Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

Impacts of a NoCAP Scenario on Sub-Saharan Africa

Authors. Boulanger, P., Dudu, H., Ferrari, E., M'barek, R., Philippidis

Disclaimer. The views expressed in this paper are the sole responsibility of the authors and do not necessarily reflect those of the European Commission.

Abstract. This paper provides a model-based impact analysis of the Common Agricultural Policy (CAP) on the four main regional blocks in Sub-Saharan Africa (SSA). It uses the Modular Agricultural GeNeral Equilibrium Tool (MAGNET), a multi-region computable general equilibrium model. To provide a comprehensive analysis, other key EU policies, such as trade or GHG policies, are modelled as well. A thoroughly prepared reference scenario is contrasted with a counterfactual scenario, where the CAP is removed and ambitious trade agreements with non-African EU trade partners are implemented. Results provide interesting insights into the identification and quantification of - mainly indirect - effects of the CAP in SSA.

JEL classifications. C68, F11, F15, Q17

Paper prepared for the 21st Annual Conference on Global Economic Analysis, "Framing the future through the Sustainable Development Goals", Cartagena de Indias, Colombia, June 13-15, 2018.

WORK IN PROGRESS: PRELIMINARY DRAFT.
PLEASE DO NOT QUOTE WITHOUT PRIOR AGREEMENT WITH THE AUTHORS.

1 Introduction

The agricultural sector of the European Union (EU) is facing numerous challenges: the need to contribute to global food security, an increased demand for various uses of agricultural commodities with finite resources and a changing climate. The design of the post-2020 Common Agricultural Policy (CAP) has to address all of these manifold issues. Of particular concern is that any EU policy, including the CAP, has to account for development objectives that could affect developing countries through policy coherence for development (PCD).

PCD aims to minimise contradictions and build coherence between EU policies to benefit developing countries and increase the effectiveness of cooperation (European Commission, 2015a). The 2030 Agenda presents a significant opportunity to address the challenges of poverty eradication and sustainable development. The new universal agenda aims to enable sustainable development for all. In a new global partnership, all developed, upper middle-income countries and emerging economies should assess the impact of their policies on poorer countries. The EU remains committed to taking account of development objectives in those policies which are likely to affect developing countries and will contribute to the global agenda. The agricultural policies of industrialised countries may affect the trade and development opportunities of developing countries, and, as a result, the income of small farmers and the resilience of rural communities. As a consequence, the coherence of the EU agricultural and development policies is crucial.

The CAP provides an example where critical progress has been made on PCD through the reforms of the last 25 years. In addition to ensuring food security for EU citizens, the CAP and agricultural trade policy are designed to actively benefit farmers and exporters in developing countries and to avoid adverse economic impacts. Although it has evolved dramatically since its creation, the CAP still has effects on foreign markets and consequently on developing economies, and these should be assessed before any additional reform of the policy.

Serious analysis of the impact of CAP reform on developing countries cannot leave trade policies out of consideration. The agricultural sector in the EU plays an important role in maintaining an open trading system and in sharing innovations, good farming techniques and sustainable practices. The EU is one of the world's most open markets for agri-food imports and it is the top importer of agri-food products from developing countries and from least developed countries (LDCs). Economic partnership agreements (EPAs) between the EU and African, Caribbean and Pacific (ACP) countries and regions aim to promote ACP-EU trade, and ultimately contribute, through trade and investment, to sustainable development and poverty reduction. Most ACP countries have either implemented an EPA or concluded EPA negotiations with the EU. It is worth mentioning that EPAs are a process dating back to the signing of the Cotonou Agreement in 2000 (which expires in 2020). Negotiations between the EU and the 79 ACP countries to renew this relationship in terms of politics, economics and trade will begin in September 2018. Note that EUR 30.5 billion has been allocated to the 11th European Development Fund (EDF) for the period 2014-2020.

Against this background, the design of the post-2020 CAP is under consultation and a wide range of policy options are being considered, from retaining the status quo to a radical reform.

The aim of this paper is to shed some light on the direct, indirect and combined effects of the EU agricultural policies on third countries, with a focus on selected regions in SSA. Drawing on Scenar 2030 (M'barek et al., 2030), this paper aims to analyse the impact of the removal of the CAP on selected regions in sub-Saharan Africa (SSA). It employs the global computable general equilibrium (CGE) model MAGNET (Modular Applied GeNeral Equilibrium Tool), calibrated on the global multisector Global Trade Analysis Project (GTAP) database, with further disaggregation of SSA. The simulation not only produces results for the EU Member States but also quantifies direct and indirect impacts of the selected policies in SSA. Importantly, MAGNET simulates *ex ante* policy change, in other

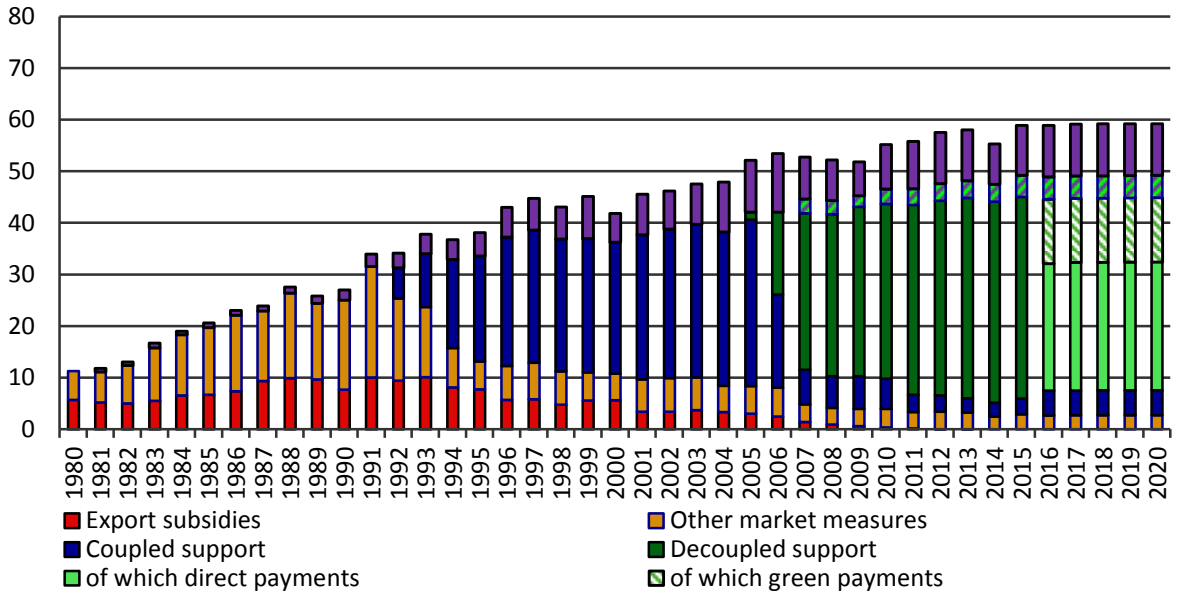
words from a given point in time, after a policy has been embedded for several decades. Therefore, the results cannot be interpreted as an *ex post* assessment of the effects of the current CAP on developing countries.

This paper is structured as follows. Section 2 reviews modelling exercises which challenge possible effects of the CAP on development. Section 3 presents the methodology of the paper. Section 4 describes both the reference and the CAP removal scenarios. Section 5 shows results at Horizon 2030. Section 6 provides some concluding remarks.

2 Literature review

The CAP has dramatically evolved over the past 25 years, and is expected to continue on this reforming path. Since the 1992 reform, there has been a sharp shift from price support to coupled payments (Figure 1). Previously, almost the only instruments available to the CAP were market measures and export subsidies. With the aims of reducing market distortions, increasing provision of 'public goods' and easing the burden of targeting and monitoring payments, subsidies have been progressively decoupled from production and prices. Alongside these incremental policy changes (1992, 1999, 2003, 2008), CAP expenditures nowadays constitute approximately 40% of the EU budget, compared with 70% in the early 1970s. The 2013 reform continued this trend, while increasing sustainable direct support by the introduction of green payments.

Figure 1. Breakdown of CAP support, EUR billion, 1980-2020



Source: European Commission, Directorate-General for Agriculture and Rural Development (DG AGRI).

In view of the radical changes in both agricultural and trade policies that have occurred over the last 25 years, eliminating the remaining distortions would lock in the benefits of reform and simultaneously address some policy incoherence, which in turn would have implications for food security (Brooks, 2014). Despite this, and despite the fact that the annual CAP expenditure amounts to EUR 60 billion, almost no quantification of the possible impacts of removing this policy is currently available in the economic literature.

Using a standard GTAP model, Costa et al. (2009) show that the estimated net effect of the CAP would reduce global welfare by about USD 45 billion. The largest contributor to this welfare loss is border protection, before direct payments and export refunds. Removing the CAP would increase world prices of crops by 2.1%, of livestock by 3.9% and of processed food by about 0.8%.

Interestingly, Africa's gross domestic product (GDP) would slightly decrease with the removal of the CAP, mainly because of terms-of-trade effects. That said, production of crops, livestock and food processing products in Africa would increase by 0.8%, 2.9% and 6.1% respectively. In Costa et al. (2009), the overall effects of the CAP are made up of the effects of direct payments, border protection effects and export subsidies. Based on 2004 data, they do not include key aspects of recent CAP reforms, such as decoupled and greening payments.

Boysen et al. (2016) combine a CAP-tailored GTAP model with 2007 data and a single-country International Food Policy Research Institute (IFPRI) model to assess the effects on Uganda of removing EU border protection and direct payments. While the former model provides macroeconomic results, the latter provides insights on households and poverty impacts. The authors conclude that the removal of EU instruments would have marginal positive effects on Uganda, driven by the modelling of decoupled payments, only partially decoupled from production. Indeed, a lower degree of coupling would further diminish the effect of removal of the CAP.

