Impact of EU Common Agricultural Policy reform on Uganda

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Abbreviations

CAP	Common Agricultural Policy
CAPRI	Common Agricultural Policy Regional Impact
CARIFORUM	Caribbean Forum
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
CGE-MS	Computable General Equilibrium Micro-simulation
CMO	Common Market Organisation
CPI	Consumer Price Index
EAC	East African Community
EAFRD	European Agricultural Fund for Rural Development
EBA	Everything But Arms
EC	European Commission
EPA	Economic Partnership Agreement
EU	European Union
FAO	Food and Agricultural Organization
FGT	Foster-Greer-Thorbecke
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Partnership
IFPRI	International Food Policy Research Institute
LDC	Least-developed Country
LES	Linear Expenditure System
MDG	Millennium Development Goal
Mercosur	Common Market of the South
MFF	Multi-annual Financial Framework
MFN	Most-favoured Nation
NDP	National Development Plan
NGO	Non-governmental organisation
NPC	Nominal Protection Coefficient
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PE	Partial Equilibrium
SAM	Social Accounting Matrix
SPS	Single Payment Scheme
UBoS	Uganda Bureau of Statistics
UN	United Nations
UNCTAD	UN Conference on Trade and Development
UNHS	Uganda National Household Survey
US	United States
USDA	US Department of Agriculture
WHO	World Health Organization
WTO	World Trade Organization

Executive summary

Introduction

The European Union (EU)'s Common Agricultural Policy (CAP) has long been criticised for its damaging effects on developing countries, and developing country agriculture in particular. The EU has committed itself to greater policy coherence for development in its non-aid policies, including agricultural policy. To evaluate its success in moving towards policies that are more coherent with its development cooperation objectives, estimates of how the CAP currently affects developing countries are needed. Taking Uganda as a case study, this study examines the impact of proposed as well as potential EU agricultural policy reforms on its economic structure, poverty and food security. The objective is to contribute to the debate on how to monitor the effects of the CAP on developing countries.

Changes to the CAP can affect developing countries in different ways; empirical evidence is needed on the magnitude and direction of these effects. This study uses a quantitative modelling methodology to examine how CAP reform might affect a particular developing country. It adopts a three-level approach. First, it assesses the world price impacts of CAP reform. Second, it evaluates the national price-level effects, taking into account the degree of transmission between world market prices and national prices. Third, it calculates the impact of changes in national prices on household welfare and poverty, again taking into account in principle the degree of transmission of national price changes spatially within the country. In practice, the role of price transmission is only partially addressed in this report.

Uganda is selected as a case study country because of the availability of a Ugandan simulation model developed by the authors that allows us to establish the impact of world market price changes on economic welfare, the allocation of resources, consumption and poverty within Uganda. Given the structural characteristics of the Ugandan economy, CAP reform is unlikely to have major impacts, either positive or negative. However, this study is intended as a template to illustrate an approach to evaluating the impact of the CAP on a developing country. Although the substantive results are of interest, we also want to explore the advantages and disadvantages of this methodological approach. Thus, in addition to reporting our results, we emphasise the assumptions and data requirements necessary to undertake an analysis of this kind. The analysis should be seen as a pilot study using quantitative modelling to provide relevant guidance to developing country policymakers on how CAP reform might affect their country.

CAP reform scenarios

Empirical modelling is one way to assess the impact of further CAP reform on developing countries. We review the approaches used in some recent modelling studies and use the results to create a set of world price shocks to represent different possible CAP reform as well as relevant non-CAP scenarios in the future. Three scenarios are examined which would have different world market effects and hence different impacts on developing countries:

1. A 'CAP2020' scenario to represent the impact of the European Commission (EC)'s post-2013 legislative proposals published in October 2011;
2. A 'liberalisation' scenario, in which all CAP instruments, including export subsidies, domestic support and production quotas, as well as non-CAP interventions such as import tariffs, are eliminated;
3. A 'biofuels' scenario, in which the EU is assumed to meet its 2020 target for the incorporation of renewables in transport fuels contrasted with a situation in the absence of such a mandate. EU biofuels policy is not as such a part of EU agricultural policy, but it has significant implications for EU land use and agricultural production and demand.

We adopt an eclectic and synthetic approach to estimate world price impacts in the three scenarios. The shocks in the 'limited' policy change scenarios (CAP2020 and biofuels) are very small. The shocks assumed in full CAP liberalisation are considerably larger. The latter is deliberately extreme to assess the sensitivity of the outcomes to a range of alternative assumptions about the impact of the CAP on world markets.

