7. THE WEST AFRICAN TRADE OUTLOOK: BUSINESS-AS-USUAL COMPARED WITH ALTERNATIVE OPTIONS

Sunday Pierre Odjo and Ousmane Badiane

Recent studies indicate that Africa's global trade performance has strengthened over time (Bouët, Laborde, and Deason 2014), as has its trade performance within Africa, both as a whole and by subregion (Badiane, Makombe, and Bahiigwa 2014). This aligns with the trend of faster demand growth within African and regional export markets compared with the global export market. For instance, Africa's relative share of the global export market rose sharply in terms of value between 1996 and 2013, both for all goods (from 0.05 to 0.21 percent) and for agricultural products (from 0.15 to 0.34 percent). Increased Africa-wide and intra-regional trade, and the rising role of African markets as major destinations for agricultural exports by African countries and regions, suggest that crossborder trade flows will exert greater influence on the level and stability of domestic food supplies. The more countries find ways to accelerate the pace of trade growth within Africa, the larger that influence is expected to be in the future.

This chapter assesses the future outlook for intra-regional trade expansion in West Africa and the implications for the volatility of regional food markets. The chapter begins with an analysis of historical trends in intra-regional trade of major staple food products, as well as the positions of individual West African countries in the regional market. This is followed by an exploration of the potential of regional trade to contribute to stabilizing food markets, and an assessment of the scope for expanding crossborder trade. The chapter then presents results from a regional trade model used to simulate alternative scenarios for increasing trade and reducing volatility within West Africa's regional market. Finally, conclusions are presented.

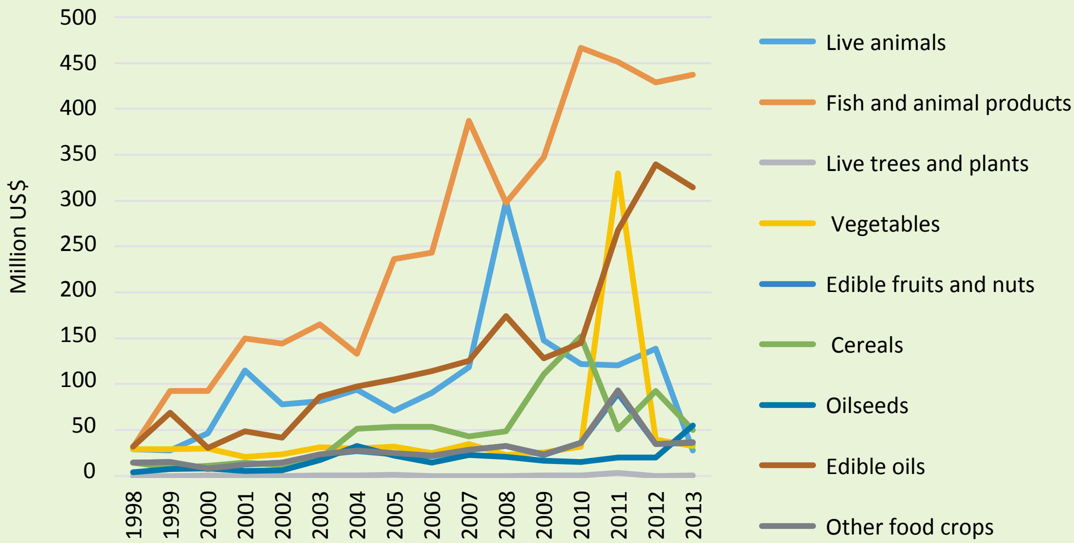
Long-Term Trends in Intra-Regional Trade in Staple Food Products

Between 1998 and 2013, crossborder trade in staple food products followed an increasing but unsteady trend. Fish and animal products, including meat, dairy, and eggs, were the most traded commodities among West African countries in value terms (Figure 7.1; Table 7.1). On average, intra-regional trade of these products amounted to US$439.2 million during 2011–2013, up from only US$165.7 million approximately a decade earlier. The exchange of live animals and edible oils averaged US$95.7 million and US$307.3 million, respectively, during 2011–2013, representing a fourfold growth over average levels in the early 2000s.

The value of trade in cereals and vegetables within West Africa was generally lower. For instance, the regional market for cereals and vegetables averaged US$81.5 million and US$28.5 million, respectively, during 2006–2010. In that period, the region more than doubled its level of trade in cereals in the early 2000s; however, the regional cereals market contracted heavily during 2011–2013. In contrast, trade in vegetables surged in 2011, inflating the average market size to US$133.7 million for the 2011–2013period.

Oilseeds are the least traded product within West Africa in value terms. Crossborder exchange of this commodity amounted to US$31.8 million on average in 2011–2013, almost doubling its value in the early 2000s. Other staple food crops, including edible fruits and nuts and live trees and plants such as roots and tubers, constituted a relatively larger share of the regional market value, amounting to US$54.8 million in 2011–2013, more than double the corresponding value in the early 2000s.

Figure 7.1. Trends in the export of staple food products within West Africa, 1998–2013



Source: Authors' calculations based on HS4-level bilateral trade values from CEPII (2015).

Note: Data include 15 members of the Economic Community of West African States, plus Chad and Mauritania

Table 7.1. Average value of trade of staple food products within West Africa

Product	2001-2005	2006-2010	2011-2013
	US dollars (millions)		
Live animals	87.7	155.6	95.7
Fish and animal products	165.7	348.4	439.2
Vegetables	27.3	28.1	133.7
Cereals	30.1	81.5	64.5
Oilseeds	16.8	17.8	31.8
Edible oils	75.8	137.4	307.3
Other food crops	20.6	28.5	54.8
All staple food products	424.1	797.3	1,127.0

Source: Authors' calculations based on HS4-level bilateral trade values from CEPII (2015).

Note: Data include 15 members of the Economic Community of West African States, plus Chad and Mauritania

In sum, crossborder trade of major food products among West African countries expanded during 2001–2013. The net trade positions of each country by commodity group within the West African regional market are presented in Table 7.2, where negative or positive values indicate net importing or exporting countries and their shares of the total value of net imports and exports for each commodity across the region. For example, Nigeria was the region's largest net importer of live animals in the period under study (50.4 percent), followed by Côte d'Ivoire and Senegal (20.6 and 18.4 percent, respectively). Thus, these major importing countries accounted for 89.4 percent of the regional import market, the remaining 10.6 percent comprising imports by Benin, Ghana, Guinea, Mauritania and Togo. In contrast, Niger (50.5 percent) and Mali (43.2 percent) were the largest regional net exporters of live animals, followed by Burkina Faso (6.2 percent); other countries contributed negligible shares.

Table 7.2. Contributions of individual countries to values of net imports and net exports of staple food products among West African countries, 1998–2013 (%)