Scenar 2020 (Nowicki et al., 2006, 2009) and Scenar 2030 (M'barek et al., 2017) contemplate cuts in CAP spending with a focus on EU effects. Among modelling tools that are used to simulate such cuts, the model of the Landbouw Economisch Instituut Trade Analysis Project (LEITAP) and its sister model, MAGNET, allow a comprehensive representation of the CAP within a CGE framework. Other studies using MAGNET show minor effects in LDCs (Boulanger and Philippidis, 2015) and SSA (Philippidis et al., 2016) due to the largely non-distortionary nature (representation) of EU agricultural policy. They demonstrate that, outside the EU, welfare effects (per capita real income) from cuts to the CAP budget over the period 2014-2020 are negligible (Boulanger and Philippidis, 2015), as are those stemming from the removal of all remaining pillar 1 expenditures at Horizon 2030 (Philippidis et al., 2016). Indeed, they show that agricultural net exporters gain, with concurrent losses in net importing regions. This reflects the slight increase in agricultural export prices, which has beneficial (detrimental) terms-of-trade impacts for agricultural net exporters (importers). Interestingly, because the CAP budget over the period 2014-2020 already contemplates a decrease in real terms, potential small effects on third countries are becoming even smaller over time. That said, regional results mask the heterogeneity of relative agricultural trade competitiveness within dissimilar regional aggregates such as LDCs or SSA.

Confronting net food importers (which correspond to most SSA countries) and exporters is also pertinent when assessing effects of (past) export refunds. With a modified version of the GTAP model, Revoredo-Giha et al. (2013) assess the effects of EU export refunds on developing countries, with an emphasis on African countries. They complement the CGE analysis with detailed (country- and commodity-specific) case studies to better consider institutional arrangements and supply chain peculiarities. The CGE analysis shows that, although export refunds are relatively small, their complete withdrawal would hurt net food-importing countries principally through terms-of-trade effects. The magnitude of this effect would be related to the model parameterisation (Armington import demands) and exclude any distributive aspect (i.e. it does not differentiate larger-scale from smaller-scale farmers, or wealthier from poorer farmers).

It seems that trade policy is by far the most significant source of distortion, especially some non-tariff measures (NTMs) such as technical, sanitary or phytosanitary norms; and quantitative assessments of trade liberalisation uses to underestimate the positive impact of trade liberalisation on welfare because they do not eliminate key NTMs (Bouet, 2008). For instance, Otsuki et al. (2001) quantify the trade effects of imposing a European food safety standard (using the example of aflatoxin) on African exports. Based on trade and regulatory survey data for 15 European countries and nine African countries between 1989 and 1998, they show with a gravity model that the imposition of an EU-specific standard would decrease African exports by 64% (USD 670 million) compared with what would be achieved if it were necessary to adhere only to the corresponding international standard. It remains to scrutinise the trade-off with health effects; in this case, application of the EU standard would reduce health risk and result in a reduction in mortality of approximately 1.4 per billion population per year.

3 Methodology

3.1 Why a CGE model? Why a global CGE model?

MAGNET (Woltjer and Kuiper, 2014) is a multi-region CGE model which is a derivative of the well-known GTAP model (Hertel, 1997). A key strength of the MAGNET model is that it allows the user to choose à la carte those sub-modules of relevance to a specific study. The user can (among other things) choose between different nesting structures, apply various assumptions about the workings of the factor markets, include various agricultural, trade and biofuels policy mechanisms, and incorporate dynamic assumptions relating to investment allocation over time.

To characterise the peculiarities of agricultural markets, the model accounts for the heterogeneity of land usage by agricultural activity; a regional endogenous land supply function; the sluggish mobility of capital and labour transfer between agricultural and non-agricultural sectors with associated wage and rent differentials; the inclusion of explicit substitution possibilities between various feed inputs in the livestock sectors; and additional behavioural and accounting equations to characterise EU agricultural policy mechanisms (e.g. production quotas, single farm payments, coupled payments, rural development measures) (Boulanger and Philippidis, 2015). The results of the MAGNET model are typically presented in value terms or as percentage change in price and quantity. The MAGNET model compiles a large number of indicators, in particular related to production, trade flows, consumption, use of endowments, intermediate input use, income and price changes, land use, emissions and employment.

3.2 The MAGNET aggregations

As a GTAP model derivative, MAGNET is calibrated to the GTAP Version 9 database, with 2011 as reference year (Aguiar et al., 2016). For the purposes of this paper, the MAGNET model distinguishes 25 commodities:

- Nine primary agricultural sectors: (1) wheat; (2) other cereal grains; (3) vegetables, fruits, nuts; (4) oil seeds; (5) sugar cane, sugar beet; (6) other crops; (7) cattle, sheep, goats, horses; (8) other animal products (mainly pigs and poultry, but also features other live animals and eggs); and (9) raw milk.
- Ten processed food and related agricultural input supplying sectors: (10) bovine meat products (i.e. red meat); (11) other meat products (i.e. white meat); (12) vegetable oils and fats; (13) dairy products; (14) processed rice; (15) sugar; (16) other food products; (17) beverages and tobacco; (18) feed; and (19) fertilisers.
- The database accounts for further primary sectors: (20) natural resources (forestry and fishing); (21) crude oil; (22) extracted gas; (23) coal; and finally (24) a composite sector for all manufacturing sectors; and (25) a composite sector for all service sectors.

In terms of regions, the database has been disaggregated to the following 38 countries or regions: each of the EU-28; members of the North American Free Trade Agreement (NAFTA); members of Mercosur; Australia and New Zealand; China; the five Asian countries that have signed an FTA with the EU (Indonesia, Japan, Philippines, Thailand, Vietnam); the South African Custom Union (SACU); the East African Community (EAC); the Economic Community Of West African States (ECOWAS); the Common Market for Eastern and Southern Africa (COMESA); and the rest of the world.

The African regional blocs aggregate the following countries:

- SACU: Lesotho, Namibia, South Africa and Swaziland;
- EAC: Kenya, Rwanda, Tanzania and Uganda;

- ECOWAS: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo and the rest of western Africa (Cape Verde, the Gambia, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Saint Helena and Sierra Leone);
- COMESA: Egypt, Ethiopia, Madagascar, Malawi, Zambia, Zimbabwe and the rest of eastern Africa (Burundi, Comoros, Djibouti, Eritrea, Mayotte, Seychelles, Somalia, Sudan) and south central Africa (Angola, Democratic Republic of the Congo).

3.3 General caveats of modelling exercises

Economic models provide a conceptual framework that allows for the representation of the economy in a structured but schematic and simplified manner. By definition, they cannot reproduce reality in its fullest complexity and thus present shortcomings and limitations.

Comparison of the new scenario with the reference scenario at a given point in the simulation period, usually in terms of percentage differences, establishes the direction and relative magnitude of the impacts on all the endogenous variables of the change that is depicted in the hypothetical scenario at that point in time.

Although this type of model is calibrated to fit a given year, its solutions become less reliable the further into the future it goes, because of structural economic change. Given the very large number of assumptions, estimated or calibrated parameters and stylised specification features that these models assemble, each of which is 'plausible' only up to an (unknown) probability, it is difficult to establish exact confidence intervals or margins of error around individual projected numbers.

The quality of the model output is directly related to the input data. Whereas calibration procedures allow matching key exogenous variables such as production, trade or GDP, the parameters, in particular the behavioural elasticities, often remain unchanged over time in the models.

3.4 Assumptions on trade policy modelling

NTMs are not modelled explicitly and no assumptions are made on possible NTM quantification, modelling and reduction arising from the FTAs in our baseline design. The trade-restrictive impact of NTMs is implicitly considered in the underlying trade database of MAGNET, so far as it concerns the current (observed) pattern of international trade. Thus, moving forwards, the modelling results will underestimate the magnitude of the potential effects of the current EU FTA agenda. The quantification of NTMs is an area that requires considerable additional research.

Another issue that the paper does not consider, although it could certainly have implications for EU free trade negotiations, is the impact of the UK's exit from the EU.

Finally, the current model envisages a perfect transmission between world and domestic prices, while no local markets are considered by the global model.

4 Implementation of scenarios

This section explains how the reference scenario and the removal of the CAP are implemented (Table 1).

4.1 Reference scenario implementation

The reference scenario for 2011-2030 is calibrated such that MAGNET represents as closely as possible the assumptions and market projections of the 'Medium-term prospects for EU agricultural markets and income 2015-2025' (European Commission, 2015b). The macroeconomic developments (GDP, population growth rate, world crude oil price) are exogenously imposed in the model following the projections adopted in DG AGRI outlook. While population, land productivity and non-land endowment changes remain exogenous in the scenario, GDP and world fossil fuel price projections are targeted by exogenous economy-wide productivity and global fossil tax shifter variables, respectively.

The CAP in the reference scenario represents the current implementation in as much detail as allowed by the model characteristics. The trade policies in the reference scenario follow the assumptions made in the DG AGRI market outlook 2015.

The reference and policy scenarios are implemented in MAGNET over four periods. More specifically, the model runs from the benchmark year (2011) to 2016 and then to 2020, 2025 and, finally, to 2030.

In terms of CAP, pillar 1 includes the 30% greening by the end of the first period, which is maintained until the end of the simulation run. Pillar 2 follows the standard CAP baseline, which is based on data from DG AGRI.

Table 1. Assumptions shaping the reference scenario (2016-2030)

2016-2030 Period
Trade Policy (Trade)
• EU enlargement — elimination of border protection between incumbent EU Member States and Croatia. • Extension to Croatia of an EU common external tariff (CET) on third-country trade, and reciprocal third-country CETs extended to Croatia as an EU Member State. • Elimination of remaining EU tariffs with Columbia, Peru and South Korea.
Agricultural Policy (CAP)
• Pillar 1 and pillar 2 nominal expenditures are cut by 13% and 18%, respectively. This corresponds to a 15.2% cut in nominal CAP budgetary funding. • Phasing in of decoupled payments for 2007 accession Member States and Croatia. • Greening of 30% of pillar 1 payments, represented as pillar 2 agro-environmental payments. • Pillar 2 payments extended to Croatia. • Abolition of raw milk (2015) and raw sugar (2017) quotas. • Croatia incorporated within the CAP budget and UK rebate mechanism. • Projected reduction in CAP expenditure share of the EU budget, consistent with 15.2% cut in nominal CAP budget reduction. • Change in Danish, Dutch and Swedish lump sum rebates corresponding to CAP expenditure share in EU budget. UK rebate is maintained.

4.2 Scenario — NoCAP

Under the NoCAP scenario, pillar 1 payments and all pillar 2 payments are eliminated. In this scenario, the agricultural sector is treated in the same way as any other sector of the economy, in that it is forced to focus on those products that are competitive and gain its income solely from the market. Indeed, the EU agriculture-specific market support

policies are assumed to be abolished by 2030. Market competitiveness is achieved by lowering costs and optimising economies of scale. Farmers, subject to available physical and labour endowments, pursue greater market orientation by focusing on those products demanded by the global market.