Another important difference between the scenarios is the commodity structure of the price shocks. In the CAP2020 scenario, primarily the crops sector is affected. In the full liberalisation scenario, it is primarily animal production. In the biofuel scenario, the main impact is on vegetable oils. These differences determine the nature of the overall impact of each scenario on Uganda. An important limitation of the price changes identified in the literature review for each scenario is that they are limited to price changes for agri-food commodities. The CAP also attracts resources away from the EU manufacturing and services sectors and affects the world market price of the commodities produced by these sectors. This effect is taken into account through a sensitivity analysis of the empirical results.

Quantifying CAP impacts on Uganda

We describe the simulations for the second and third stages of the three-level approach and estimate the impact of world price changes as already identified on the Ugandan economy and households. The simulations are implemented using an integrated computable general equilibrium micro-simulation (CGE-MS) model, which enables quantification of the adjustment impacts on the economy following world market price changes and also of the impacts on income distribution and poverty.

The world price shocks selected will affect Uganda through a number of channels. Producers will reallocate resources in response to the altered relative profitability of commodities. This will be accompanied by changes in factor and thus household incomes. Consumers will reallocate their spending in response to the altered relative prices of consumer goods and incomes. Government revenue will be affected as the flows on which taxes are levied (income, imports, sales) alter in response to these changes in behaviour. Imports and exports will change, affecting the exchange rate. The CGE model of the Ugandan economy captures these simultaneous impacts.

The link between these national effects and the poverty impacts of world market price changes owing to the CAP is assessed using an integrated micro-simulation model based on the Ugandan National Household Survey (UNHS). A shock to world market prices is translated into poverty impacts via three main channels: consumption, enterprise and government (McCulloch et al., 2001). Households are affected as consumers when consumer prices and thereby the purchasing power of their incomes change (the consumption channel). Changes in profits affect factor demand and thus employment and wages (the enterprise channel). Taxpayers and users of government services are also affected when changes in tax revenues both directly induce changes in government policies regarding direct transfers, taxes and provision of public goods and social services and lead to new policies to counter negative effects (the government channel). Apart from these immediate, static, impacts, changes in world market prices may affect incentives for investment and innovation and thus economic growth. This study concentrates on the impact of the three static channels.

The impact of world market price changes on Uganda will be determined by the extent to which these price changes are transmitted to the Ugandan border and diffused to producers and consumers within the country. This is an important issue for all developing countries but particularly for Uganda where, as a land-locked country, the correlation between national and world market price changes is weak. In this study, the model methodology incorporates imperfect price transmission from world to national prices (the extent is determined endogenously by model parameterisation and closure rules). However, the issue of price transmission does not stop at the border. Spatial transmission to local markets is influenced by the domestic transportation and information infrastructure and also depends on local supply and demand conditions. Hence, the changes in price incentives faced by individual producers and consumers may vary widely in spatial terms; there may be cases where internal trade costs are so high that little transmission occurs. Prices also transmit imperfectly vertically through the different levels of the supply chain. This study does not take into account the damping of the world market price effects as they are transmitted across Uganda; it would be desirable to address this limitation in future work.

Uganda is a net food exporter, and the three scenarios modelled in this paper all lead to an improvement in the country's terms of trade. However, because of the large value difference

between exports and imports, Uganda's balance of trade is affected differently in the three scenarios. The model closure assumes a fixed current balance, so the (real) exchange rate changes to restore external equilibrium. Whether overall welfare and household consumption increase or not depends on the strength and composition of the terms of trade effect. In the CAP2020 and biofuel scenarios, total absorption and household consumption fall; in the CAP liberalisation scenario, both absorption and household consumption rise.

The change in the poverty headcount follows the direction of change in private consumption in each scenario, although all changes are only a fraction of a percentage point. The simulations measure the poverty effects of world market price changes owing to the CAP taking into account producer and consumer responses within Uganda; government responses are designed to be neutral with respect to the distribution of income and thus do not allow for differentiated tax and/or public expenditure policies to offset or mitigate increases in poverty. The poverty headcount rises in the CAP2020 and biofuels scenarios, but falls in the CAP liberalisation scenario. The situation for the already poor deteriorates, as indicated by the poverty gap in both the CAP2020 and biofuels scenarios, but improves in the CAP liberalisation scenario. There is very little impact in any scenario on the severity of poverty.