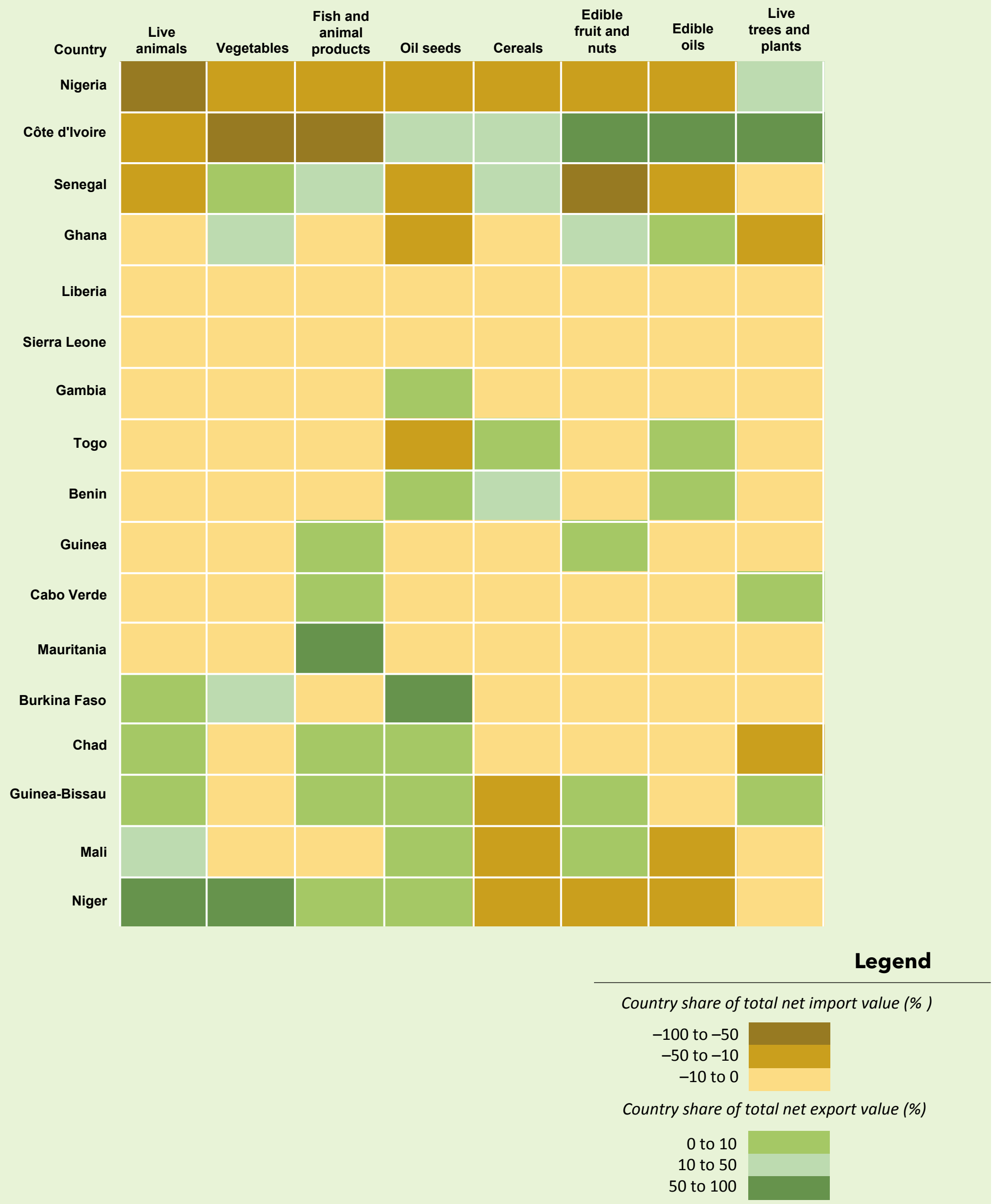
Country	Live animals	Fish and animal products	Live trees and plants	Vegetables	Edible fruit and nuts	Cereals	Oilseeds	Edible oils
	Share (%)							
Benin	-6.1	-1.4	-1.9	-6.4	-6.5	33.8	0.3	8.4
Burkina Faso	6.2	-4.1	-8.8	11.8	-3.7	-1.9	66.5	-7.7
Cabo Verde	0.0	0.2	0.0	-0.1	-0.3	-1.1	0.0	0.0
Chad	0.1	0.4	-32.2	-0.1	-0.7	-0.8	0.0	0.0
Côte d'Ivoire	-20.6	-54.6	52.6	-67.6	78.6	18.3	18.9	88.3
Gambia	0.0	-0.2	-0.3	-0.2	-0.7	-1.6	7.5	-0.2
Ghana	-3.0	-7.2	-37.4	15.2	12.4	-1.9	-45.4	0.7
Guinea	-0.4	8.8	-0.5	-0.1	1.8	-1.4	-1.4	-1.3
Guinea-Bissau	0.0	3.2	0.0	-0.1	0.1	-11.7	0.0	-0.4
Liberia	0.0	-0.4	-5.2	-0.4	-0.1	-0.8	-0.6	-0.4
Mali	43.2	-4.7	-1.4	-3.3	7.2	-21.7	5.1	-21.0
Mauritania	-0.9	71.6	-1.3	-0.3	-7.3	-4.9	-3.7	-0.1
Niger	50.5	0.1	-1.2	71.2	-14.5	-30.0	1.7	-16.7
Nigeria	-50.4	-25.4	47.4	-18.3	-13.4	-22.2	-11.9	-28.6
Senegal	-18.4	15.8	-5.2	1.8	-52.7	39.5	-12.6	-23.6
Sierra Leone	0.0	-0.4	-0.9	-0.5	-0.1	-0.1	-1.5	0.0
Togo	-0.3	-1.5	-3.6	-2.6	0.0	8.3	-22.9	2.6

Source: Authors' calculations based on HS4-level bilateral trade values from CEPII (2015).

Note: Data include 15 members of the Economic Community of West African States, plus Chad and Mauritania.
Positive values indicate net exporting countries' shares of net export values across the region's countries; negative values indicate net importing countries' shares of net import values across the region's countries

These differences are presented visually in Figure 7.2, where major net importers and exporters are clustered at the top and bottom of the figure, and countries with modest market participation are spread in between. Nigeria and Côte d'Ivoire were the largest net importers of vegetables, whereas Niger, Ghana, and Burkina Faso were the largest net exporters. In addition, Nigeria and Côte d'Ivoire were net importers of fish and animal products, whereas net exports were supplied by Mauritania, Senegal, Cabo Verde, and Guinea. The regional oilseeds market was dominated by Ghana, Togo, Senegal, and Nigeria as net importers, and by Burkina Faso, Côte d'Ivoire, Gambia, and Benin as net exporters. Cereals were mostly imported by Niger, Mali, Nigeria, and Guinea-Bissau and exported by Senegal, Benin, and Côte d'Ivoire. Edible fruit and nuts were mainly imported by Senegal, Nigeria, and Niger and exported by Côte d'Ivoire and, to a lesser degree, by Ghana. The regional market of vegetable oils was dominated by Nigeria, Senegal, Mali, and Niger as major net importers and by Côte d'Ivoire as the only major net exporter. Finally, Ghana and Chad dominated the market of live trees and plants as net importers, whereas Côte d'Ivoire and Nigeria were the largest net exporters.

Figure 7.2. Distribution of net exports and net imports of staple food products among West African countries, 1998–2013

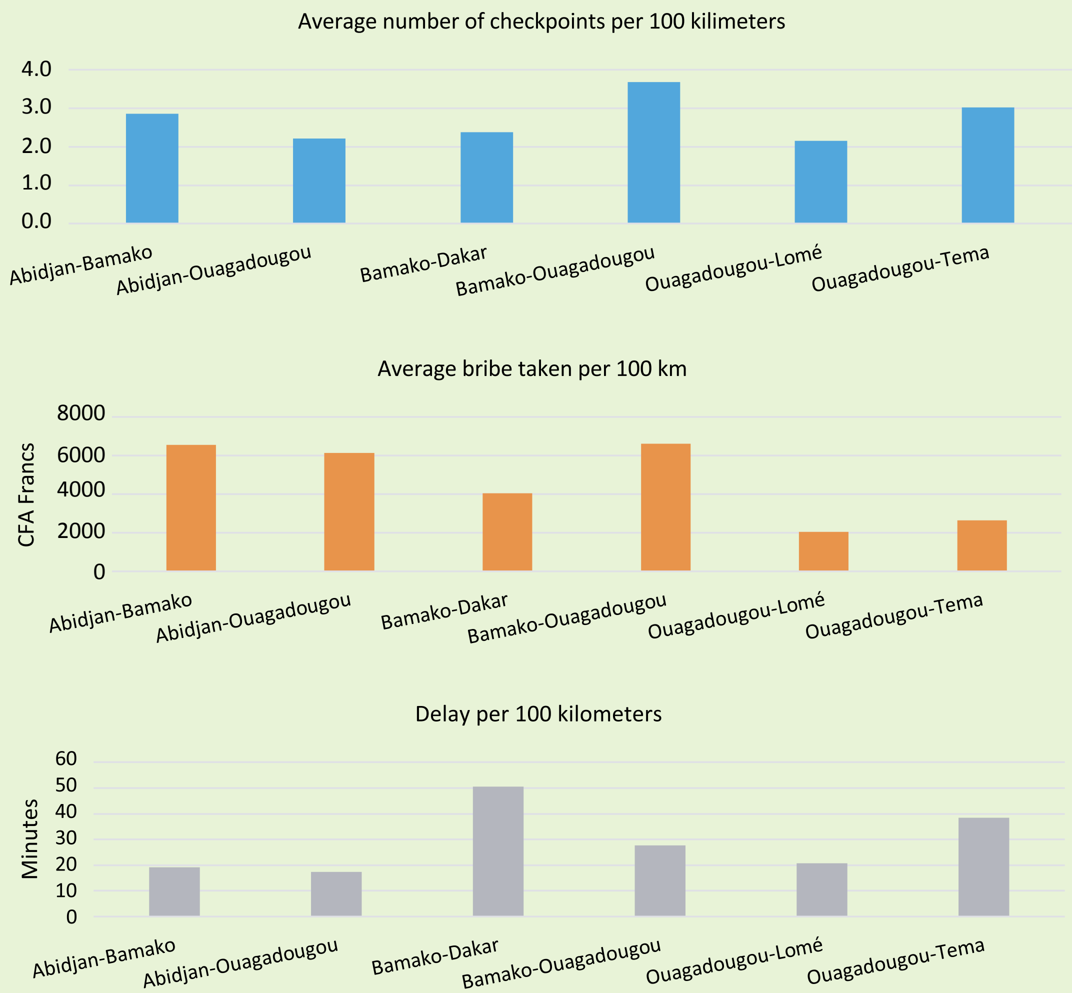


Source: Authors' calculations based on HS4-level bilateral trade values from CEPII (2015).