The key policy areas under this scenario envisage a complete abolishment of the CAP, including:

- the abolition of the direct payment scheme, which includes both the basic payment and the conditional greening part of the payment;
- the abolition of coupled production support;
- the removal of rural development programmes.

No supply management of price support measures is envisaged. The markets should regulate themselves to ensure equilibrium between demand and supply.

In an attempt to increase its global competitiveness, the EU is taking steps to liberalise its markets. Significant progress is being made in bilateral trade agreements, ensuring increased market access for offensive products and access to cheap inputs and commodities. By 2025, FTAs with Australia, Indonesia, Japan, Mercosur, Mexico, New Zealand, the Philippines, Thailand, Turkey and the USA will be concluded and ratified (in addition to those already ratified with Canada and Vietnam) (Boulanger et al., 2016). Multilateral trade negotiations are not expected to increase market access but would also fit within the view on EU agricultural policies.

The implementation of trade liberalisation follows an ambitious theoretical scenario, providing full tariff liberalisation for 98.5% of Harmonised System (HS) 6-digit lines, and a partial tariff cut of 50% for the other lines (sensitive products) for the ongoing and upcoming FTAs between the EU and 12 trade partners (Australia, Canada, Japan, Indonesia, Mercosur, Mexico, New Zealand, the Philippines, Thailand, Turkey, the USA and Vietnam) as described in Boulanger et al. (2016). Last but not least, it should be emphasised that no changes in trade relationships between the EU and African regions, e.g. EPAs, are considered in this scenario.

5 Scenario results — 2030

In this section, we outline the results of the NoCAP scenario against the reference scenario results presented above for the year 2030. The focus is on the main indicators relative to the four regions in SSA analysed in this paper. For details on the EU results, see M'barek et al. (2017).

5.1 Trade and self-sufficiency

Trade is the main mechanism through which changes in EU domestic and trade policies are transmitted to third countries. These domestic changes cause change in EU domestic production either directly (mainly in the case of the CAP), or indirectly, through changes in trade flows (in the case of FTAs), which then change the demand for and supply of agricultural products versus third countries not directly affected by FTAs.

As a general pattern, we observe a reduction in EU agricultural and food production due to the direct effects of the elimination of the CAP, and indirectly due to increased imports following implementation of new trade policy (agri-food exports also increase, but in general at a slower pace than imports). These changes translate into a reduction in exports to third countries as a result of lower production and a reduction in imports from third countries (not affected by the new trade policies, i.e. trade diversion).

Looking in more detail, African regions' trade balances with the EU improve following the removal of the CAP (Table 2). ECOWAS and COMESA improve their trade balance with the EU by around EUR 1 billion, while the improvement is smaller for SACU and EAC. The improvement is between 10% and 12% of the trade volume at the reference. However, the sign of the trade balance (deficit or surplus) is maintained in all regions for all commodities. That is to say, although abolition of the CAP provides SSA with a competitive edge in the EU markets, it does not significantly change the general pattern of the trade flows.

Table 2. Trade balance versus EU, EUR million, 2030 (reference and NoCAP)

Commodity	SACU		EAC		ECOWAS		COMESA	
	Reference	NoCAP	Reference	NoCAP	Reference	NoCAP	Reference	NoCAP
Wheat	−76	−51	−27	−14	−727	−566	−1 862	−1 413
Rice	0	0	11	10	5	4	34	30
Other cereals	4	15	25	29	6	11	−165	−142
Oilseeds	7	8	52	57	93	98	27	35
Oils and meals	−599	−568	−1	0	241	285	−550	−525
Raw sugar	8	9	6	6	3	3	32	35
Sugar	210	191	−67	−61	−528	−513	241	187
Fruits and vegetables	1,192	1,420	202	242	565	684	246	358
Other crops	100	142	1 693	1 879	3 116	3 609	823	1 008
Cattle	5	6	36	38	3	3	−25	−20
Beef and sheep meat	104	92	49	41	14	11	-6	−5

Pigs and poultry	41	50	5	6	−12	−10	−20	−15
Pig and poultry meat	−96	−63	2	4	−290	−240	−255	−186
Raw milk	−5	−3	−3	−2	−15	−11	−15	−10
Dairy	−125	−111	−22	−20	−852	−790	−491	−432
Beverages and tobacco	−48	−47	−87	−87	−790	−789	−1 076	−1 072
Other food	189	195	258	252	872	868	−978	−965
Feed	16	16	28	28	133	137	−57	−55
Agri-food total	926	1 300	2 160	2,408	1 837	2 795	−4 099	−3 187

Table 3. Trade balance versus the rest of world, EUR million, 2030 (reference and NoCAP)

Commodity	SACU		EAC		ECOWAS		COMESA	
	Reference	NoCAP	Reference	NoCAP	Reference	NoCAP	Reference	NoCAP
Wheat	−367	−381	−1 076	−1 098	−4 107	−4 324	−6 893	−7 413
Rice	−346	−347	−312	−313	−3 579	−3 585	−559	−560
Other cereals	608	615	−24	−24	−73	−73	−2,640	−2,637
Oilseeds	37	39	175	178	489	501	−818	−807
Oils and meals	−228	−245	−580	−581	−1 650	−1 662	−5 604	−5 632
Raw sugar	4	4	1	1	0	0	7	7
Sugar	86	87	−383	−394	−1 483	−1 506	−1 470	−1 481
Fruits and vegetables	2 112	2 116	458	461	2,930	2,954	262	282
Other crops	544	556	4 205	4 258	7 437	7 430	3 055	3 152
Cattle	29	27	34	32	−3	−3	634	578
Beef and sheep meat	20	17	49	47	−68	−72	−1 042	−1 047
Pigs and poultry	365	373	98	100	−40	−41	5	7
Pig and poultry meat	−106	−102	1	2	−260	−281	−692	−718
Raw milk	0	0	0	0	0	0	1	2
Dairy	77	77	23	22	−526	−584	−268	−282
Beverages and tobacco	1 021	1 022	173	172	−631	−635	−806	−807

Other food	795	798	103	97	−6 751	−6 794	−2 497	−2 534
Feed	43	43	30	30	42	42	−223	−224
Agri-food total	4 695	4 700	2 977	2 990	−8 273	−8 634	−19 550	−20 117

The improvement in the trade balance is due to both declining imports (trade diversion) and increasing exports (a decrease in domestic production within the EU due to elimination of the CAP) for most of the commodities in all regions. Only sugar and (to a limited extent) beef exports to the EU decline in all regions, together with their imports. Rice and 'other food' exports in all regions of SSA except SACU also decline, but, considering the low initial trade volumes, these falls do not contribute significantly to the trade balance. In the case of SACU, the contribution of decline in imports and increase in exports is around EUR 120 million and EUR 250 million respectively, indicating a better performance of exports. In the EAC, the improvement in trade balance comes mostly from increasing exports, with EUR 215 million, while imports decline only slightly, indicating a stronger domestic demand supplied by imports. In ECOWAS, the contribution of exports and imports is almost same and quite significant, at around EUR 500 million. Lastly, in COMESA, most of the improvement comes from declining imports, amounting to EUR 740 million, compared with the contribution of exports, at EUR 170 million. This suggests that a high proportion of imported food staples (especially wheat, imports of which decline by more than EUR 400 million) is being replaced by either domestic production or imports from other regions (Table 3). Note that Egypt is part of COMESA and a significant part of the decline in wheat imports is likely to be in Egypt rather than in sub-Saharan countries.

The most significant increases in exports to the EU are of fruits and vegetables, in the SACU and ECOWAS regions, and of other crops in the case of EAC, ECOWAS and COMESA (Table 4). Other crops comprise mostly cash crops, such as coffee and tea, and export-oriented products such as cut flowers. Thus, removing the CAP strengthens the export capacity of SSA only in the case of commodities that are already competitive in the EU markets. In contrast, the decline in imports is less homogeneous across commodities in different regions. In SACU, the decline in imports is distributed almost evenly among wheat, oils and meals, the meat sectors (pig and poultry, and beef and sheep meat) and, to a lesser extent, dairy. In ECOWAS and COMESA, a decline in imports of wheat and other crops accounts for more than 60% of the total decline.

Table 4. Trade flows with the EU, EUR million, 2030 (NoCAP, difference from reference)

Commodity	SACU		EAC		ECOWAS		COMESA	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Wheat	0.5	−24.8	1.5	−11.9	0.0	−161.5	4.5	−444.5
Other cereals	8.5	−2.9	4.2	0.0	3.1	-1.3	3.8	−19.9
Oilseeds	0.7	−0.7	4.8	−0.2	5.2	−0.7	4.9	−3.6
Oils and meals	0.6	−30.2	0.4	−0.5	19.3	−25.1	0.4	−24.4
Raw sugar	0.5	0.0	0.3	0.0	0.2	0.0	2.7	0.0
Sugar	−18.8	−0.4	−1.6	−7.4	−3.7	−18.0	−77.7	−23.6
Fruits and vegetables	227.6	−0.6	38.8	−0.4	116.5	-2.2	86.9	−24.9

Other crops	28.6	−12.7	179.8	−6.3	373.1	−120.4	148.0	−37.3
Cattle	0.2	−0.2	1.3	−0.1	0.1	−0.2	0.9	−4.8
Beef and sheep meat	−13.9	−1.7	−7.9	0.0	−7.4	−4.5	−4.1	−4.3
Pigs and poultry	8.8	−0.7	0.6	−0.2	0.7	−1.2	2.4	−3.1
Pig and poultry meat	4.3	−28.7	0.9	−0.6	4.8	−45.4	2.9	−66.0
Raw milk	0.0	−1.6	0.0	−1.2	0.0	−4.3	0.0	−5.6
Dairy	0.2	−13.6	0.2	−2.1	0.1	−61.8	0.6	−58.8
Rice	0.0	0.0	−1.1	0.0	−0.6	0.0	−4.2	−0.1
Other food	−0.3	−6.0	−6.5	−1.2	−27.3	−22.9	−5.4	−18.4
Beverages and tobacco	0.1	−0.9	0.0	0.3	−0.1	−0.7	0.7	−3.0
Feed	0.5	−0.2	0.3	0.0	4.1	0.0	1.0	−1.5
Agri-food total	248.3	−126.0	216.0	−31.7	488.2	−470.2	168.3	−743.9

Looking at the relationship with the rest of the world (all countries except the EU-28; Table 5), African regions show a general increase in trade flows, both imports and exports. In the case of SACU and the EAC, the trade balance change is small. In the case of ECOWAS and COMESA, the negative trade balance is significant and is particularly large for COMESA (and ECOWAS) wheat, as these regions have to import wheat from the rest of the world to make up for the reduction in imports from the EU, as the deficit cannot be overcome by domestic production.