In the CAP2020 and biofuel scenarios, poverty increases among rural households but decreases among urban households. In the CAP liberalisation scenario, the positive impacts in terms of reducing the poverty headcount and the poverty gap are felt mainly in rural areas; the poverty gap and poverty severity actually increase in urban areas. These findings highlight that the nature and composition of the external price changes determine the initial impacts on poverty within Uganda, underlining the need for context-specific empirical analysis and the difficulties of making generalisations.

There seems to be no relationship between greater food availability, reductions in poverty and food consumption changes. Higher domestic prices for food products result in poorer access to food among Ugandan households, despite the increase in production self-sufficiency and the reduction in poverty in the liberalisation scenario, although the higher national income in the liberalisation scenario would permit government redistribution to mitigate this.

Further examination shows that, if the CAP scenarios also influence activity in the EU manufacturing and services sectors and if reform lowers the world price of the commodities produced in these, the resulting terms of trade gain would lower the poverty headcount in Uganda. This is an important and often overlooked way in which the CAP has an impact on developing countries.

Conclusions

Following the adoption of policy coherence for development as a cross-cutting objective for EU domestic policies, there is a need to monitor the impact of the CAP and CAP reform on developing countries, although no formal mechanisms to do this have been put in place as yet. Various non-governmental organisations (NGOs) as well as members of the European Parliament have suggested institutional procedures for conducting such monitoring (for a review of these proposals, see Ragonnaud, 2012). Central to any monitoring exercise would be the gathering of evidence on the impacts of the CAP on individual developing countries. The impact assessment of the EC's legislative proposals for the CAP post-2013 noted that there are few studies of this kind from which to draw reliable conclusions.

This paper explores the feasibility and the implications of a particular empirical modelling approach to assessing the impact of the CAP on a developing country, taking Uganda as the case study. The strength of this approach is that it explicitly identifies a path of causation between decisions on EU agricultural policy and poverty and food security impacts in developing countries. First, the impact of CAP policy instruments or CAP reforms on world markets is measured. Second, taking into account the transmission of these world market price impacts into national prices, their impact on the structure of production and consumption and on economic welfare in the national economy is assessed. Third, taking into account the spatial transmission of these price changes within the

national economy and the initial distribution of household incomes and expenditure patterns, the distributional impact of these national changes across households is investigated, paying particular attention to the impact on households at or close to the poverty line. In practice, this ideal approach is only partially implemented, given data and modelling constraints.

This study finds different impacts on Uganda of changes to the CAP, some negative, some positive. The common feature is that these changes are of a very small order of magnitude. The poverty effects would be further damped if account were taken of imperfect spatial transmission of prices within Uganda, as this would tend to insulate households from the impact of the price changes, whether positive or negative. Relative to the year-on-year volatility in world food markets, or to the poverty impacts from additional public investment in agricultural public goods, EU agricultural and trade policy plays only a minor role in the Ugandan case. This was anticipated, given the country's structural characteristics and its trade relationship with the EU. Greater effects could be observed for a different country, underlining the importance of empirical work taking into account individual country specificities.

An important lesson that emerges is that apparently similar world market price changes arising from CAP reforms or non-CAP policies that also raise world market prices of CAP commodities have very different quantitative impacts, in terms of both macroeconomic effects and household poverty effects. Although all three scenarios assume a positive terms of trade impact on Uganda (which is a net food exporter), the impacts on gross domestic product and poverty levels are different even under the same model closure assumptions. Both the size and the commodity composition of the terms of trade changes are important for the poverty impacts observed. This obvious, although often forgotten, finding has important implications for future modelling of CAP reforms on developing countries.

Some limitations of the study and suggestions for improvement in future work are as follows:

Make use of an integrated model to improve consistency of results. For this pilot study, it was not possible to make use of one of the existing multi-regional CGE models to run customised simulations of specific CAP reforms and evaluate their impact on Uganda. In future work, it would be desirable to undertake a consistent and integrated analysis of the first and second stage impacts using a multi-regional CGE model.[1] An advantage of using an integrated model is that the specific scenarios of CAP reform investigated are under the control of the analyst and not dependent on what can be found in the literature.