Note: Data include 15 members of the Economic Community of West African States, plus Chad and Mauritania.

In concluding the focus on historical trends in intra-regional trade, it is important to analyze harassment practices, which are perceived as bottlenecks to the free movement of goods (and people) across the region. Survey data on checkpoints, bribes paid, and delays along major crossborder transport corridors in West Africa are summarized in Figure 7.3. The average values plotted illustrate the importance of abnormal trade costs to traders operating within the regional West African market. As of 2010–2012, at least two checkpoints were encountered every 100 kilometers, and a minimum of 2000 West African CFA francs (CFAF) were paid in bribes across the surveyed transport corridors. More than three checkpoints were found along the corridor connecting Bamako (Mali) and Ouagadougou (Burkina Faso), and bribes exceeded CFAF 6000 on average.

Figure 7.3. Indicators of harassment practices along West African transport corridors, 2010–2012



Source: Authors' calculations based on survey results from the Improved Road Transport Governance (IRTG) Initiative (IRTG 2010–2012).

The Regional Potential for Stabilizing Domestic Food Markets through Trade

The variability of domestic production is a major contributor to local food price instability in low-income countries. The causes of production variability mean that an entire region is less likely to be affected than are individual countries. Moreover, fluctuations in national production levels for different countries tend to partially offset each other, such that fluctuations are less than perfectly correlated. As a result, food production can be expected to be more stable at the regional level than at the country level. In this case, expanding crossborder trade and allowing greater integration of domestic food markets would reduce supply volatility and price instability in these markets.

Integrating regional markets through increased trade raises the capacity of domestic markets to absorb local price risks by (1) enlarging the area of production and consumption, thus increasing the volume of demand and supply that can be adjusted to respond to and dampen the effects of shocks; (2) providing incentives to invest in marketing services and expand capacities and activities in the marketing sector, thereby raising the capacity of the private sector to respond to future shocks; and (3) lowering the size of needed carryover stocks, thereby reducing the cost of supplying markets during periods of shortage and hence decreasing the likely amplitude of price variation.

This section presents a simple comparison of the variability of cereal production in individual countries against the regional average to illustrate the potential for trade and local market stabilization through greater market integration (Badiane 1988). For that purpose, a trend-corrected coefficient of variation was used as a measure of production variability at the country and regional levels. Following Cuddy and Della Valle (1978), the trend-corrected coefficient of variation in cereal production was calculated for each member of the Economic Community of West African States (ECOWAS) as follows:

$$TCV_i = CV_i \cdot \sqrt{1 - \bar{R}_i^2}$$

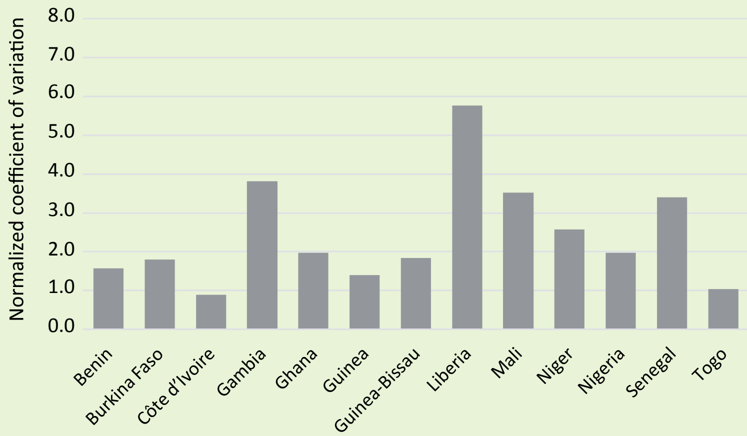
where CV_i is the coefficient of variation in the series of cereal production quantities in country i from 1980 to 2010, and $\bar{R}_i^2$ is the adjusted coefficient of determination of the linear trend model fitted to the series. Next, an index of regional cereal production volatility TCV_{reg} was derived for the ECOWAS region as a weighted average of the trend-corrected coefficients of variation of its member countries with the formula (Koester 1986):

$$TCV_{reg}^2 = \sum_i^n S_i^2 \cdot TCV_i^2 + 2\sum_i^n \sum_i^n S_i \cdot S_j \cdot V_{ij} \cdot TCV_i \cdot TCV_j$$

where TCV_i and TCV_j are the trend-corrected coefficients of variation in cereal production in countries i and j, n is the number of ECOWAS member countries, S_i and S_j are the shares of countries i and j in the region's overall cereal production, and V_{ij} is the coefficient of correlation between the series of cereal production quantities in countries i and j. Finally, the trend-corrected coefficients of variation calculated at the country level were normalized by dividing them by the regional coefficient.

For almost all countries, national production volatility was considerably larger than regional level volatility during 1980–2010, the exception being Côte d'Ivoire (Figure 7.4). Gambia, Liberia, Mali, Niger, and Senegal all recorded considerably higher volatility levels than the region. As a result, these countries would be the biggest beneficiaries of increased regional trade in terms of greater stability of domestic supplies. However, the likelihood of a given country benefiting from the trade stabilization potential of less volatile regional production also depends on the correlation between the fluctuations in its production and that of other countries in the region: the weaker the relationship, the more likely that regional production will be able to fill national shortfalls.

Figure 7.4. Cereal production instability in ECOWAS countries, 1980–2010



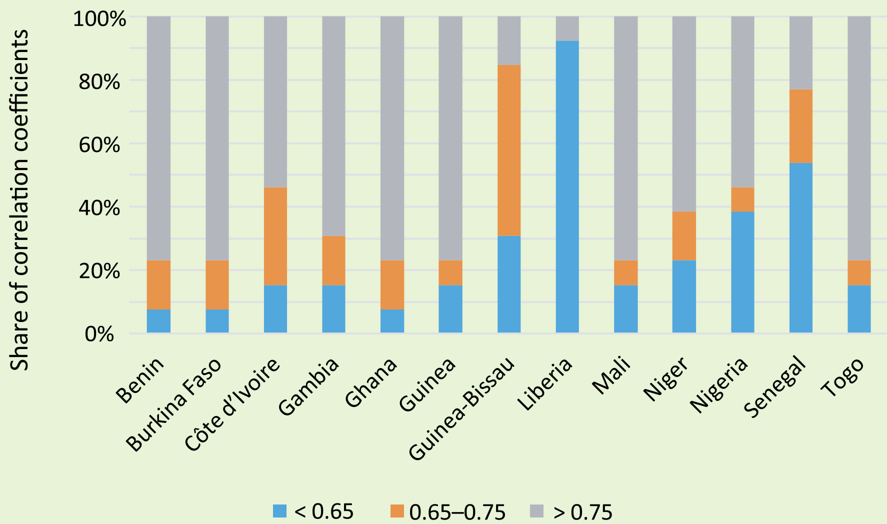
Source: Authors' calculations based on FAO (2014).

Note: The normalized coefficients of variation indicate by how much individual country production levels were more or less volatile (greater or less than 1) than production in the Economic Community of West African States (ECOWAS) region.

Therefore, the distribution of production correlation coefficients between individual countries in the region was plotted (Figure 7.5). For each country, highly correlated production fluctuations are indicated by coefficients of 0.75 or more, moderately correlated country production fluctuations are indicated by coefficients between 0.65 and 0.75, and weakly correlated production fluctuations are indicated by coefficients of 0.65 or less. Country production levels tend to fluctuate together, as shown by the high share of coefficients above 0.75 for the majority of countries.

