppression of subsidies must also be sustained as well as reduction and binding of domestic supports. Financial compensations should be required and oriented towards restructuring their economies to render them more competitive. Member States must also apply for SSM and SSG and in compensation, bind their tariff rates to the neighbourhood of the applied rates. This is all the more because they are already constrained by the common external tariff of the sub-region.

The different levels of development and the differential impact of negotiations modalities on CEMAC countries recommend a step-by-step approach of negotiations, specific to each country while acknowledging that the regional integration frame is appropriate for an adequate scheduling of complementary, compensatory and institutional measures that would help mitigate the nefarious effects of trade liberalisation. This frame is thus important for EPA negotiations,
which should nevertheless be considered as complementary to WTO negotiations in order to derive maximum added value.

Acknowledgements

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Appendix A. Model structure

In the model datasets a country is often an importer and exporter of one (aggregate) good. To accommodate this feature of trade data, composite tariffs for determining the domestic consumption and production price are estimated. The technique chosen to derive the composed tariffs is to divide the volumes into three groups, imports, exports and production supplied to the domestic market ($S_d$). First, a domestic market tariff ($t_d$) is computed as the weighted average of two tariffs, the export tariff ($t_x$) and import tariff ($t_m$), where the weights are export ($X$) and imports ($M$):

$$t_d = \frac{X t_x + M t_m}{M + X} \quad (1)$$

Then, a consumption (domestic market) tariff is computed as the weighted average of the import tariff ($t_m$) and the domestic market tariff ($t_d$), where the weights are imports ($M$) and domestic supply ($S_d$):

$$t_c = \frac{M t_m + S_d t_d}{D} \quad (2)$$

Similarly, a supply (domestic market) tariff is computed as the weighted average of the export tariff ($t_x$) and the domestic market tariff ($t_d$), where the weights are exports ($X$) and domestic supply ($S_d$) plus the domestic support tariff ($t_p$):

$$t_s = \frac{X t_x + S_d t_d}{S} + t_p \quad (3)$$

These calculations are applied both to the baseline and the final tariffs.

The equation system for all countries has four equations:

$$\hat{D}_{i,r} = \eta_{i,i,r}[\hat{P}_{wi} + (1 + \hat{t}_{ci,r})] + \sum_{j=1}^{J} \eta_{i,j,r}[\hat{P}_{wj} + (1 + \hat{t}_{cj,r})] \quad (4a)$$

$$\hat{S}_{i,r} = \varepsilon_{i,i,r}[\hat{P}_{wi} + (1 + \hat{t}_{pi,r})] + \sum_{j=1}^{J} \varepsilon_{i,j,r}[\hat{P}_{wj} + (1 + \hat{t}_{pj,r})] \quad (4b)$$

$$\Delta X_{i,r} = \Delta M_{i,r} - D_{i,r} \hat{D}_{i,r} + S_{i,r} \hat{S}_{i,r} \quad (4c)$$
\[ \Delta M_{i,r} = \frac{A_{\text{new}}}{1 + A_{\text{new}}} D_{i,r} \hat{D}_{i,r} + \left( \frac{A_{\text{init}}}{1 + A_{\text{init}}} - \frac{A_{\text{new}}}{1 + A_{\text{new}}} \right) D_{i,r}, \quad \text{where } A_y = \left( \frac{\alpha_m}{\alpha_d} \left( \frac{P_d}{P_m} \right) \right)^\sigma \]

where \( D, S, X, \) and \( M \) denote demand, supply, exports and imports, respectively, the hat symbol (^) denotes relative changes and \( \Delta \) is the absolute changes, \( P_w \) the world price, \( t_c \) the domestic consumption tariff and \( t_p \) the domestic production tariff, \( \eta \) the supply elasticity, \( \epsilon \) the demand elasticity, \( \gamma \) the ratio of exports to production, \( i \) and \( j \) the commodities indexes, \( r \) is a country index.