Take account of the current CAP. This study made use of world price impacts from studies that modelled the CAP as it was in the mid-2000s. These studies do not account for the significant reduction in the trade-distorting impacts of the CAP that has occurred since then. To be of use to developing country policymakers, analysis of the impact of future CAP reforms should start from the current CAP, not the CAP as it was a decade ago. On the other hand, using estimates of CAP protection at a time when world prices are high may underestimate the contingent nature of that protection. There is a risk of higher protection re-emerging under less favourable world market conditions.

Take account of imperfect price transmission. Assumptions on price transmission enter at two stages, in converting world market price changes to national changes and in calculating how these affect households. Integrating better information on observed price transmission behaviour in developing countries into quantitative models would be highly desirable.

Test the sensitivity of results to different model assumptions. Model results are dependent on the behavioural parameters and theoretical assumptions embedded in the model. Different assumptions about model specification and parameter values will influence the measured impacts. Of particular importance for CAP impact studies is how EU direct payments are modelled, which

[1] The main requirement is that the developing country of interest is identified separately in the global database used by the multi-regional CGE model. The Global Trade Analysis Partnership (GTAP) database, the main global database used for modelling of this kind, has gradually been increasing its country coverage in successive releases.

determines their presumed coupling factor and thus the effect of changes in the direct payments regime on world markets. Sensitivity analysis plays an important role in evaluating the output of quantitative models for monitoring purposes.

1. Introduction

1.1 Objective of the study

The European Union (EU) Common Agricultural Policy (CAP) has long been criticised for its damaging effects on developing countries, and developing country agriculture in particular. EU farmers have enjoyed considerable protection as a result of the CAP, through both higher prices and budget support. The resulting stimulus to production (and disincentives to consumption) meant that the EU emerged as a significant export competitor to developing countries, while its use of export subsidies enabled surpluses to be dumped at low prices on the markets of importing developing countries. Case studies undertaken by non-governmental organisations (NGOs) have highlighted the alleged impact of EU exports of particular commodities (milk powder, pig meat, poultry meat) in particular countries.[2] At the same time, the EU's high level of border protection has prevented low-cost developing country exporters from selling to the EU market. Model simulations confirm that the CAP has in the past distorted both the level and the volatility of world market prices to the detriment of farmers in developing countries, even if consumers and net importing developing countries could have reaped some benefits from lower world market prices.[3]

The EU has committed itself to greater policy coherence for development in its non-aid policies, including its agricultural policy (European Council et al., 2006). To evaluate the extent to which its policies are coherent with its development cooperation objectives, estimates of how the CAP affects developing countries are needed. Taking Uganda as a case study, this study examines the impact of proposed as well as potential EU agricultural policy reforms on economic structure, poverty and food security.

Developing countries are heterogeneous, so there is limited value in trying to summarise or assess the impacts of the CAP on them as a group. Poverty and food security will be affected differently by the CAP and CAP reform depending on, for example, whether a country is a net exporter or importer of products supported by the CAP, the commodity composition of its exports and imports, the nature of its trade relationship with the EU, the structure of its agriculture sector, its distribution of income and the urban–rural breakdown of its poor. A country-specific analysis is thus necessary in order to develop a better understanding of how the CAP affects developing countries.[4]

The CAP has been reformed in a more market-oriented direction in successive stages over the past 20 years (Cantore et al., 2011; OECD, 2011). The major milestones have been the MacSharry reform in 1992, which lowered market price supports but continued to assist farmers through partially coupled direct payments; the Agenda 2000 reform in 1999, which continued this process as part of preparing the EU for further enlargement to include the new member states of Central and Eastern Europe; the 2003 Luxembourg Mid-term Review reform. which transferred support from products to producers by largely decoupling direct payments; and the 2008 Health Check, which further reduced the extent of coupled payments and increased the transfer of resources from Pillar 1 of the CAP (concerned with market price and income support) to Pillar 2 (concerned with structural adjustment, land management and rural development measures). Despite these reforms, EU agriculture still features extensive protection (WTO, 2011b) although this is now lower than before.

[2] For a small selection of NGO studies, see ActionAid (2011a; 2011b), Aprodev (2010), Bertow and Schultheis (2007), CONCORD (2011), Fritz (2011), Oxfam (2004).

[3] Adenäuer and Kuiper (2009), Costa et al. (2009), Gohin (2009), Gouel et al. (2008), Nowicki et al. (2009).