Table 5. Trade flows with the rest of the world, EUR million, 2030 (NoCAP, difference from reference)

Commodity	SACU		EAC		ECOWAS		COMESA	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Wheat	8.0	22.5	0.3	22.5	0.1	216.9	0.5	520.8
Other cereals	6.7	0.5	0.5	1.0	0.3	0.3	3.0	0.3
Oilseeds	1.9	0.7	3.7	0.5	12.2	0.5	17.6	6.3
Oils and meals	8.0	24.7	5.2	5.9	14.0	25.8	8.1	36.5
Raw sugar	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Sugar	0.3	−0.5	0.8	12.2	0.7	23.7	9.3	19.3
Fruits and vegetables	6.2	2.6	3.7	1.2	28.2	4.2	38.2	18.2
Other crops	28.1	16.0	61.9	9.3	93.4	100.9	145.0	47.9
Cattle	−2.4	−0.3	−1.8	0.1	0.0	0.2	−53.6	2.1
Beef and sheep meat	−2.8	0.0	−2.2	0.1	−2.0	2.4	−5.2	0.4
Pigs and poultry	9.1	0.8	2.4	0.5	0.6	1.8	6.4	4.1

Pig and poultry meat	15.7	11.7	0.8	0.5	1.5	22.7	2.6	29.1
Raw milk	0.3	0.0	0.2	0.0	0.1	0.1	1.0	0.1
Dairy	4.2	4.2	0.8	1.5	4.8	62.3	24.5	38.9
Rice	0.0	0.9	−0.2	1.1	0.1	6.0	0.0	0.8
Other food	7.8	4.5	−1.9	3.8	−5.6	37.9	−2.8	33.9
Beverages and tobacco	2.1	0.7	0.2	1.6	0.6	3.9	0.9	2.1
Feed	0.7	0.4	0.1	0.0	0.5	0.5	0.2	2.0
Agri-food total	93.7	89.5	74.5	61.6	149.3	510.1	195.9	762.8

The changes in inter-African trade are focused on a few key commodities, i.e. fruits and vegetables, and other crops (Table 6). In the case of key staples, such as wheat and cereals, changes due to policies are not significant, despite the fact that, in some cases, they have substantial effects on African regions' trade with the EU or the rest of the world. This highlights one of the main issues related to African trade, which is the lack of important trade linkages among different regions, which could help African countries to overcome trade shocks by relying on neighbouring countries instead of distant international markets.

Table 6. Intra-African trade balance, EUR million, 2030 (NoCAP, difference from reference)

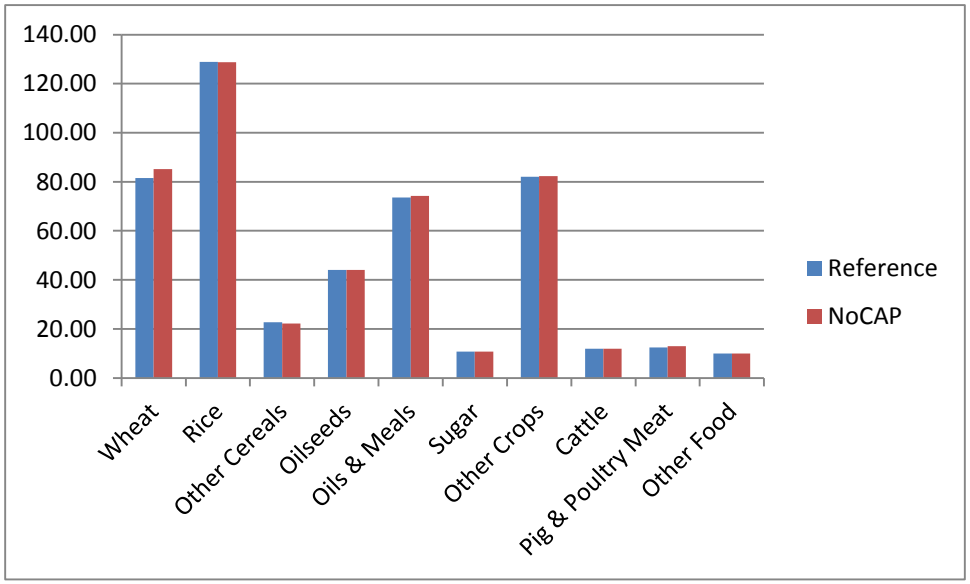
Commodity	SACU		EAC		ECOWAS		COMESA	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Wheat	0.5	0.0	1.5	0.2	4.5	0.1	0.0	0.1
Rice	0.0	0.0	−1.1	−0.1	−4.2	0.0	−0.6	0.1
Other cereals	8.5	0.3	4.2	0.9	3.8	1.0	3.1	0.0
Oilseeds	0.7	0.5	4.8	0.4	4.9	0.9	5.2	0.4
Oils and meals	0.6	0.6	0.4	2.2	0.4	2.2	19.3	9.9
Raw sugar	0.5	0.0	0.3	0.0	2.7	0.0	0.2	0.0
Sugar	−18.8	0.0	−1.6	6.3	−77.7	3.0	−3.7	1.3
Fruits and vegetables	227.6	0.4	38.8	0.6	86.9	8.9	116.5	3.1
Other crops	28.6	7.9	179.8	6.3	148.0	28.7	373.1	9.5
Cattle	0.2	0.0	1.3	0.0	0.9	2.6	0.1	0.1
Beef and sheep meat	−13.9	0.0	−7.9	0.0	−4.1	0.3	−7.4	0.0
Pigs and poultry	8.8	0.0	0.6	0.3	2.4	1.7	0.7	0.1
Pig and poultry meat	4.3	0.0	0.9	0.5	2.9	0.1	4.8	0.2
Raw milk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dairy	0.2	0.0	0.2	1.0	0.6	4.1	0.1	5.5

Other food	−0.3	0.1	−6.5	0.6	−5.4	2.0	−27.3	3.2
Beverages and tobacco	0.1	0.1	0.0	0.7	0.7	0.0	−0.1	0.8

Note: Intra-African trade balances include trade flows between and within SSA groups.

The change in trade flows is also reflected in imports as a proportion of production (Figure 2). The changes are minor but there is a consistent decrease in the ratio (a similar pattern can be seen for imports as a proportion of consumption) indicating some improvement in self-sufficiency in SSA.

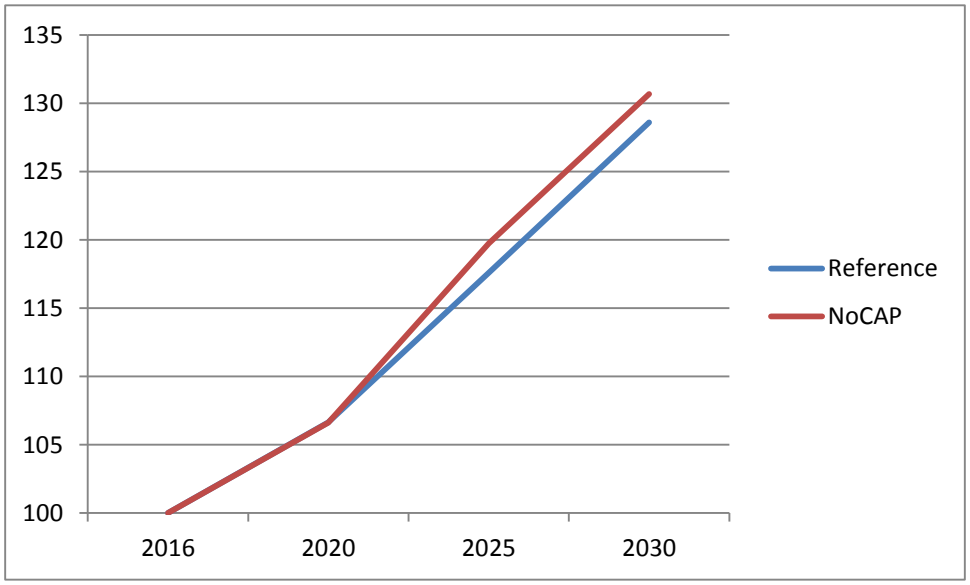
Figure 2. SACU, imports as a proportion of production, 2030 (reference and NoCAP)



5.2 Agriculture and food production

In terms of agricultural output, the results show quite small production effects in SSA. In SACU, which is the region in which the change from the reference scenario to the NoCAP scenario is greatest, the index of agricultural production shows a 2% increase compared with the reference scenario (Figure 3).

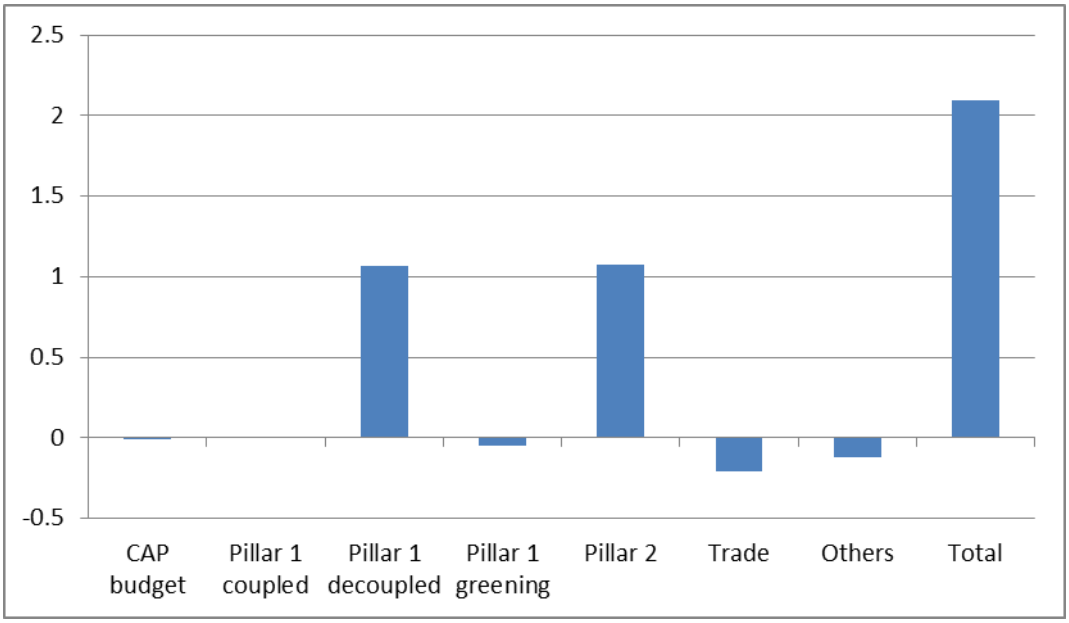
Figure 3. SACU, index of agricultural production, 2016-2030 (reference and NoCAP)



Decomposing the effect of different shocks on SACU agricultural production shows that the impacts of abolition of the CAP are almost equally divided between the two pillars, with abolition of decoupled payment and of pillar 2 payments causing an indirect increase in agricultural production in the SACU region of around 1% (Figure 4). Both effects are due to lower domestic production in the EU. At the same time, the consequences of the trade agreement with the EU are depressive for SACU agriculture, albeit the magnitude of the effect is much lower.