However, the share is less than 30 percent for some countries, including Guinea-Bissau, Liberia, and Senegal. The division of the region into two nearly uniform subregions (Sahelian and coastal) may explain this. In general, the patterns and distribution of production fluctuations across the region's countries are such that increased trade could be expected to contribute to stabilizing domestic agricultural and food markets. That is only one condition, however. The other is the actual potential to increase crossborder trade, which is examined in the next section.

Figure 7.5. Distribution of production correlation coefficients among ECOWAS countries, 1980–2010



Source: Authors' calculations based on FAO (2014).

The Scope for Specialization and Expanding Regional Trade in Agriculture

Despite the recent upward trends, the level of intra-African and intra-regional trade is still very low compared with other regions. Intra-African markets accounted only for an average of 34 percent of all agricultural exports from African countries between 2007 and 2011 (Badiane, Makombe, and Bahiigwa 2014). A host of factors may be behind these low levels of intra-regional trade, not only making trading with extra-regional partners more attractive, but also raising the cost of supplying regional markets from intra-regional sources. The exploitation of the stabilization potential of regional trade, as described above, would require measures to lower the barriers to and bias against transborder trade so as to stimulate the expansion of regional supply capacities and of trade flows across borders. This assumes that sufficient scope exists for specialization in production and trade within the region. It is often assumed that neighboring developing countries would exhibit similar production and trading patterns because of the similarities in their resource bases, which would leave little room for future specialization.

Several factors, however, may cause different specialization patterns among such countries, including (1) differences in historical technological investments and thus the level and structure of accumulated production capacities and skills; (2) the economic distance to, and opportunity to trade with, distant markets; and (3) differences in dietary patterns and consumer preferences that affect the structure of local production. The different patterns of specialization in Senegal compared with the rest of Sahelian West Africa and in Kenya compared with other Eastern African countries illustrate the influence of these factors.

Consequently, a series of indicators was used to assess the actual degree of specialization in agricultural production and trade, and whether real scope exists to expand transborder trade as a strategy to exploit the less-than-perfect correlation among national production levels to reduce the vulnerability of domestic food markets to shocks. The first two indicators are the production and export similarity indexes, which measure and rank the relative importance of the production and trading of individual agricultural products in each country. These two indexes were calculated for country pairs using the following formulas:

$$SQ_{ij} = 100\sum_k Min(q_{ik}, q_{jk})$$

and

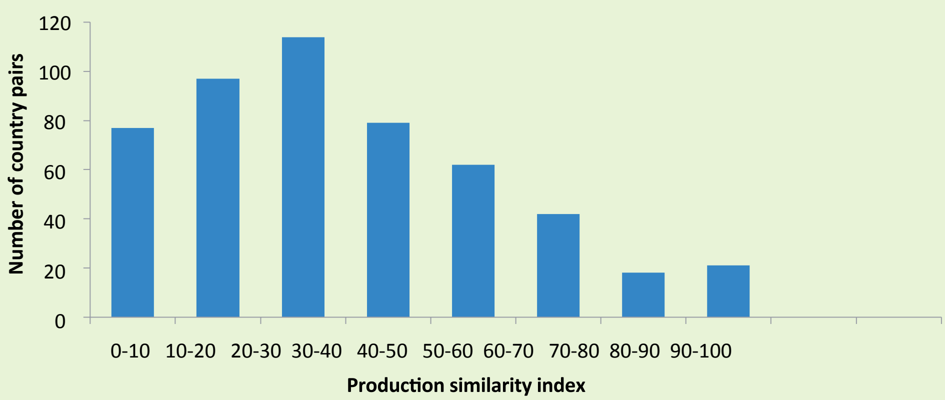
$$SE_{ij} = 100\sum_k Min(e_{ik}, e_{jk})$$

where SQ_{ij} and SE_{ij} are the production and export similarity indexes, respectively; q_{ik}, and q_{jk} are the shares of a product k in the total agricultural production of countries i and j, respectively; and e_{ik} and e_{jk} are the shares of a product k in the total agricultural exports of countries i and j, respectively. The level of importance or position of each product was then compared for all relevant pairs of countries within the region.[20] The indexes have a maximum value of 100, reflecting complete similarity of production or trade patterns between the considered pair of countries.

The more the value of the indexes tends toward zero, the greater the degree of specialization between the two countries. The results of the calculations cover 150 products in total (Figures 6.6 and 6.7).

The vast majority of country pairs fall within the 0–50 range. A value of less than 60 is conventionally interpreted as compatible with higher trade exchange between the considered pair of countries. The estimated index values therefore suggest sufficient dissimilarity in current country production and trading patterns exists such that there is scope for transborder trade expansion in the region.

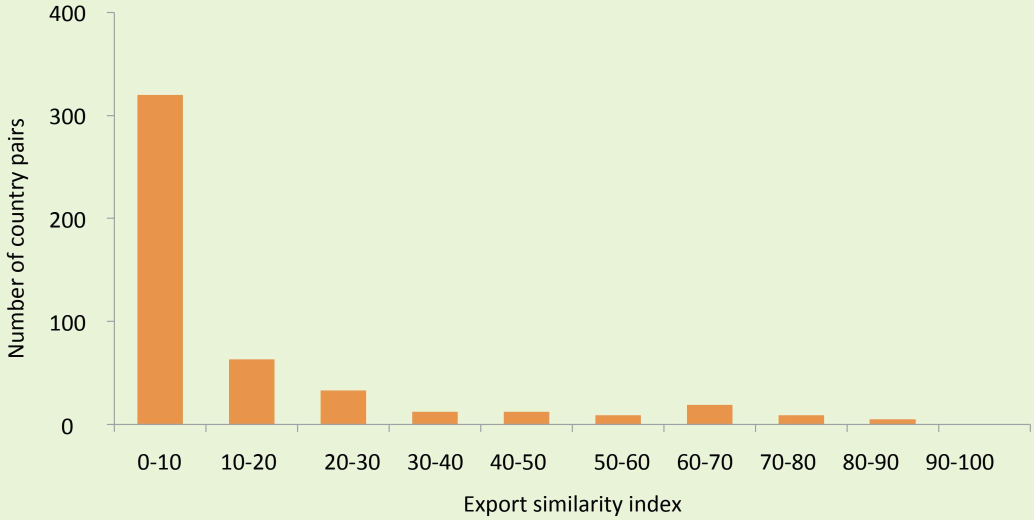
Figure 7.6. Similarity of production patterns among ECOWAS countries, 2007–2011



Source: Authors' calculations based on data from FAO (2014).

Note: Each bar represents the number of country pairs that fall within the corresponding range of index values

Figure 7.7. Similarity of trading patterns among ECOWAS countries, 2007–2011



Source: Authors' calculations based on FAO (2014).

A third indicator, the revealed comparative advantage (RCA) index, was computed to further assess the degree of trade specialization among countries within the region. This index was calculated according to the following formula (Balassa 1965):

$$RCA_{ijk} = \frac{E_{ijk}}{\Sigma_k E_{ijk}} \Big/ \frac{E_{wjk}}{\Sigma_k E_{wjk}}$$

where E_{ijk} is the export value of an agricultural product k from country i to destination j, and $E_{wjk} = \Sigma_i E_{ijk}$ is the world export value of the same product to the same destination.

The RCA index compares the share of a given product in a given country's export basket with that of the same product in total world exports. A value greater than 1 indicates that the considered country performs better than the world average.

The higher the value, the stronger the performance of the country in exporting the considered product. Of the nearly 450 RCA indicators estimated for various products exported by different ECOWAS countries, 73 percent recorded a value higher than 1. Following Laursen (2000), the RCA index is normalized through the formula

$$NRCA_{ijk} = (RCA_{ijk} - 1) / (RCA_{ijk} + 1)$$

Thus, the normalized RCA (NRCA is positive for RCA indicators that are greater than 1 and negative otherwise. For very high RCA indicators, the normalized value tends towards 1. The 20 products with the highest normalized RCA index values are presented in Table 7.3. All the products in the table have normalized RCA values above 0.98. The rankings reflect the degree of cross-country specialization within the ECOWAS region. For instance, 12 products spread across 8 of the 15 member countries account for the region's highest 20 normalized RCA indicator values.