[4] Annex 12 of the impact assessment published together with the European Commission (EC)'s legislative proposals for the CAP post-2013, which addressed the relationship between the CAP and development, noted that 'impacts should be assessed on a case by case basis, as the economic, social, cultural and demographic heterogeneity among and within developing countries, as well as the multitude of factors that affect food security policies and situations in the short-, medium- and long-term, make generalisations difficult. The assumption of direct price transmission mechanisms calls for a methodological approach that combines aggregate/national with household level data' (EC, 2011d: 4).

In addition, the EU has pursued a series of bilateral and regional free trade agreements (FTAs) since the publication of its Global Europe strategy in 2006 (EC, 2006). Apart from bilateral FTAs with other European countries, the EU has FTAs in force with, Algeria, states of the Caribbean Forum (CARIFORUM), Chile, Egypt, Israel, Jordan, Lebanon, Mexico, Morocco, the Palestinian Authority, South Africa and Tunisia (WTO, 2011b). FTAs have been concluded with Korea, as well as Peru, Colombia and Central America. Talks with the Gulf countries, India, Canada and Singapore are at an advanced stage, while negotiations with the Common Market of the South (Mercosur) region have been reopened. If all these ongoing negotiations are concluded successfully, about half of the EU's external trade would be covered by FTAs (EC, 2010a). Agricultural trade liberalisation is often limited in these agreements, but they do lead to some additional market opening, albeit on a discriminatory basis.

During 2012 and 2013, the EU is preparing its multiannual financial framework (MFF) for the period 2014-2020. The EC proposed that the overall EU budget (in commitment appropriations) would increase slightly in real terms, by just over 3%. Within this total, it proposed a small increase in nominal terms but a small decrease in real terms in the CAP budget for the period 2014–2020, so that the share of the CAP in the EU budget would fall from 39% in 2013 to 33% in 2020 (EC, 2011a). The MFF becomes a legally binding act only after a special legislative procedure requiring its adoption by unanimity by the Council, after obtaining the consent of the Parliament by a majority of its members. These negotiations are difficult, not least because public budgets are under severe pressure in most member states. Thus, whether the budget for EU agricultural policy will be maintained at its current level in the next MFF period is not yet known.

The CAP regulations are again under review in parallel with these negotiations on the 2014–2020 MFF which will determine the overall size of the total CAP budget in the next MFF. Following a Communication from the EC in November 2010 that set out a number of options for the further evolution of the CAP (EC, 2010a), in October 2011 the EC published its legislative proposals for the main CAP regulations for the period 2014–2020 (EC, 2011b). The main themes in these proposals were convergence, targeting and greening. A move towards a more even level of payments per hectare across member states, by shifting payments to member states (mainly the new ones) with lower average payments per hectare, is suggested, as is a move towards uniform per hectare payments within countries or regions, to replace the prevailing distribution of payments to farmers based on the historical payments introduced in the MacSharry 1992 reform. Greater targeting of direct payments to young farmers, active farmers and farms in areas with natural and specific constraints, as well as capping of payments to individual farmers, is envisaged. The proposals also suggest tying a proportion of direct payments paid to farmers to compliance with a number of management measures designed to lead to environmental improvements. All these measures aim to legitimise and justify continued budgetary transfers to EU farmers in the coming budget period and beyond. The European Council and European Parliament are now debating these proposals with a view to their adoption by 1 January 2014.

While reforms have been in a liberalising and market-oriented direction during the past two decades, a reversal of this trend cannot be excluded. Member states still call for the reintroduction of export subsidies when farm sectors face difficulty.[5] Despite higher product prices in recent years, EU farm incomes are under pressure as a result of even higher increases in input costs. Price volatility in the EU is increasing as the reforms have linked EU market prices more closely to world market prices. Greater economic insecurity within the EU is linked to growing concerns about food insecurity and support for increased EU production to reduce dependence on imports (Matthews, 2012).

Proposed and possible changes to the CAP could affect developing countries in different ways. This study uses a modelling methodology to examine how CAP reforms might affect Uganda, divided into three steps. First, it assesses the world price impacts of CAP reforms. Second, it

[5] For example, in April 2012, the Polish Minister of Agriculture, supported by Spain, Portugal, Hungary, Lithuania and Latvia, requested the EC introduce export refunds and increase intervention prices for dairy commodities (USDA, 2012).

evaluates the national price-level effects, taking into account the degree of transmission between world market prices and national prices. Third, it calculates the impact of changes in national prices on household welfare and poverty. In this stage, the response of the Ugandan government in light of the altered national economic situation could have an independent impact on poverty outcomes. The simulations are designed to minimise the impact of such second-round responses as much as possible in order to focus on the initial poverty impact of changed world prices as a result of CAP reform. In addition to presenting the results for Uganda, the study illustrates the advantages and disadvantages of this methodological approach as a way of providing relevant guidance to developing country policymakers on how CAP reforms might affect their country.