Eq. (4c) requires that the change in exports in each market is same proportion of the change in production. This proportion is determined by the ratio of exports to production. For example, if all the initial production is exported, all the change in production is exported. If half the initial production is exported, half of the change in production is exported. This implies that the proportion of exports to production is maintained. Eq. (4d) clears the market, so that production plus imports equals domestic consumption and exports.

By transforming \( (M(D - M)) = ((\alpha_m/\alpha_d)(P_d/P_m))^\sigma, \hat{D}, \hat{S}, \Delta X \) and \( \Delta M \) to vectors with dimensions of 5832 \((162 \times 36)\) by 1, the equation system above can be simplified to the following four equations:

\[
\begin{align*}
\hat{D} &= k_1 \hat{P}_w + k_2 \\
\hat{S} &= k_3 \hat{P}_w + k_4 \\
k_5 \hat{S} + \Delta X &= 0 \\
k_6 \Delta \hat{D} + k_7 \hat{S} + k_8 \Delta X + \Delta M &= 0
\end{align*}
\]

Using matrix inversion and multiplication techniques, the model solves the equation system for world prices. Define the main determinant \( F \) and the vectors \( V, y_2, \) and \( y_3 \) as follows:

\[
\begin{align*}
k_1 &= \eta + \sum \eta_j \\
k_2 &= \eta(1 + \hat{t}_c) + \sum \eta_j(1 + \hat{t}_{cj}) \\
k_3 &= \epsilon + \sum \epsilon_j \\
k_4 &= \epsilon(1 + \hat{t}_p) + \sum \epsilon_j(1 + \hat{t}_{pj}) \\
k_5 &= -X \\
k_6 &= -D \\
k_7 &= S \\
k_8 &= -1
\end{align*}
\]

Then

\[
F = \begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & k_5 & 1 & 0 \\
k_6 & k_7 & k_8 & 0
\end{bmatrix}, \quad V = \begin{bmatrix}
\hat{D} \\
\hat{S} \\
\Delta X \\
\Delta M
\end{bmatrix}, \quad y_2 = \begin{bmatrix}
k_1 \\
k_2 \\
k_4 \\
k_8
\end{bmatrix}, \quad y_2 = \begin{bmatrix}
k_2 \\
k_4 \\
0 \\
0
\end{bmatrix}
\]
Solving for $V$ gives

$$V = y_3 + y_2 \hat{P}_w$$  \hspace{1cm} (17)

Using the relevant horizontal element vectors of the inverted determinant allows the derivation of the export and import changes. Define

$$V = F^{-1}y_3 + F^{-1}y_2 \hat{P}_w$$  \hspace{1cm} (18)

Then

$$y_1 = |F_{31} \quad F_{32} \quad F_{33} \quad F_{34}|, \quad y_4 = |F_{41} \quad F_{42} \quad F_{43} \quad F_{44}|$$

The next step is to summarise the export and import changes over $N_p$ countries. Define

$$\Delta X = y_1 y_2 \hat{P}_w + y_1 y_3$$  \hspace{1cm} (19)

$$\Delta M = y_4 y_2 \hat{P}_w + y_4 y_3$$  \hspace{1cm} (20)

The totals of the $T$ coefficients are used to constitute the world market equation system:

$$T_1 = \sum_{n=1}^{N_p} y_{1,n} y_{2,n}, \quad T_2 = \sum_{n=1}^{N_p} y_{1,n} y_{3,n}, \quad T_3 = \sum_{n=1}^{N_p} y_{4,n} y_{2,n}, \quad T_4 = \sum_{n=1}^{N_p} y_{4,n} y_{3,n}$$  \hspace{1cm} (21)

Equilibrium requires that

$$\sum_{n=1}^{N} \Delta X_n = T_1 \hat{P}_w + T_2$$  \hspace{1cm} (22)

$$\sum_{n=1}^{N} \Delta M_n = T_3 \hat{P}_w + T_4$$  \hspace{1cm} (23)

i.e. the change in world excess supply is zero. This implies that

$$\sum_{n=1}^{N} (\Delta M_n - \Delta M_n) = 0$$  \hspace{1cm} (24)