Table 7.3. The top-20 products with the highest normalized comparative advantage index values in ECOWAS countries, 2007–2011 average

Commodity	Country
Cashew nuts, with shell	Guinea-Bissau
Cake of groundnuts	Gambia
Groundnut oil	Gambia
Cashew nuts, with shell	Benin
Groundnuts, shelled	Gambia
Cashew nuts, with shell	Gambia
Groundnut oil	Senegal
Copra	Gambia
Cake of groundnuts	Senegal
Cake of cottonseed	Benin
Rubber, natural dry	Liberia
Cottonseed oil	Togo
Cottonseed oil	Benin
Sugar beet	Gambia
Cashew nuts, with shell	Côte d'Ivoire
Cotton Linter	Benin
Cocoa beans	Côte d'Ivoire
Cake of groundnuts	Togo
Cocoa paste	Côte d'Ivoire
Cocoa beans	Ghana

Source: Authors' calculations based on FAO (2014).

So far, the analysis has established the existence of dissimilar patterns of specialization in production and trade of agricultural products among ECOWAS countries. Two final indicators, the trade overlap indicator (TOI) and trade expansion indicator (TEI), were calculated to examine the potential to expand trade within the region based on current trade patterns. These indicators measure how much of the same product a given country or region exports and imports at the same time. The TOI measures the overall degree of overlapping trade flows for a country or region as a whole, while the TEI measures the overlapping trade flows at the level of individual products for a country or region.

The TOI and TEI are calculated as follows :

$$TOI_i = 2\left(\Sigma_k Min(E_{ik}, M_{ik})\right) / \Sigma_k (E_{ik} + M_{ik})$$

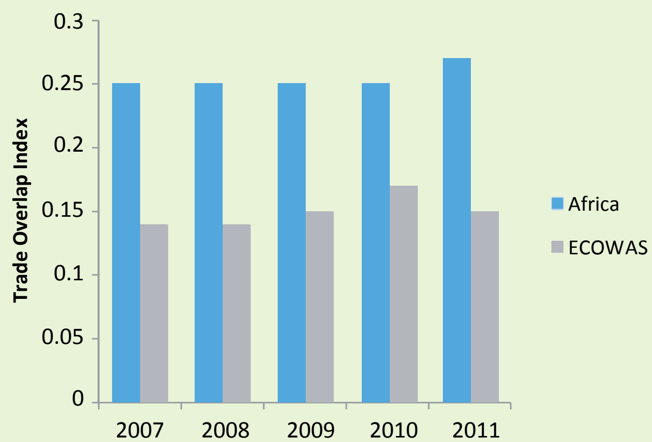
$$TEI_{ik} = 100 \cdot \left[Min(E_{ik}, M_{ik}) / Max(E_{ik}, M_{ik})\right],$$

where E_{ik} and M_{ik} denote the values of the exports and imports of an agricultural product k by a country i . The TOI varies between 0 and 1 and will be 0 if the country only exports or imports any individual products. It will be 1 in the unlikely situation in which the country both exports and imports all traded products by an equal amount.

The TEI indicates the percentage of the country's exports (imports) of a product that are matched by the country's imports (exports) of the same product (Figure 7.8 and Table 7.4). The figure indicates a considerable degree of overlapping trade flows: 25 percent for Africa as a whole and as much as 17 percent for the ECOWAS region. Normalized TOI values obtained by dividing country TOI values by the TOI value for the region can be found in Badiane, Makombe, and Bahiigwa (2014). In the vast majority of cases, they are significantly less than 1. The overlapping regional trade flows must therefore be from different importing and exporting countries. In other words, some countries are exporting (importing) the same products that are being imported (exported) by other ECOWAS member countries, but—in both cases—to and from countries outside the region. By redirecting such flows, countries should be able to expand transborder trade within the region.

The TEI indicates which products have the highest potential for increased transborder trade based on the degree of overlapping trade flows. The 20 products with the highest TEI value for the region are listed in Table 7.4. The lowest indicator value for any of the products is 0.41, and the average value is 0.56. RCA values for the same products, presented in Badiane, Makombe, and Bahiigwa (2014), are all greater than 1, except for fresh fruit. The fact that products with high TEI values also have high RCA values points to real scope for transborder trade expansion in the region.

Figure 7.8. Trade overlap indicators for the ECOWAS region, 2007-2011



Source: Authors' calculations based on FAO (2014).

Table 7.4. Trade expansion indicators for the ECOWAS region, 2007-2011 average

Commodity	TEI value
Tobacco products	0.926
Fatty acids	0.763
Groundnuts, shelled	0.744
Hides, cattle, wet salted	0.681
Coffee, extracts	0.676
Fruit, fresh	0.62
Fruit, tropical fresh	0.592
Cigarettes	0.573
Tea, mate extracts	0.535
Oilseeds	0.524
Onions, dry	0.513
Oil, cottonseed	0.51

Table 7.4. (Continued)

Commodity	TEI value
Pepper	0.479
Margarine	0.456
Roots and tubers	0.454
Cereal preparations	0.439
Chickpeas	0.415
Vegetables, fresh or dried products	0.412
Fruit, prepared	0.412
Pineapple, canned	0.406

Source: Authors' calculations based on FAO (2014).

Note: Italics designate products with an RCA value of less than 1; six products with high TEI values that are not produced in the region are included because they relate to re-export trade.

The findings presented above point to the existence of a real potential to expand intra-regional trade within ECOWAS beyond its current levels, even with current production and trade patterns. The remainder of the chapter therefore analyzes the outlook for expanding intra-regional trade and the expected impact on the volatility of regional food markets from 2008 to 2025. This is done by simulating alternative policy scenarios to boost intra-regional trade, comparing the effects on the level and volatility of trade flows against historical trends and outcomes under a baseline scenario that would continue those trends.

Regional Trade Simulation Model

The preceding analysis presented evidence showing that ECOWAS countries could use increased regional trade to enhance the resilience of domestic markets to supply shocks. The high cost of moving goods across domestic and transborder markets and outwardly biased trading infrastructure are major determinants of the level and direction of trade among African countries. A strategy to exploit the regional stabilization potential must, therefore, include measures to lower the general cost of trading and remove additional barriers to crossborder trade. This section simulates the impact on regional trade flows of changes in that direction. Simulations of changes are carried out using the regional Economywide Multimarket Model of the International Food Policy Research Institute (IFPRI) described below (see Diao et al. 2007 and Nin-Pratt et al. 2010). The original model has been augmented in this study to account for intra-versus extra-regional trade sources and destinations, as well as informal versus formal trade costs in intra-regional trade transactions. In its original version, the model solves for optimal levels of supply QX_{rc}, demand QD_{rc} and net trade (either imports QM_{rc} or exports QE_{rc}) of different commodities c for individual member countries r of the modeled region.

Supply and demand balance at the national level determines domestic output prices PX_{rc} as stated by equation (1), while equation (2) connects domestic market prices PD_{rc} to domestic output prices, taking into account an exogenous domestic marketing margin $margD_{rc}$. The net trade of a commodity in a country is determined through mixed complementarity relationships between producer prices and potential export quantities, and between consumer prices and potential import quantities. Accordingly, equation (3) ensures that a country will not export a commodity $(QE_{r,c} = 0)$ as long as the producer price of that commodity is higher than its export parity price, where pwe_{rc} is the country's free on board (FOB) price and $margW_{rc}$ is an exogenous trade margin covering the cost of moving the commodity from and to the border.

If the domestic market balance constraint in equation (1) requires that the country exports some excess supply of a commodity ($QE_{r,c} > 0$), then the producer price will be equal to the export parity price of that commodity. Additionally, equation (4) governs any country's possibility to import a commodity, where pwm_{rc} is its cost, insurance, and freight (CIF) price. There will be no imports ($QM_{rc} = 0$) as long as the import parity price of a commodity is higher than the domestic consumer price. If the domestic market balance constraint requires that the country imports some excess demand of a commodity ($QM_{r,c} > 0$), then the domestic consumer price will be equal to the import parity price of that commodity.

$$QX_{rc} + QM_{rc} - QE_{rc} = QD_{rc} \quad (1)$$

$$PX_{rc} \cdot (1 + margD_{rc}) = PD_{rc} \quad (2)$$

$$PX_{rc} \geq pwe_{rc} \cdot (1 - margW_{rc}) \quad \perp \quad QE_{r,c} \geq 0 \quad (3)$$

$$pwm_{rc} \cdot (1 + margW_{rc}) \geq PD_{rc} \quad \perp \quad QM_{r,c} \geq 0 \quad (4)$$

In the version of the model used in this study, the net export of any commodity is an aggregate of two output varieties differentiated according to their (regional and extra-regional) market outlets, assuming an imperfect transformability between the two export varieties. Similarly, the net import of any commodity is modeled as a composite of two varieties differentiated by their (regional and extra-regional) origins, assuming an imperfect substitutability between the two import varieties.