1.2 Uganda as the focus country

Uganda has been selected as the focus country because of the availability of a Ugandan simulation model, developed by the authors, which allows to calculate the impact of world market price changes on economic welfare, the allocation of resources within Uganda, consumption and poverty.

There are advantages and disadvantages in this choice. Uganda is classified as a least-developed country (LDC) (nominal per capita income of $500 in 2010) and has a high, if declining, share of its population living in poverty. It is thus representative of countries that are intended to be the focus of EU development aid. The Ugandan economy showed increasing economic growth over the 1980–2009 period; beginning in the 1980s, with an average annual growth rate of 2.6%, the economy accelerated to a 6.9% average annual growth rate in the 1990s and a 7.2% growth rate in the 2000s. Growth in its agricultural gross domestic product (GDP) was more volatile during the 1980–2009 period, showing an average annual rate of 2.3% (ReSAKKS, 2012).

Uganda has heavy dependence on agriculture. The sector employed 66% of the labour force and accounted for 24% of total GDP in 2010. Agricultural exports accounted for 61% of total exports in 2010 (WTO, 2011a), and much of the industrial activity in the country is agro-based. However, most of Uganda's main food staples (plantains, beans and cassava) are not widely traded, and the EU CAP does not affect its main agricultural exports (coffee, tea, tobacco and cotton) significantly. As an LDC, and having initialled the interim EU–East African Community (EAC) Economic Partnership Agreement (EPA), it receives duty-free access for all of its exports to the EU.

The impressive GDP growth performance in recent years has contributed to a significant reduction in poverty levels. Uganda is very close to meeting both its Millennium Development Goal (MDG) poverty and hunger targets (ReSAKSS, 2012). The percentage of the population living below the poverty line declined from 56% in 1992/93 to 44% in 1997/98, and further to 25% in 2009. The country's National Development Plan (NDP) projects that the national poverty rate of 31% in 2005/06 will decline to about 24.5% in 2014/15, below its MDG target of 28% (Government of Uganda, 2010).

Likewise, some malnutrition estimates show Uganda falling just 1.4 percentage points short of its 2005 target rate for nutrition. The country's average caloric intake per person per day improved from 1,494 in 1992 to 2,193 in 1999, but declined to 2,066 in 2002 and to 1,971 in 2005. The average intake is less than the World Health Organization (WHO) recommended daily intake of 2,300 calories per adult per day (Government of Uganda, 2010).

Given these policy and structural characteristics, CAP reform is unlikely to have major impacts, either positive or negative, on the Ugandan economy. However, our methodology illustrates the steps involved, and the data required, to investigate the impact of the CAP on a developing country. Studies of this kind could be replicated in other developing countries where the relevant data are available.

1.3 Structure of the report

Section 2 of this report identifies three illustrative scenarios for future CAP reform and other policies affecting EU agriculture, and discusses the derivation of the associated world market price shocks. Two of the scenarios focus on agricultural policy reforms: implementation of the EC's legislative proposals for the CAP after 2013, as announced in October 2011, and a benchmark scenario of full CAP liberalisation. In addition, a biofuels scenario is included to capture the impact of increased competition for land resources both in Europe and outside as a result of the EU's mandatory renewable energy targets. Given limited resources for this study, world market price changes in these scenarios are derived from previously published studies rather than being independently estimated. Various caveats and limitations of the price changes assumed are discussed. The importance of capturing correctly the extent of price transmission from the world market price to the border price and subsequently within country is emphasised, although this is taken into account only partially in the results reported here.

Section 3 investigates the projected impact of these world market price changes using a single country computable general equilibrium (CGE) model of the Ugandan economy integrated with a micro-simulation model of Ugandan households to derive estimates of the overall welfare implications as well as the poverty and food security effects. The simulations show that, on balance, further unilateral CAP reform would have very small overall effects on Uganda in terms of its GDP, poverty rates and food security, and that whether these effects are positive or negative depends on the scenario of reform and the population groups of interest. Tracking the effects of these world price changes gives a better understanding of how changes in EU agriculture and agricultural policy affect households in a developing country.