Note that $T_1$ and $T_3$ are square commodity matrices and that all other variables are commodity vectors. Solving for the world market price change gives

$$(T_1 - T_3) \hat{P}_w + (T_2 - T_4) = 0$$  \hspace{1cm} (25)

The absolute world market price change is

$$\hat{P}_w = -(T_1 - T_3)^{-1}(T_2 - T_4)$$  \hspace{1cm} (26)

Once the world price changes are derived, these changes can then be inserted into Eqs. (4a)–(4d) to get the volume responses.

Given the volume responses $\Delta X, \Delta M, \Delta S,$ and $\Delta D$, the trade revenue and welfare effects can be computed. The trade revenue effect of the policy changes is computed for each country and commodity from

$$\Delta P_w = \hat{P}_w P_w$$  \hspace{1cm} (27)

The welfare change has three components. The first two are the changes in producer surplus ($\Delta PS$) and consumer surplus ($\Delta CS$). These changes depend on the domestic market price changes and the own price domestic demand and supply volume responses. The change in producer surplus is also dependent on the change in quota rent received. Quota rents, $U$, are calculated for
each country and commodity as the volume of imports times the world price times the difference
between the in-quota and out-quota tariffs:

\[
\Delta R = (P_w + \Delta P_w)(X + \Delta X) - (M + \Delta M) - P_w(X - M)
\] (28)

The capture rate, \(c\), is the proportion of the rent captured by exporting producers as opposed to the proportion, \(1 - c\), and going to the importing government. The change in quota rent received, \(c\Delta U\), is added to producer surplus (PS). For each country and commodity:

\[
\Delta PS = \Delta P_p(S + 0.5\Delta S) + c\Delta U
\] (29)

\[
U = QP_w(t_{m2} - t_{m1})
\] (30)

\[
\Delta CS = \Delta P_p(D + 0.5\Delta D_d)
\] (31)

where \(Q\) denotes the import quota, \(t_{m1}\) the in-quota and \(t_{m2}\) is the out-quota or applied tariff rates. Rent accrues only if the importing country is applying the out-quota tariff rate. The change in quota rent received, \(c\Delta U\), is added to producer surplus.

The third part is the change in net government revenue (\(\Delta NGR\)), consisting of change in tariff revenue, change in export subsidy expenditure, and change in domestic support expenditure and change in quota rent not received by exporters.\(^1\) For each country:

\[
\Delta NGR = \Delta TR + \Delta ES + \Delta DS + (1 - c)\Delta U = (t_w + \Delta t_w)(Q + \Delta Q) - t_w Q
\]

\[
+ \frac{(t_0 + \Delta t_0)(M + \Delta M) - (Q + \Delta Q)}{C_0} - t_0(M - Q)
\]

\[
+ \frac{[(t_x + \Delta t_x)(X + \Delta X) - t_x X] - [(t_d + \Delta t_d)(S + \Delta S) - t_d S]}{C_0}
\]

\[
+ \frac{(1 - c)\Delta U}{C_0}
\]

(32)

The sum is the total welfare effect:

\[
\Delta W = \Delta PS + \Delta CS + \Delta NGR
\] (33)

As the interdependence between animal products and feedstock is concerned, the theoretical hypothesis is that the volume of animal production and, hence, feed production is determined by profitability rather than by price. Approximating profitability by gross value added (product value minus feed input value), the supply function for each country becomes

\[
S = f(P_i - \sum_j r_{ij}P_j)
\] (34)

where \(p\) denotes the price, \(r\) the feed share, subscript \(i\) the animal product, and subscript \(j\) is the feed. Expressing the function in basic model terms, it becomes

\[
\hat{S} = e\left\{[\alpha \tilde{P}_{w,i} + (1 + \tilde{t})_p_i] - \sum_j r_{ij}[-\beta \tilde{P}_{w,j} + (1 + \tilde{t})_{c,j}]\right\}
\] (35)

\(^1\) Note that for countries, for which there is no information on agricultural trade policies, there is no change in net government revenue and changes in producer and consumer surplus only occur as a result of changes in the world price.
The terms for the animal product price change are already included in the equations shown above, but not the terms for the feed commodities. The results are somewhat imprecise because the supply and demand elasticity used in the model have been estimated in relation to product price rather than in relation to profitability.