In order to implement export differentiation by destination, the mixed complementarity relationship in equation (3) is replaced with two new equations that specify the price conditions for export to be possible to both destinations. Equation (5) indicates that, for export to extra-regional market outlets to be possible ($QEZ_{rc} > 0$), suppliers should be willing to accept a price for that destination, PEZ_{rc} , that is not greater than the export parity price. Similarly, equation (6) assures that export to within-region market outlets is possible ($QER_{rc} > 0$) only if suppliers are willing to receive a price for that destination, PER_{rc} , that is not more than the regional market clearing price, PR_c , adjusted downward to account for exogenous regional trade margins, $margR_{rc}$, incurred in moving the commodity from the farm gate to the regional market (see equation 17 below for the determination of PR_c).

$$PEZ_{rc} \geq pwe_{rc} \cdot (1 - margW_{rc}) \quad \perp \quad QEZ_{rc} \geq 0 \quad (5)$$

$$PER_{rc} \geq PR_c \cdot (1 - margR_{rc}) \quad \perp \quad QER_{rc} \geq 0 \quad (6)$$

Subject to these price conditions, equations (7) through (10) determine the aggregate export quantity and its optimal allocation to alternative destinations. Equation (7) indicates that the aggregate export of a commodity by individual countries, QE_{rc} , is obtained through a constant elasticity of transformation (CET) function of the quantity QEZ_{rc} sold on extra-regional market outlets and the quantity QER_{rc} sold on intra-regional market outlets, where ρ^e_{rc} , δ^e_{rc} , and α^e_{rc} represent the CET function exponent, share parameter, and shift parameter, respectively. Equation (8) is the first-order condition of the aggregate export revenue maximization problem, given the prices suppliers can receive for the different export destinations and subject to the CET export aggregation function.

It says that an increase in the ratio of intra-regional to extra-regional destination prices will increase the ratio of intra-regional to extra-regional export quantities—that is, a shift toward the export destination that offers the higher return. Equation (9) helps identify the optimal quantities supplied to each destination. It states that aggregate export revenue at producer price of exports, PE_{rc} is the sum of export sales revenues from both intra- and extra-regional market outlets at supplier prices, whereas equation (10) sets the producer price of exports to be the same as the domestic output price PX_{rc}, which is determined through the supply and demand balance equation (1) as previously explained.

$$QE_{rc} = \alpha^{e}_{rc} \cdot \left(\delta^{e}_{rc} \cdot QER_{rc}^{\rho^{e}_{rc}} + (1 - \delta^{e}_{rc}) \cdot QEZ_{rc}^{\rho^{e}_{rc}} \right)^{\frac{1}{\rho^{e}_{rc}}} \quad (7)$$

$$\frac{QER_{rc}}{QEZ_{rc}} = \left(\frac{PER_{rc}}{PEZ_{rc}} \cdot \frac{1 - \delta^{e}_{rc}}{\delta^{e}_{rc}} \right)^{\frac{1}{\rho^{e}_{rc} - 1}} \quad (8)$$

$$PE_{rc} \cdot QE_{rc} = PER_{rc} \cdot QER_{rc} + PEZ_{rc} \cdot QEZ_{rc} \quad (9)$$

$$PE_{rc} = PX_{rc} \quad (10)$$

Import differentiation by origin is implemented following the same treatment as described above for export differentiation by destination. Equation (4) is replaced with equations (11) and (12). Accordingly, import from the extra-regional origin will occur ($QMZ_{r,c} > 0$) only if domestic consumers are willing to pay for the extra-regional variety at a price, PMZ_{rc}, that is not smaller than the import parity price. Furthermore, import from the intra-regional origin is possible ($QMR_{rc} > 0$) only if domestic consumers are willing to pay for the intra-regional variety at a price, PMR_{rc}, that is not smaller than the regional market clearing price, PR_{c}, adjusted upward to account for exogenous regional trade margins, $margR_{rc}$, incurred in moving the commodity from the regional market to consumers.

$$pwm_{rc} \cdot (1 + margW_{rc}) \geq PMZ_{rc} \perp QMZ_{r,c} \geq 0 \quad (11)$$

$$PR_{r} \cdot (1 + margR_{rc}) \geq PMR_{rc} \perp QMR_{rc} \geq 0 \quad (12)$$

Under these price conditions, equation (13) represents an aggregate import quantity, QM_{rc}, as a composite of intra- and extra-regional import variety quantities, QMR_{rc} and $QMZ_{r,c}$, respectively, using a constant elasticity of substitution (CES) function, with ρ^{m}_{rc}, δ^{m}_{rc}, and α^{m}_{rc} representing the CES function exponent, share parameter, and shift parameter, respectively. The optimal mix of the two varieties is defined by equation (14), which is the first-order condition of the aggregate import cost-minimization problem, subject to the CES aggregation equation (13) and given import prices from both origins. An increase in the ratio of extra- to intra-regional import prices increases the ratio of intra- to extra-regional import quantities—that is, it effects a shift away from the import origin that becomes more expensive. Equation (15) identifies the specific quantities imported from each origin. It defines the total import cost at the consumer price of imports PM_{rc} as the sum of intra-regional and extra-regional import costs, while equation (16) sets the consumer price of imports to be the same as the domestic market price PD_{rc}, which is determined through equations (1) and (2) as previously explained.

$$QM_{rc} = \alpha^{m}_{rc} \cdot \left(\delta^{m}_{rc} \cdot QMR_{rc}^{-\rho^{m}_{rc}} + (1 - \delta^{m}_{rc}) \cdot QMZ_{rc}^{-\rho^{m}_{rc}} \right)^{\frac{1}{\rho^{m}_{rc}}} \quad (13)$$

$$\frac{QMR_{rc}}{QMZ_{rc}} = \left(\frac{PMZ_{rc}}{PMR_{rc}} \cdot \frac{\delta^m_{rc}}{1 - \delta^m_{rc}} \right)^{\frac{1}{1+\rho^m_{rc}}} \quad (14)$$

$$PM_{rc} \cdot QM_{rc} = PMR_{rc} \cdot QMR_{rc} + PMZ_{rc} \cdot QMZ_{rc} \quad (15)$$

$$PM_{rc} = PD_{rc} \quad (16)$$

Having determined export quantities and prices by destination and import quantities and prices by origin, the regional market clearing price, PR_c , can now be solved. Equation (17) imposes the regional market balance constraint by equating the sum of intra-regional export supplies to the sum of intra-regional import demands, with $qdstk_c$ standing for discrepancies existing in observed aggregate intra-regional export and import quantity data in the model's base year. Thus, PR_c is determined as the price that ensures the regional market balance:

$$\sum_r QER_{rc} = \sum_r QMR_{rc} + qdstk_c \quad (17)$$

Calibration is performed so as to replicate, for every member country within the region, the same production, consumption, and net trade data observed for different agricultural subsectors and two nonagricultural subsectors in 2007–2008. Baseline trend scenarios are then constructed such that, until 2025, changes in crop yields, cultivated areas, outputs, and GDP reflect the same observed changes. Although the model is calibrated to the state of national economies seven years earlier, it closely reproduces the countries' current growth performance.