Section 4 summarises the steps in the modelling approach and identifies possible improvements that could be made in the modelling framework to monitor the impact of the CAP on developing countries.

2. CAP reform scenarios

The three scenarios are:

1 A 'CAP2020' scenario representing the impact of the EC's post-2013 legislative proposals published in October 2011 (EC, 2011a). The proposals would result in a redistribution of direct payments within and among member states, and direct payments would be linked more closely to the production of environmental public goods. Farmers would face additional 'greening' conditions for eligibility to receive a proportion (30%) of these payments.
2 A 'liberalisation' scenario, in which all CAP as well as other agricultural policy instruments, including export subsidies, import tariffs, domestic support and production quotas, are eliminated. Full elimination of the CAP is not a politically relevant proposal at the current time, but modelling its elimination provides a benchmark to measure its total impact on developing countries.
3 A 'biofuels' scenario, in which the EU is assumed to meet its 2020 target for the incorporation of renewables in transport fuels. Strictly speaking, this scenario does not depend on changes in EU agricultural policy. However, biofuels compete for land and feedstock with food commodities, and thus have the opposite effects on world market prices from the CAP. Thus, it is an important scenario in terms of exploring the development impacts of non-agricultural policies that affect the EU farm sector.[6]

An eclectic and synthetic approach drawing on the existing literature is adopted to estimate the world price impacts in the three scenarios. We review likely impacts on EU production, demand and net trade of each of the three scenarios, and select or synthesise world market price changes based on this literature review. The estimates themselves are contained in Table 3 at the end of this section.

2.1. Empirical modelling of the CAP

The empirical literature specifically examining the impact of the CAP on world market prices is surprisingly limited and rather dated in light of recent changes in levels of EU agricultural protection and support (OECD, 2011). There are also significant differences in the results different studies report. Empirical results differ because of differences in model assumptions, scenarios and data.

Different types of models can be employed to study the effects of changes in EU agricultural policy. When examining a single commodity or group of commodities, researchers often use partial equilibrium (PE) models. The analysis is conducted assuming that the commodity sector operates in isolation from other sectors of the economy (the *ceteris paribus* assumption). CGE models examine the economy as a whole, taking into account the inter-linkages between different sectors. They have the further advantage that the simulation outcomes are required to observe standard accounting identities (income/expenditure and resource constraints). In principle, results from a general equilibrium analysis will differ significantly from a PE analysis only if the modelled scenario change leads to significant price changes in other sectors. In the case of agricultural policy, this is more likely to be true for multilateral trade liberalisation and in situations where the agriculture sector is large relative to the rest of the economy. In practice, global price changes found in simulations using CGE models tend to be smaller than those observed using PE modelling of similar policy changes.

Within the set of studies using CGE modelling, results can differ because of differences in the values of the behavioural parameters they assume. Behavioural parameters in CGE models include the degree of substitutability between domestic and imported goods, between domestic and exported goods, among factors of production and possibly intermediate inputs, income and price responses of demand and the mobility assumed between factors in alternative uses. These values determine the supply and demand responses to changes in relative prices. Where resources are very mobile, there will be stronger resource reallocation away from other industries into farming when agricultural prices increase. Where an input is either less mobile or in fixed supply, such as agricultural land, any potential aggregate supply response will be lowered, depending on the degree of substitutability of this input with other inputs.

[6] This scenario also takes account of US renewable energy mandates.

CGE models differ in their theoretical assumptions and their closure rules. Closure rules determine how the three macroeconomic balances (government balance, current account balance and savings-investment balance) are achieved and different assumptions will give different results. CGE models also differ as to whether they are static or dynamic (allowing for capital accumulation over time), how their factor markets (such as land and labour) are formulated (with fixed supply or fixed returns or some more sophisticated model), whether they assume perfect or imperfect competition in markets, and in the aggregation of commodities and regions they adopt.

Model results also differ because they model different scenarios. Whether CAP reform is evaluated assuming a unilateral liberalisation, or as part of a multilateral liberalisation, will affect the production and trade responses. Another reason for differences between studies is the extent to which they fully model all the CAP instruments. Some models take into account changes in CAP Pillar 2 instruments; other models leave them out. The basic Global Trade Analysis Project (GTAP) model (Hertel, 1997), for example, does not take account of milk and sugar quotas or set-aside of arable land. Simulations that ignore the existence of these production constraints in the base period when simulating the impact of 'no CAP' will overestimate the impact of the CAP on these markets.