As regarding tariff quota rents and tariff revenues, an importer that applies the tariff quota system generates quota rents for those suppliers that export goods within the quota, due to the lower within-quota than out-of-quota tariff. In the model, it is assumed the exporter captures these rents. The distribution of the rents among exporters is determined by the difference between the out-of-quota and within-quota tariff and on the allocation of bilateral quotas.

Bilateral quotas need to be calculated by the model. The principle adopted is to assume that the quotas are distributed on the basis of historical bilateral trade. However, bilateral trade information does not exist for all policy countries. The total volume of exports from each country is used to allocate the remaining global quota of a commodity where bilateral trade information does not exist.

This method can lead to the construction of a bilateral quota matrix where the total of bilateral quotas offered by all importers to an individual exporter can exceed that country’s export capacity. Hence, bilateral quota redistribution is required to ensure that no supplier receives a sum of bilateral quotas that exceeds their export capacity. This redistribution is achieved through the use of an iteration algorithm. In short, this algorithm can be described as follows. Given the bilateral quota matrix for each commodity, \( c_{ij}, i = 1, \ldots, n, j = 1, \ldots, m \), where \( i = \) importer and \( j = \) exporter, the bilateral sum vectors are

\[
Q_i = \sum_j c_{ij}, \quad j = 1, \ldots, m, \text{ hence } Q_i \text{ should equal the global quota } G_i \tag{36}
\]

\[
Q_i = \sum_j c_{ij}, \quad i = 1, \ldots, n \text{ hence } Q_j \text{ should be less than or equal to } X_j \tag{37}
\]

If \( Q_j < X_j \), for all \( j \) no adjustment is needed. Otherwise the bilateral quotas assigned to exporting country \( j \) are multiplied by a coefficient equal to \( X_j/Q_j \).

This adjustment ensures \( Q_j < G_j \) for some importing countries. Hence, the bilateral quotas from the importing country, \( i \) are multiplied by a coefficient equal to \( G_j/Q_j \). This process is iterated until the average ratio of \( G_j/Q_j < 1.001 \).

To estimate quota rents it is necessary to multiply the adjusted bilateral quota matrix with the unit value of the tariff difference. This unit value is obtained by multiplying the difference between the out-of-quota tariff rate \( (t_2) \) and the within-quota tariff rate \( (t_1) \) with the world market price. Thus, the bilateral rent, \( r_{i,j} \) is

\[
r_{i,j} = c_{i,j}P_w(t_2 - t_1) \tag{38}
\]

The bilateral rents are summed over importers for each exporter to get the rent \( r_j \). The rent is computed for the reference case, \( r_{j,b} \), and the policy scenario, \( r_{j,f} \). The policy scenario rent is affected by changes in the bilateral quota matrix, changes in within-quota and out-of-quota tariffs and changes in world market prices. Thus

\[
r_{i,j,f} = c_{i,j,f}(P_w + \Delta P_w)(t_{2,f} - t_{1,f}), \quad \text{for the exporters } j = 1, \ldots, m \tag{39}
\]

The global sum of forgone quota rents is, by definition, equal to the global sum of receivable quota rents.
Tariff revenue, \( T \), for each country and commodity is the sum of the within-quota tariff \( t_1 \) multiplied by the global quota and by the out-of-quota tariff \( t_2 \) multiplied by the difference between total imports, \( M \), and the quota, \( Q \). Thus

\[
T = P_w [t_1 Q + t_2 (M - Q)]
\]  

(40)

References