Looking at the effects on the food industry in SSA, a similar pattern is observed. In general, the production index shows a very slight increase compared with the reference scenario, even though the decomposition shows that trade shocks have a much more relevant and depressive impact (in terms of share rather than in absolute terms) on food industry production.

Figure 4. Decomposition of change in SACU agricultural production (%), 2030 (NoCAP versus reference)



Figures by commodity confirm the finding that the changes are minor for agricultural production in all four regions, except in the case of wheat, the production of which increases significantly (by between 2.1% and 3.8%), more than any other commodity (Table 7). Interestingly, adopting a historical perspective, wheat has notably been a subsidised commodity in the EU.

Table 7. Production change (%), 2030 (NoCAP versus reference)

Commodity	SACU	EAC	ECOWAS	COMESA
Wheat	2.1	2.1	1.8	3.8
Rice	−0.2	−0.4	0.0	0.0
Other cereals	0.2	0.1	0.0	1.0
Oilseeds	0.6	0.2	0.1	1.6
Oils and meals	1.2	0.5	1.0	1.9
Raw sugar	−0.5	0.2	0.1	−0.1
Sugar	−1.1	0.2	0.6	−0.7
Fruits and vegetables	0.3	0.4	0.1	3.0
Other crops	1.5	1.9	1.1	2.4
Cattle	-0.5	0.0	−0.1	−0.2
Beef and sheep meat	−0.1	−0.4	0.0	−0.3
Pigs and poultry	0.3	0.4	0.3	1.1
Pig and poultry meat	1.4	0.3	0.7	1.2
Raw milk	0.2	0.5	2.4	0.6
Dairy	0.5	0.3	3.0	0.5
Other food	−0.1	0.1	−0.1	0.0
Beverages and tobacco	−0.1	0.0	−0.3	0.1

5.3 Prices and consumption

Under the NoCAP scenario, agriculture and food industry price indexes slightly increase compared with the reference scenario (Figure 5), in line with the small increase in domestic production.

Figure 5. Agriculture and food industry price index change (%), 2030 (NoCAP versus reference)

The pattern is more diversified looking at the various agri-food commodities. Following a similar pattern of production results, price changes are most evident for wheat and other crops; for many other commodities, price changes are almost insignificant.

In general, the increase in producer prices compared with baseline (Figure 6) is lower than the increase in consumer prices (Figure 7). The former is mainly due to domestic movement in supply and demand, which, to a limited extent, pushes prices up. Consumer prices, which are calculated as the weighted average of commodities produced domestically to those that are imported, also factors in the price increase in imports, which adds to the already increasing domestic price trend. It should again be emphasised that the general tendency in the reference scenario is a stabilisation of agricultural prices over the period, and a reduction in food prices.

Figure 6. Producer prices change (%), 2030 (NoCAP versus reference)

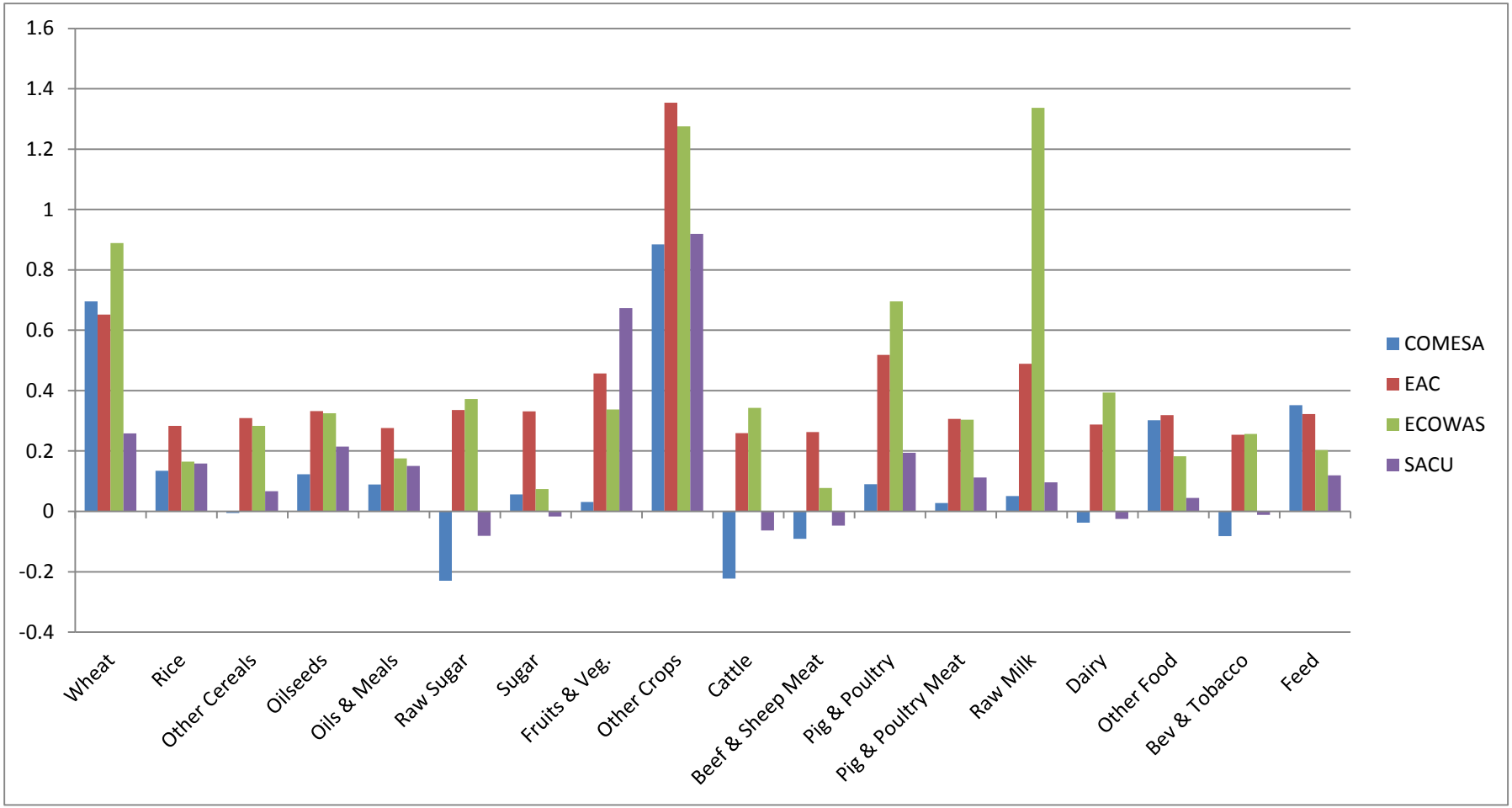
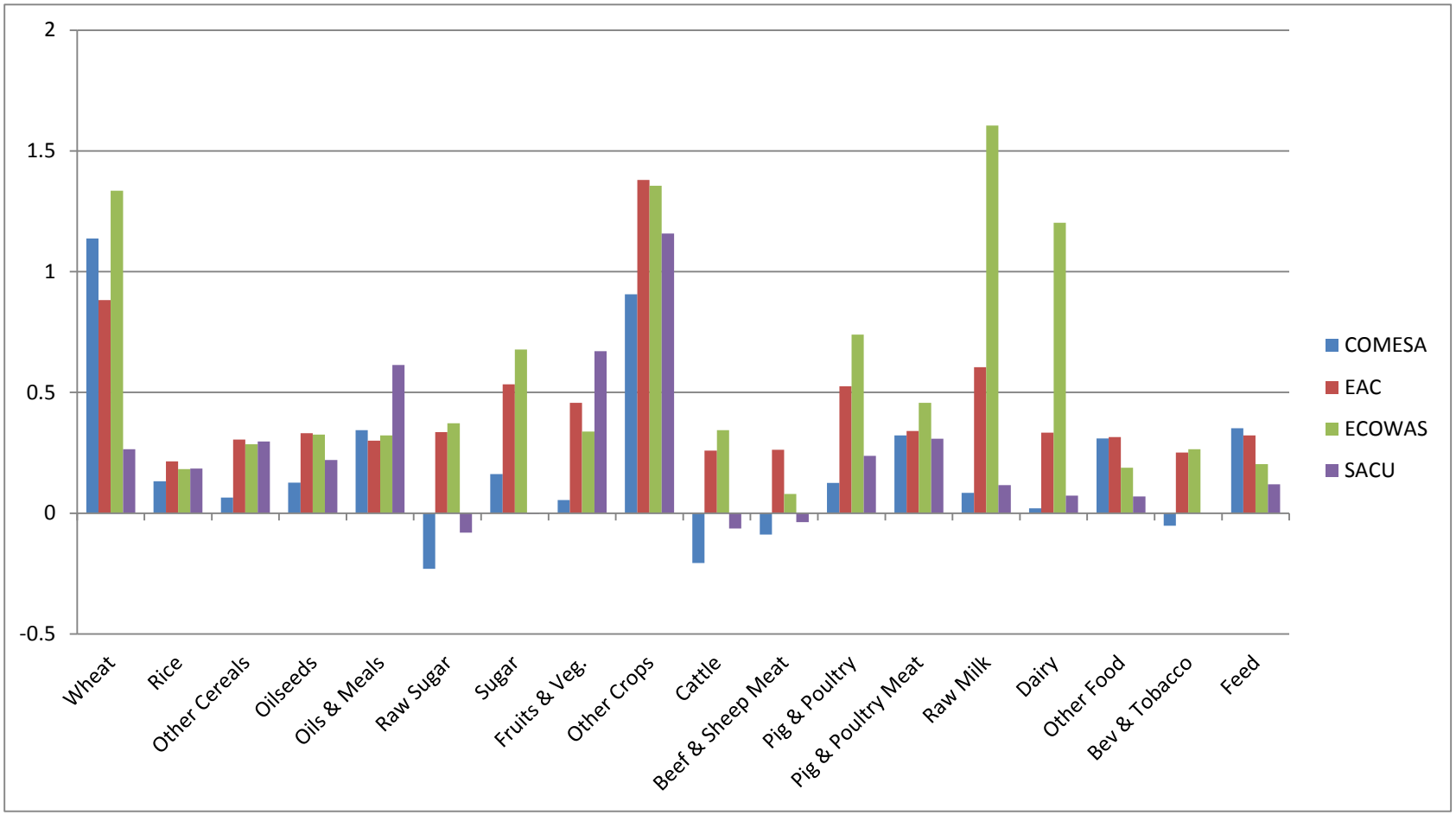