Four different scenarios are simulated using the model. The first is the baseline scenario described above, which assumes a continuation of current trends to 2025 and is used as a reference to evaluate the impact of changes under the remaining three scenarios. These other scenarios introduce three different sets of changes to examine their impacts on regional trade levels:

1. A 10 percent reduction in the overall cost of trading across the economy;

2. Removal of all harassment costs (that is, a reduction of their tariff equivalent to zero); and

3. A 10 percent increase in yields across the board.

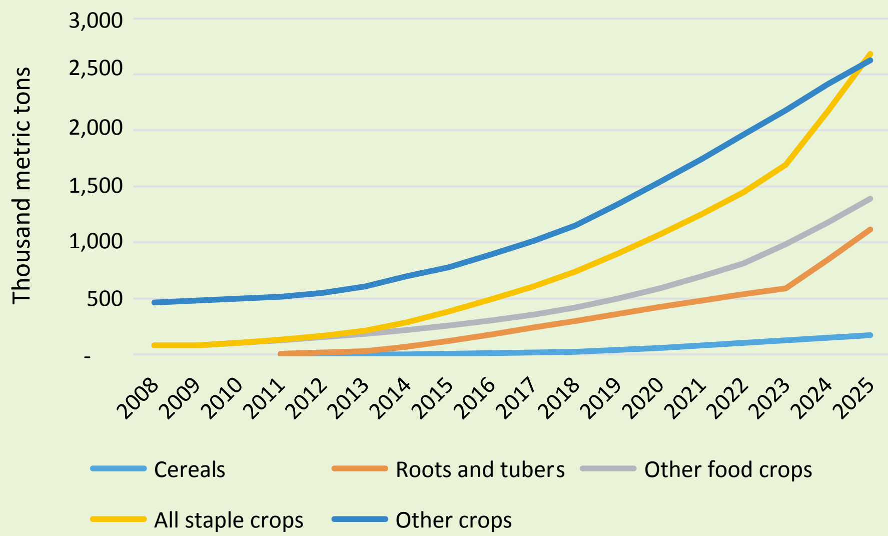
These changes occur between 2008 (the base year) and 2025. The change in crossborder exports is used as an indicator of the impact on intra-regional trade. In the original data, large discrepancies exist between recorded regional export and import levels, with import levels often being a multiple of export levels. The more conservative export figures are therefore the preferred indicator of intra-regional trade.

Simulation Results for Intra-Regional Trade

Assuming a continuation of current trends, intra-regional trade in ECOWAS is expected to expand rapidly, but with marked differences across crops (Figure 7.9). The aggregate volume of intra-regional trade in staples approaches 3 million tons under a scenario where the current rates of growth in yields, cultivated areas, population, and income are sustained to 2025. Cereals undergo the smallest gains, whereas trade in roots and tubers and other food crops undergo much faster growth.

This is in line with the current structure of and trends in commodity demand and trade. While the increase in demand for roots and tubers is being met almost exclusively from local sources, the fast-growing demand in cereals is heavily tilted toward rice, which is supplied from outside of the region. The two leading cereals that are traded regionally, maize and millet, therefore benefit less from the expansion of regional demand and have historically seen slower growth in trade than roots and tubers.

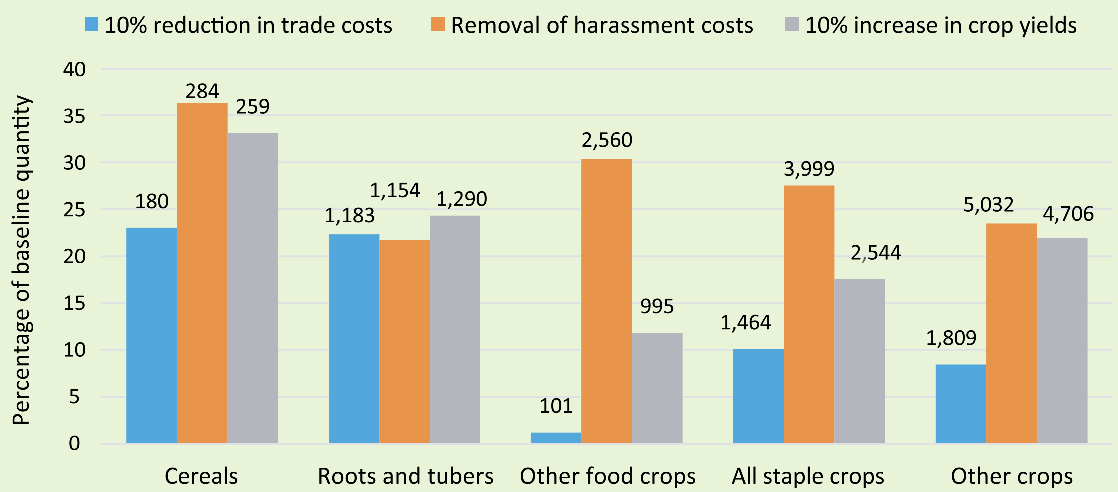
Figure 7.9. Baseline crossborder export projections for the ECOWAS region, 2008–2025



Source: Authors' calculations based on Regional Economywide Multimarket Model simulation results.

The cumulative changes in intra-regional export levels by 2025 were compared against baseline levels to determine what would result from a reduction in total trading costs, removal of harassment costs, and an increase in yields (Figure 7.10). The results invariably show considerable increases in intra-regional trade in cereals and roots and tubers, the main food crops, in response to changes in trading costs and yields. Intra-community trade levels in ECOWAS climb by between 10 and 35 percent for most products over the entire period. The volume of cereal trade increases by a cumulative total of between 200,000 and 300,000 tons for individual products, and that of overall trade in staples by between 1.5 and 4.0 million tons by 2025, compared with baseline trends. In general, cereals seem to respond better than other products. It also appears that removing harassment costs has the strongest impact on trade flows across the board. Countries respond more significantly to the removal of harassment costs than to the reduction of normal trade costs, except for Benin, Guinea-Bissau, Niger, and Sierra Leone, which appear to be more responsive to increases in crop yields than to reductions in normal trading costs or harassment costs (Table 7.5).

Figure 7.10. The impact of changes in trade costs and yields on crossborder exports within the ECOWAS region



Source: Authors' calculations based on Regional Economywide Multimarket Model simulation results.

Note: The bars represent the percentage changes, whereas the values on top of the bars indicate the corresponding absolute changes in thousand metric tons.

Table 7.5. Country-level impact of changes in trade costs and yields on regional exports of staple food crops

	10 percent reduction in trade costs	Removal of harassment costs	10 percent increase in crop yields
Benin	27.6	18.2	39.5
Burkina Faso	22.2	34.9	39.1
Chad	22.5	39.1	33.9
Côte d'Ivoire	8.9	17.7	14.2
Gambia	1.9	8.5	5.3
Ghana	5.7	24.1	15.5
Guinea	4.7	32.0	16.2
Guinea-Bissau	51.1	37.1	91.5
Liberia	9.0	34.2	22.1
Mali	4.6	21.6	10.5
Mauritania	17.5	33.2	28.6
Niger	80.8	1.4	289.6
Nigeria	26.0	32.9	46.3
Senegal	10.6	32.6	25.3
Sierra Leone	93.4	40.3	117.6
Togo	6.6	32.1	21.1

Source: Authors' calculations based on Regional Economywide Multimarket Model simulation results.

Regional Market Volatility under Alternative Policy Scenarios

Under each scenario, the model's simulated quantities of intra-regional exports, QER_{rc}, are used to estimate an index of future export volatility at country and regional levels as follows. First, a trend-corrected coefficient of variation, TCV, is calculated for each country:

$$TCV_i = CV_i \cdot \sqrt{1 - \bar{R}_i^2}$$

where CV_i is the coefficient of variation in the series of the intraregional exports of staple food crops by a country i from 2008 to 2025, and $\bar{R}_i^2$ is the adjusted coefficient of determination of the linear trend model fitted to the series.

Then an index of regional volatility, TCV_{reg}, is derived for the ECOWAS region as a weighted average of trend-corrected coefficients of variation for its member countries with the formula.

$$TCV_{rec}^2 = \sum_i^n S_i^2 \cdot TCV_i^2 + 2\sum_i^n \sum_i^n S_i \cdot S_j \cdot V_{ij} \cdot TCV_i \cdot TCV_j$$

where TCV_i and TCV_j are the trend-corrected coefficients of variation in the export of staple food crops in countries i and j, n is the number of ECOWAS member countries, S_i and S_j are the shares of countries i and j in the region's overall intra-regional exports of staple food crops, and V_{ij} is the coefficient of correlation between the food crop exports of countries i and j. Finally, the coefficients of variation at the country level are normalized by dividing them by the regional coefficient. The historical and simulated levels of volatility of crossborder trade in food staples in the region under historical trends and each of the alternative scenarios are reported in Table 7.6. Volatility levels under historical trends are calculated based on bilateral export volumes from the Trade-Maps database (1996–2012). Simulated volatility levels under the various scenarios are compared with the historical levels of volatility, with the difference expressed in point changes (Table 7.7). As can be seen from the figures in the two tables, regional crossborder trade volatility decreases with a reduction of overall trading costs but rises under the removal of crossborder trade barriers or with increases in yields. The magnitude of the changes are, however, rather small across all three scenarios. The results also show that under the continuation of current trends of rising volumes of intra-regional trade, the volatility level in the region is expected to decline compared with historical trends.