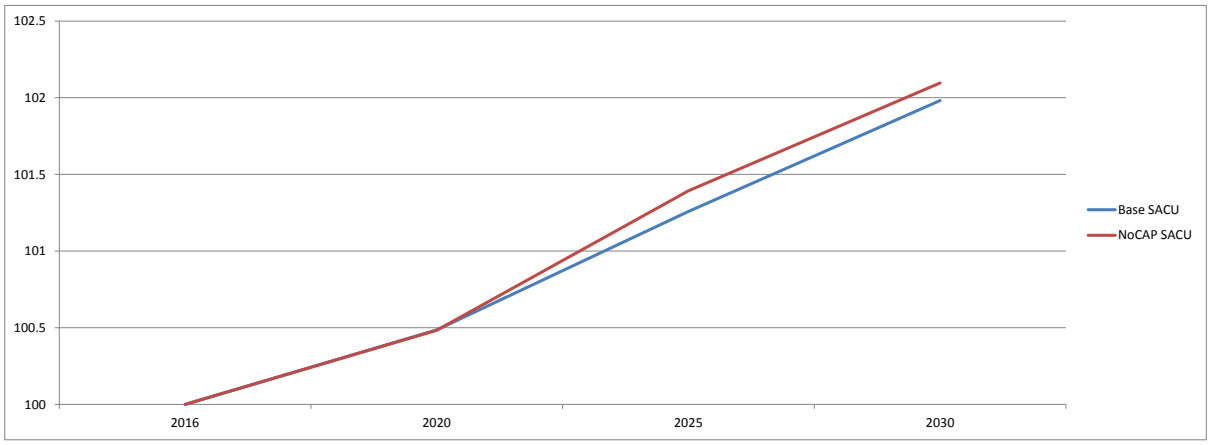
Figure 7. Consumer prices change (%), 2030 (NoCAP versus reference)



5.4 Factor and land use

The effects of shocks on land use are again very limited, with almost insignificant change in the land use index in all four regions. In all cases, the reference scenario records an increasing trend in the use of land, which is replicated under the NoCAP scenario with an increasing wedge compared with the reference scenario (Figure 8).

Figure 8. SACU land use index, 2016-2030 (reference and NoCAP scenario)



MAGNET also models the return associated with land use (which in the case of capitalist economies can be equated with land price). The increasing trend under the reference scenario is very similar to the trend seen in land use. Under the NoCAP scenario, the trend does not change, while the policy shocks contribute to an additional but small increase in the return of land due to the slightly increased pressure on demand caused by the increase in production.

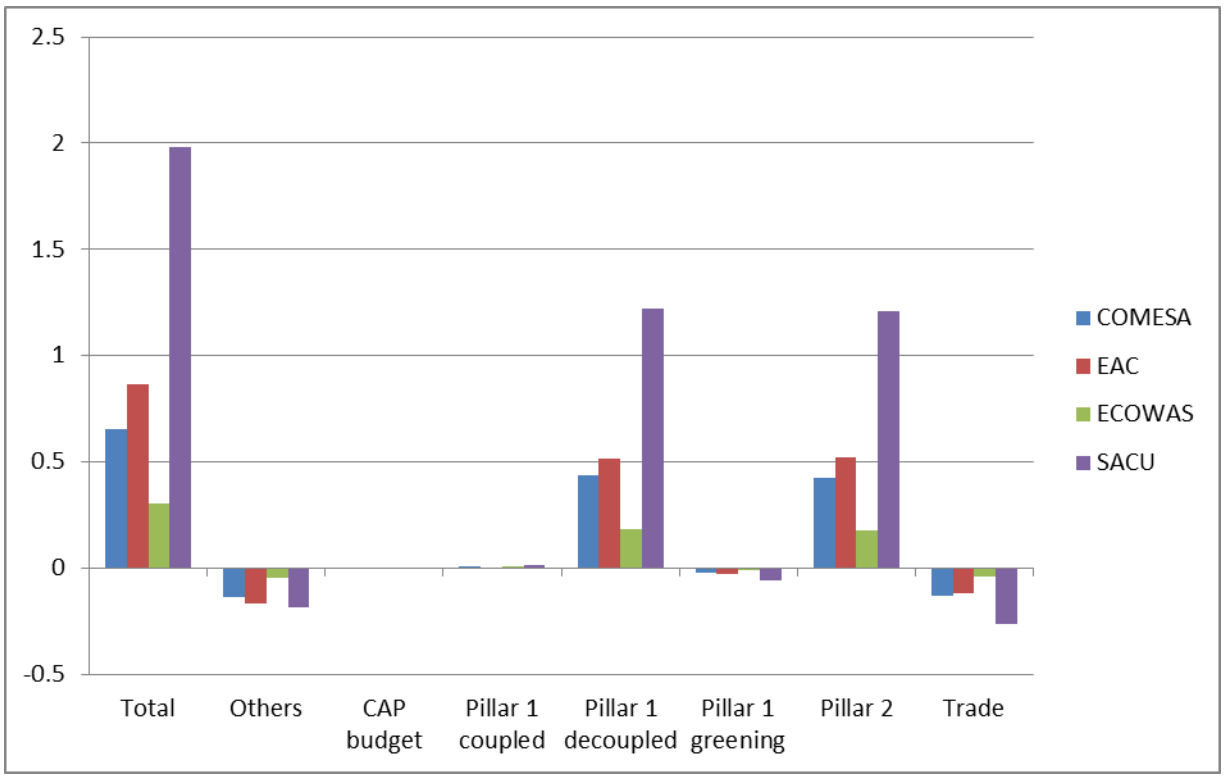
5.5 Income and jobs (and competitiveness)

In terms of jobs in agriculture, EU policies have a divergent impact in all four African regions. The trade policies have negative impacts on the number of agricultural jobs, as a result of the trade diversion effect already highlighted during analysis of the production effects of policies. At the same time, the removal of the CAP creates more jobs because of increased production in SSA.

As already highlighted, the biggest effect is in the SACU region, where an agricultural job index under the reference scenario of 100 would increase by almost two percentage points under the NoCAP scenario (Figure 9).

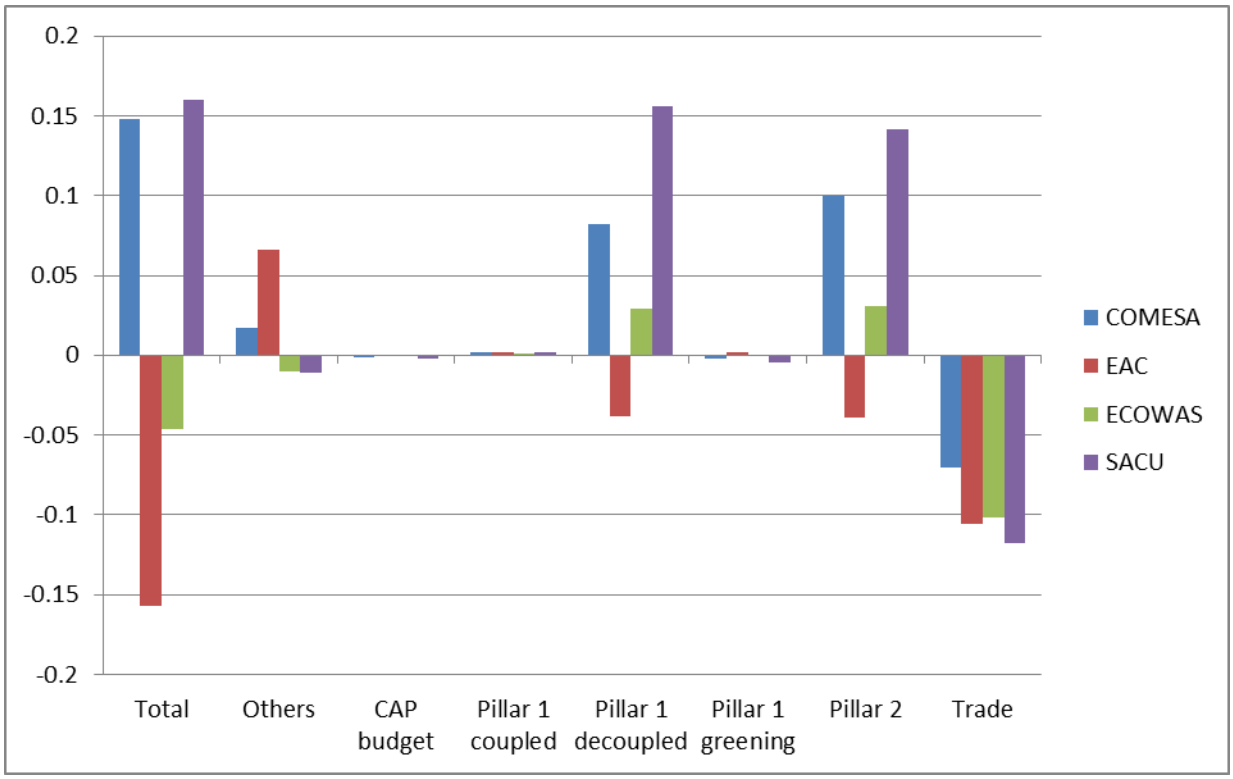
Looking at the decomposition of the shocks, the impact of the removal of pillar 1 and removal of pillar 2 on the number of jobs in agriculture in SACU is similar. Trade shocks have a smaller but negative impact on job creation in agriculture in all selected SSA regions.

Figure 9. Decomposition of change in agricultural jobs (%), 2030 (NoCAP versus reference)



The food industry sector has a different reaction to the same shocks (Figure 10). First, the impacts are more limited than in the agricultural sector, with a change of between +1.5 and −0.15 percentage points compared with the reference scenario. In some regions, such as ECOWAS, the negative effects of EU trade policies on SSA overwhelm the increase due to the CAP removal, while in the EAC all policies have negative impacts (very limited in the case of the CAP) on job creation in the sector.

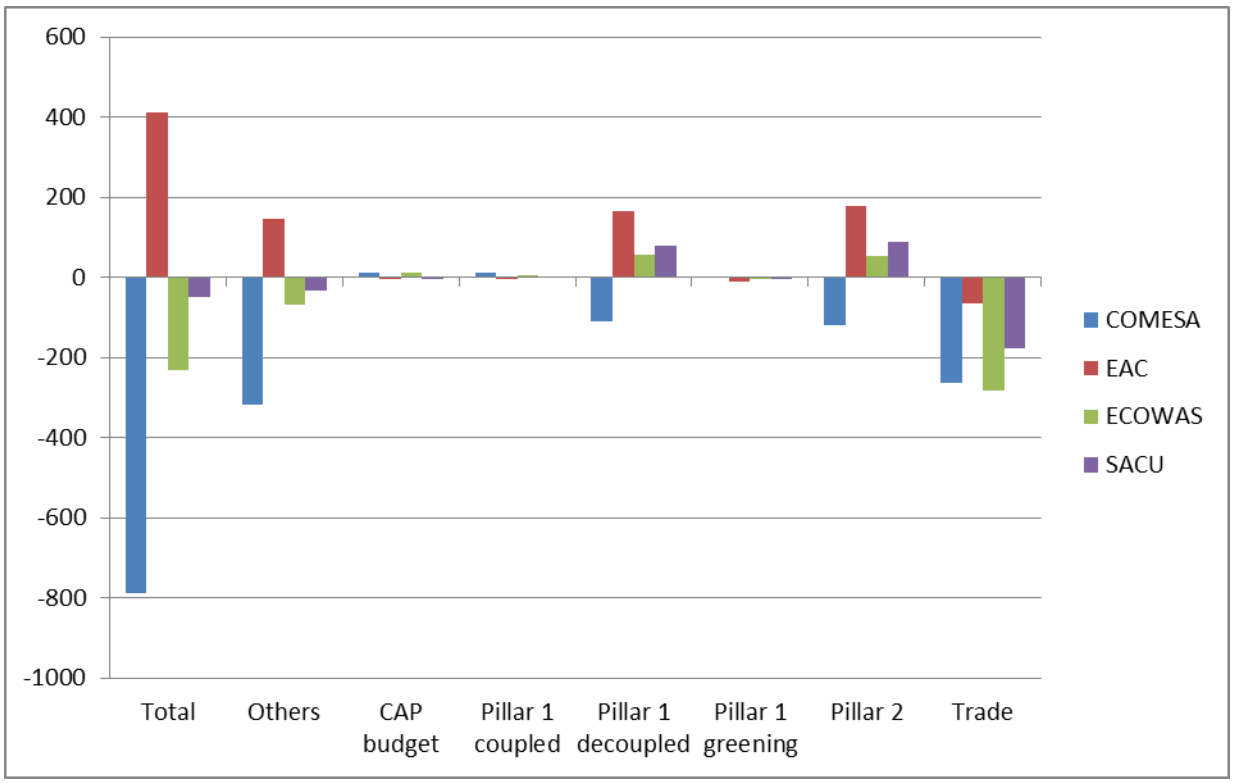
Figure 10. Decomposition of change in food industry jobs (%), 2030 (NoCAP versus reference)



5.6 Macro trends and economy-wide effects

GDP in SSA is barely affected by the modelled policy shocks, and the change compared with the baseline is never above 0.01%.

Figure 11. Decomposition of change in welfare, EUR million, 2030 (NoCAP versus reference)



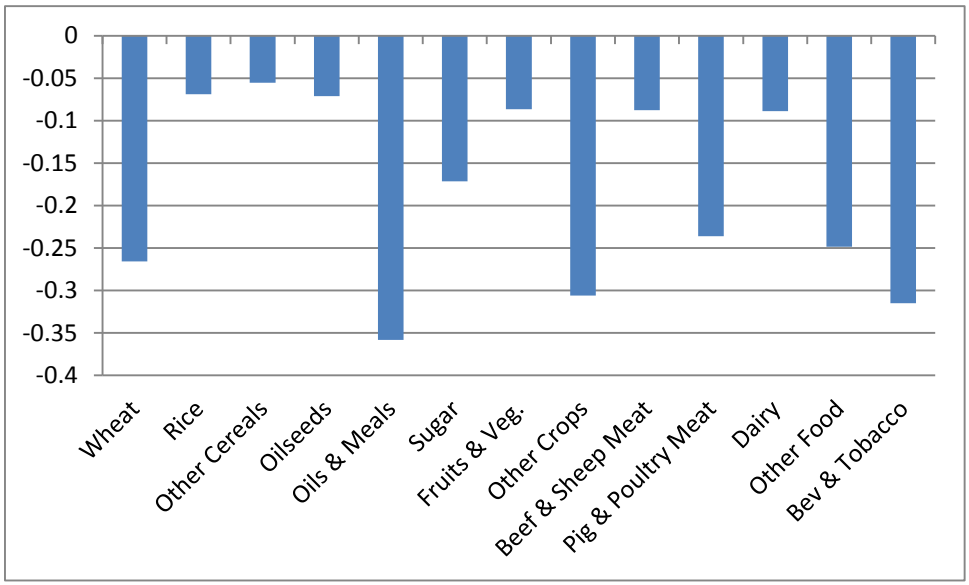
Looking at welfare changes, the dismantling of the CAP has negative impacts on net importers such as COMESA, and positive impacts on net exporters (all other regions) (Figure 11). The abolition of pillar 1 payments has the strongest impact, as this has some implications for production due to coupling effects and income support for EU farmers. Again, in the case of COMESA, dismantling of pillar 1 has a negative welfare effect. The same holds for pillar 2 payments. A decline in EU productivity (compared with the reference scenario) produces a positive effect on the welfare of net exporters and a negative effect on net importers, with payments to human capital the main drivers.

Liberalisation of EU trade policies towards non-African countries has a generalised negative impact on SSA welfare. The pattern is diverse, and depends on the trade relationship between the EU and the region concerned. With the exception of te EAC, negative impacts resulting from trade measures outweigh the positive impacts resulting from CAP abolition.

In SACU, the negative impact is equivalent to the positive impact resulting from abolition of the CAP. In the case of the EAC, the negative impact is much smaller, while for ECOWAS and COMESA the negative impact is significant. In ECOWAS, the negative impact counteracts the positive impact resulting from CAP abolition, while in COMESA it adds to the negative outcome of CAP abolition, COMESA regions being those most negatively affected by this new policy framework.

Macroeconomic, welfare and price changes have an effect on agri-food consumption. In general, we observe a very limited reduction, compared with the baseline, in agri-food consumption in all African regions except the EAC. This is the only region that has an increasing welfare trend compared with the baseline. The reduction in imports from the EU and the pressure on prices due to increased domestic demand reduce the impacts on COMESA. Figure 12 shows the reduced impacts on the various commodities. Given that the results, because of the configuration of this model, can be shown only at an aggregate representative household level, no sensible conclusions can be drawn about how these policies might affect food security. Nevertheless, this result highlights the fact that, in future research on this topic, possible impacts on more food-insecure individuals should be more carefully taken into account.

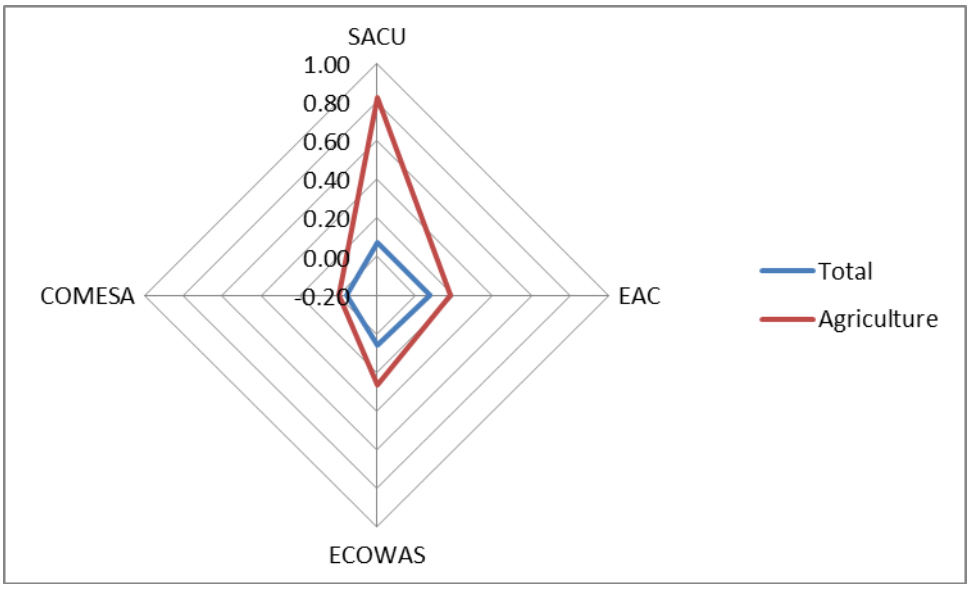
Figure 12. Change in consumption growth (percentage point difference), 2030 (NoCAP versus reference)