Table 7.6. Volatility in crossborder exports of staple food products within the ECOWAS region

Country	Historical trend, 1996-2012	Baseline trend, 2008-2025	10 percent reduction in trade costs, 2008-2025	Removal of harassment costs, 2008-2025	10 percent increase in crop yields, 2008-2025
Benin	1.753	0.703	0.629	0.660	0.618
Burkina Faso	1.269	1.566	1.353	1.643	1.539
Cabo Verde	2.802				
Côte d'Ivoire	0.285	0.657	0.531	0.631	0.591
Gambia		1.585	1.546	1.379	1.291
Ghana	2.145	0.214	0.191	0.135	0.126
Guinea	1.347	0.538	0.540	0.698	0.654
Guinea-Bissau		2.101	2.188	2.156	2.020
Liberia		0.521	0.520	0.656	0.615
Mali	0.856	1.107	1.138	1.164	1.090
Niger	2.011	1.913	2.004	1.785	1.672
Senegal	0.926	0.029	0.048	0.166	0.155
Sierra Leone		2.741	3.407	2.667	2.499
Togo	0.863	1.492	1.574	1.641	1.538
ECOWAS region	0.345	0.330	0.323	0.354	0.378

Source: Authors' calculations based on ITC (2016) and Regional Economywide Multimarket Model simulation results.

Table 7.7. Change in trade volatility under alternative scenarios, 2008–2025

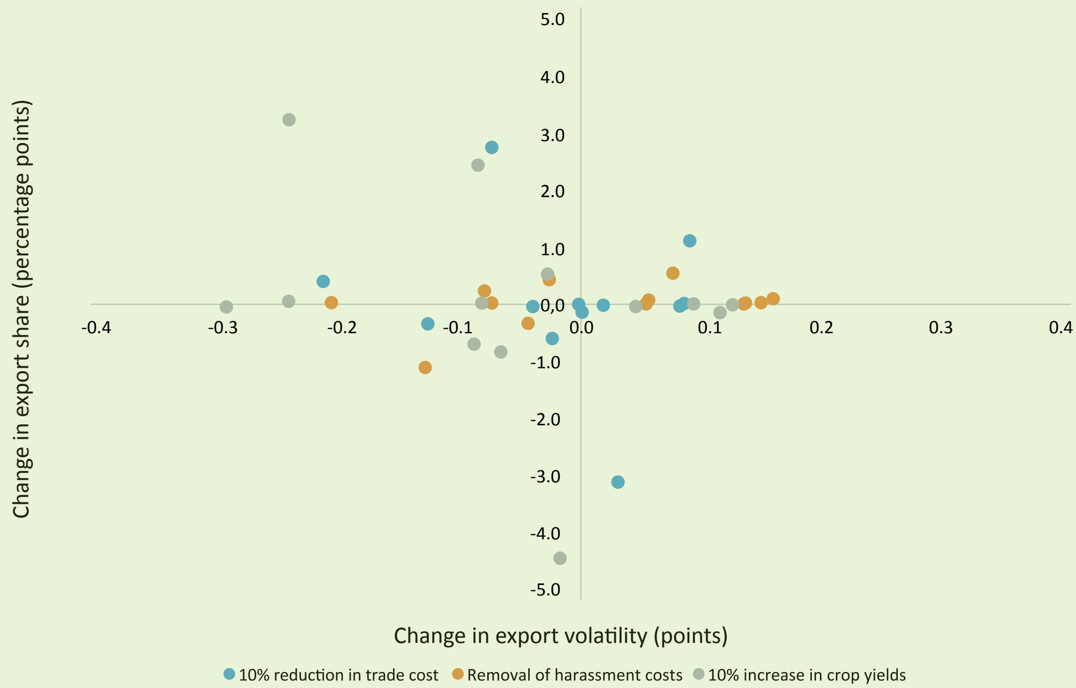
Country	Baseline trend, 2008-2025	10 percent reduction in trade costs	Removal of harassment costs	10 percent increase in crop yields
	Point change compared with historical trend			
Benin	-1.050	-1.124	-1.093	-1.135
Burkina Faso	0.297	0.084	0.374	0.270
Côte d'Ivoire	0.372	0.246	0.346	0.307
Ghana	-1.931	-1.954	-2.010	-2.019
Guinea	-0.809	-0.807	-0.649	-0.693
Mali	0.251	0.282	0.307	0.234
Niger	-0.098	-0.007	-0.226	-0.339
Senegal	-0.897	-0.878	-0.760	-0.770
Togo	0.629	0.711	0.779	0.675
ECOWAS region	-0.015	-0.022	0.009	0.033

Source: Authors' calculations based on ITC (2016) and Regional Economywide Multimarket Model simulation results.

A better comparison, therefore, is to contrast changes under the two trade policy scenarios and the productivity scenario with expected volatility levels under the baseline scenario. Furthermore, the direction and magnitude of changes in the level of intra-regional trade volatility are determined by the combined effect of changes in the level of volatility, as well as the shares of crossborder exports by individual countries (Figure 7.11).

The dots in the figure indicate the position of different countries under the three scenarios. The tilted distribution of country positions to the left of the x-axis indicates that exports by most countries would experience a lower level of volatility under regional policies that would reduce the overall cost of trading, eliminate harassment costs by dismantling administrative and regulatory obstacles to transborder trade, or raise yields of staple crops in member countries.

Figure 7.11. Changes in national export shares and volatility among ECOWAS member countries compared with baseline trends



Source: Authors' calculations based on ITC (2016) and Regional Economywide Multimarket Model simulation results.

Changes in country production patterns resulting from the simulated policy actions lead to changes in both the volatility and export levels, hence the shares in regional trade for each country (Table 7.8). The magnitude and direction of these changes determine the contribution of individual countries to changes in the level of volatility in regional food markets.

Table 7.8. Change in volatility and share of staple exports from ECOWAS member countries under alternative scenarios, 2008–2025

Country	Point change in volatility compared with baseline			Percentage point change in share compared with baseline		
	10 percent reduction in trade cost	Removal of harassment costs	10 percent increase in crop yields	10 percent reduction in trade cost	Removal of harassment costs	10 percent increase in crop yields
Benin	-0.073	-0.043	-0.085	2.756	-0.338	2.448
Burkina Faso	-0.213	0.077	-0.027	0.398	0.545	0.530
Côte d'Ivoire	-0.126	-0.026	-0.066	-0.351	0.428	-0.843
Gambia	-0.039	-0.206	-0.294	-0.047	0.026	-0.052
Ghana	-0.023	-0.079	-0.088	-0.609	0.227	-0.704
Guinea	0.002	0.160	0.116	-0.144	0.095	-0.151
Guinea-Bissau	0.086	0.055	-0.082	0.009	0.005	0.016
Liberia	-0.001	0.136	0.094	-0.002	0.003	-0.002
Mali	0.031	0.057	-0.017	-3.137	0.069	-4.475
Niger	0.091	-0.129	-0.241	1.111	-1.115	3.247
Senegal	0.019	0.137	0.126	-0.020	0.014	-0.016
Sierra Leone	0.666	-0.073	-0.242	0.075	0.016	0.045
Togo	0.083	0.150	0.046	-0.038	0.026	-0.042

Source: Authors' calculations based on ITC (2016) and Regional Economywide Multimarket Model simulation results.

Conclusion

The distribution and correlation of production volatility, as well as the current patterns of specialization in the production and trade of agricultural products among West African countries, suggest that it is indeed possible to increase crossborder trade to reduce the level of instability of local food markets. The results of the baseline scenario indicate that continuing recent trends would sustain the expansion of intra-regional trade flows in the ECOWAS region. The findings also reveal that it is possible to significantly boost the pace of regional trade expansion, which in turn would contribute to creating more resilient domestic food market through a modest reduction in the overall cost of trading, a similarly modest increase in crop yields, or the removal of barriers to transborder trade. More importantly, the simulation results also suggest that such policy actions to promote transborder trade would reduce volatility in regional markets and help lower the vulnerability of domestic food markets to shocks.

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