5.7 Environmental impacts

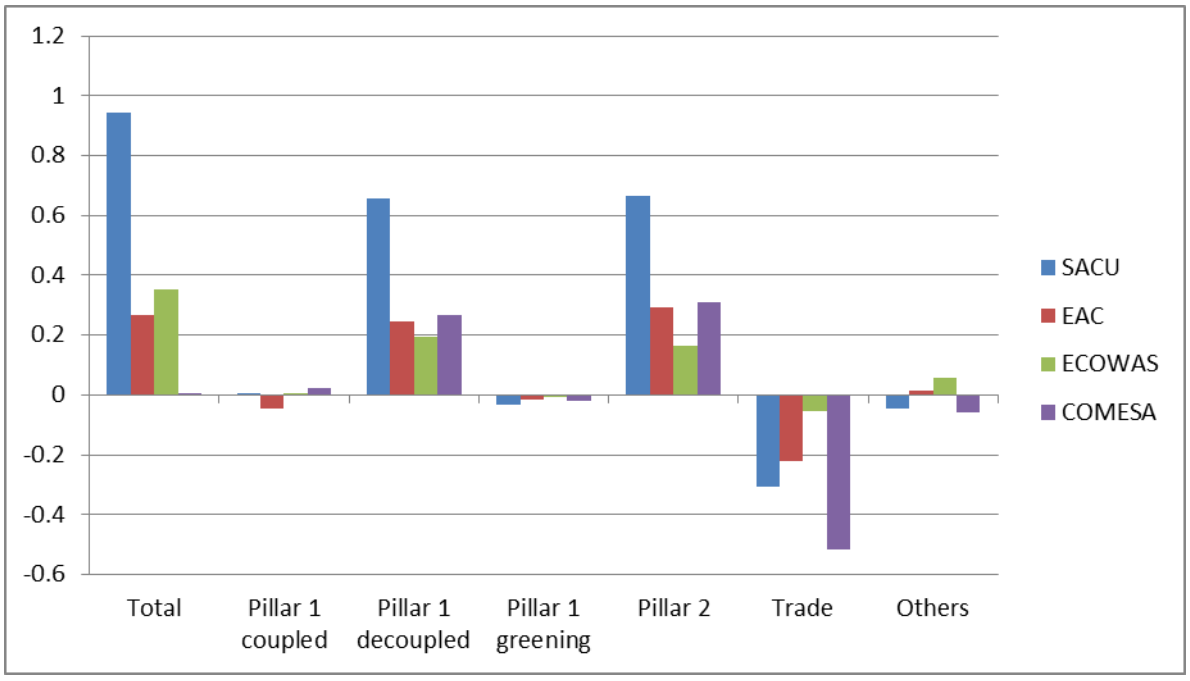
The impact on GHG emissions in SSA is minimal. As a result of higher production, all regions except COMESA observe an increase in GHG emissions. This is very limited when considering the whole economy (less than 0.1% in all regions) (Figure 13).

Figure 13. Greenhouse gas emissions change (%), 2030 (NoCAP vs. reference)



The increase in GHG emissions due to the effects of EU policies is slightly higher when considering the agricultural sector alone. CAP removal causes an increase in agricultural production, pushing GHG emissions up, while trade diversion and, consequently, loss of agricultural production in SSA causes a drop in GHG emissions in all regions (Figure 14).

Figure 14. Decomposition of change in GHG emissions from agriculture (%), 2030 (NoCAP versus reference)



6 Concluding remarks

This paper provides a model-based analysis of the impact of the CAP on the four main regional blocks in SSA, i.e. COMESA, EAC, ECOWAS and SACU, using MAGNET, a multi-region CGE model. To provide a comprehensive analysis, other key EU policies, such as trade and GHG policies, are also modelled. A thoroughly prepared reference scenario is contrasted with a counterfactual scenario, in which the CAP is removed and ambitious trade agreements with non-African EU trade partners are implemented.

This analysis provides interesting insights into the identification and quantification of the effects of the CAP — mainly indirect — in SSA. It should be emphasised that the model is simulating *ex ante* the removal of the CAP at a given point in time, after it has been in place for several decades. Therefore, the results cannot be interpreted as an *ex post* assessment of the effects of the current CAP on developing countries.

As expected, and implemented through modelling assumptions, decoupled payments have minimal effects on third countries. Indeed, decoupled payments have similar impacts to rural development policies, which aim, among other things, to enhance EU agricultural productivity. Elimination of pillar 2 payments causes a productivity fall in the EU compared with the reference scenario and, through trade, affects world and third-country markets.

The effects differ by country/region (e.g. exporters versus importers), sector (e.g. cash versus staple foods) and agent (e.g. producers versus consumers). In SSA, the most positively affected sectors (output) are wheat (production increases between by 1.8% and 3.8%), other crops (production increases between by 1.1% and 2.4%), and pig and poultry meat (production increases by up to 1.4% in SACU).

Increased production in SSA also leads to a slight rise in agriculture and food prices compared with the reference scenario. In this context, it should be noted that the absolute prices in 2030 are projected to decrease (or stabilise) compared with the base year.

The price increase resulting from the removal of the CAP is, on the one hand, detrimental to food-importing countries/regions because consumers face slightly higher food prices. On the other hand, it benefits agricultural producers in SSA and has a positive impact on jobs in the SSA agricultural sector due to an increase in production. It remains to assess whether this expansion will be a source of growth and development (e.g. by creating decent jobs in rural areas, which is outside the scope of the current modelling framework), or lead to a so-called poverty trap.

The combined effects of CAP removal and trade liberalisation (not including SSA) improve the trade balance of SSA with the EU by about EUR 2.5 billion, with the main beneficiaries being ECOWAS and COMESA (by about EUR 1 billion each). The trade balance for wheat, sugar, beef and sheep, raw milk, and dairy improves in all SSA regions. In general, EU trade liberalisation with its main non-SSA partners causes only small trade diversion effects.

The results advocate for strengthened support for agricultural productivity gains in SSA. Increasing productivity in agriculture will be the key to sustainable agricultural development in SSA. The results also highlight that an EU trade agenda that does not incorporate agreements with partners from SSA will have negative impacts on this region. It remains to be seen how other EU policies, such as in the areas of trade or cooperation, are able to enhance policy coherence for development (PCD).

It is important to bear in mind that the analysis is subject to important caveats. The level of product disaggregation is limited, as is the capacity to model sectorial interrelations, and policy and institutional constraints. In addition, the level of regional aggregation masks national and local effects. In terms of modelling techniques, externalities of the CAP (positive and negative) are excluded, as is the cost of administering the policy. In addition, NTMs (standards) that potentially affect SSA exports to the EU single market

are not taken into account. Last but not least, EU relations with SSA countries remain uncertain (e.g. EPAs, Cotonou Agreement), as does EU internal development (e.g. further market integration, Brexit).

References

Aguiar, A., Narayanan, B., McDougall, R., 2016. An Overview of the GTAP 9 Data Base, Journal of Global Economic Analysis 1 (1): 181-208. http://dx.doi.org/10.21642/JGEA.010103AF

Bouët, A., 2008. The Expected Benefits of Trade Liberalization for World Income and Development Opening the "Black Box" of Global Trade Modeling, Food Policy Review 8, International Food Policy Research Institute, Washington D.C..DOI: 10.2499/0896295109FPRev8

Boulanger P., Dudu, H., Ferrari, E., Himics, M., M'barek, R., 2016. Cumulative economic impact of future trade agreements on EU agriculture, EUR 28206 EN, Publications Office of the European Union, Luxembourg. doi:10.2788/194880

Boulanger, P., Philippidis, G., 2015. The EU budget battle: Assessing the trade and welfare impacts of CAP budgetary reform, Food Policy 51: 119–130. doi:10.1016/j.foodpol.2015.01.004

Boysen, O., Jensen, H. G., Matthews, A., 2016. Impact of EU agricultural policy on developing countries: A Uganda case study, The Journal of International Trade & Economic Development 25(3): 377-402. http://dx.doi.org/10.1080/09638199.2015.1069884

Brooks, J., 2014. Policy coherence and food security: the effects of OECD countries' agricultural policies, Food Policy 44 (2014): 88-94. https://doi.org/10.1016/j.foodpol.2013.10.006

Costa, C., Osborne, M., Zhang, X-G., Boulanger, P., Jomini, P., 2009. Modelling the Effects of the EU Common Agricultural Policy, Productivity Commission Staff Working Paper, Melbourne. http://www.pc.gov.au/research/supporting/european-agricultural-policy

European Commission, 2015a. Policy Coherence for Development, 2015 EU Report, Commission Staff Working Document, SWD(2015) 159 final, 3.8.2015, Brussels.

European Commission, 2015b. EU agricultural outlook, Prospects for EU agricultural markets and income 2015-2025 DG AGRI, December, Brussels. http://ec.europa.eu/agriculture/markets-and-prices/medium-term-outlook/2015/fullrep_en.pdf

Hertel, T.H, van der Mensbrugghe, D., 2016. Behavioral Parameters, GTAP 9 Data Base Documentation, Chapter 14, Purdue University, West Lafayette, Indiana. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5138

Hertel, T.H. (ed.), 1997. Global Trade Analysis: Modeling and Applications, Cambridge University Press.

M'barek, R. et al., 2017. Scenar 2030 - Pathways for the European agriculture and food sector beyond 2020, EUR 28797 EN, Publications Office of the European Union, Luxembourg. 10.2760/887521

Nowicki, P. et al., 2009. Scenar 2020-II – Update of Analysis of Prospects in the Scenar 2020 Study, Contract No. 30-CE-0200286/00-21, European Commission, Directorate-General Agriculture and Rural Development, Brussels. http://ec.europa.eu/agriculture/analysis/external/scenar2020ii/report_en.pdf

Nowicki, P. et al., 2006. Scenar 2020 – Scenario study on agriculture and the rural world. Contract No. 30–CE–0040087/00-08, European Commission, Directorate-General Agriculture and Rural Development, Brussels. https://ec.europa.eu/agriculture/sites/agriculture/files/external-studies/2006/scenar2020/full-rep_en.pdf

Otsuki, T., Wilson, J.S, Sewadeh, M., 2001. Saving two in a billion: quantifying the trade effect of European food safety standards on African exports, Food Policy 26(5): 495-514.

Philippidis, G., M'barek, R., Ferrari, E., 2016. Drivers of the European Bioeconomy in Transition (BioEconomy2030) - an exploratory, model-based assessment, EUR 27563 EN, Publications Office of the European Union, Luxembourg. doi:10.2791/529794

Revoredo-Giha, C., Philippidis, G., Toma, L., Renwick, A., 2013. The Impact of EU Export Refunds, The Journal of Development Studies 49(12): 1651-1675. http://dx.doi.org/10.1080/00220388.2013.807500

Woltjer, G., Kuiper, M., 2014. The MAGNET model. Wageningen: LEI, Wageningen UR.