An important issue in modelling CAP reforms is the treatment of the production effects of decoupled payments.[7] In some PE studies, a specific coupling factor is assumed. In general equilibrium models, the degree of coupling is determined by how payments are introduced into the model. If payments are modelled as paid directly to households, they are fully decoupled. More often, they are modelled as payments linked to land or even other factors of production. Because the payments favour agriculture sectors relative to manufacturing and services sectors, the resulting increase in farm income pulls more production factors into the agriculture sector and leads to a higher level of output (also, agriculture sectors that are more land-intensive will benefit at the expense of other agriculture sectors). If the payments are also linked to the use of capital and labour in agriculture, the coupling factor is even greater. Given the importance of decoupled payments in EU agriculture, the way decoupled payments are modelled is an important determinant of the production impacts of their removal.

Empirical studies of agricultural policy liberalisation are calibrated to a base year, and the measured impact of the CAP is sensitive to the level of CAP protection in that year. A widely used database for CGE liberalisation studies is the GTAP database, which is updated at three-year intervals (Hertel, 1997). Recent empirical studies of CAP reform most often use the GTAP 7 database calibrated to the year 2004. The CAP has undergone reforms since those years: global food prices have increased substantially, narrowing the gap with EU producer prices. The results of removing the level of CAP protection in 2012 or 2015 will thus not be the same as that calculated from the elimination of the CAP in 2004.

2.2. The EC's 2011 legislative proposals

This section reviews the limited empirical evidence to date on the likely impact of these proposals on world markets.

2.2.1 Market effects of the EC proposals

Market measures include the elimination of milk and sugar quotas, the maintenance of safety net interventions and changes in competition law to strengthen the bargaining position of milk

[7] The impact of decoupled payments on production has been explored in the literature using both theoretical and empirical models. The theoretical literature acknowledges that decoupled farm payments affect farm production through wealth effects leading to higher investment and changes in attitude to risk; through their impact on farm structural change; by reducing the need for off-farm work; through the impact of their capitalisation into land values; through expectations about future programme eligibility and the basis for future payments; and through conditional requirements on the receipt of the payments, such as cross compliance requirements. Much of the empirical work has been undertaken in the US, which has had longer experience with the use of decoupled payments, and is not necessarily transferable to the EU context.

producers in the dairy supply chain. Proposed changes in the design of direct payments relate to the overall budget for these payments, redistribution across member states and between farmers, introduction of the greening component, targeting of a proportion of these payments at young farmers, small farmers and farmers in areas of natural disadvantage and the extent to which payments can be coupled or not.

On balance, the proposals will reduce EU production capacity at least in arable crops relative to continuation of the current policy. Implementation of measures associated with the green payment could increase the costs of farming in the EU in the short term, either directly or in the form of loss of income from this subsidy. The requirement to maintain permanent pasture at existing levels on individual farms might restrict the ability of EU farmers to plant more arable crops if world prices remain high. The introduction of ecological focus areas at a rate of 7% of the arable area would halt production on at least some of this land. The requirement to diversify crops on a farm basis would adversely affect the short-term profitability of arable farming. These measures might reduce supply and increase market prices. In the longer term, there may be positive feedback from more sustainable agricultural practices in terms of higher yields, but the likely importance of this is hard to quantify. One estimate is that the cost of greening measures would be equivalent to an increase in average input costs by a little over 2% (Matthews, 2011).

The requirements to move towards greater equality in the allocation of direct payments across member states and towards a regional flat-rate model in those member states which currently use the historic model of entitlements will reduce support in more productive countries, regions and sectors in favour of more marginal regions. Depending on the assumed magnitude of the production effect of direct payments, this redistribution will tend to lower production levels in the more productive farming areas of the EU. Recent studies support this intuition but suggest that the effects will be marginal, in most cases less than 1–2% (Erjavec et al., 2011; Gocht et al., 2011). The general message from these studies is that the production (and thus trade) effects of the flattening of direct payment rates are likely to be small, but somewhat larger for cereals than for livestock. However, the distributional effects across and within countries could be significant. Overall, studies support the view that the EU's direct payments are rather decoupled in practice (Matthews, 2011).

Some elements in the proposals would offset these production-lowering effects. There will still be scope to couple direct payments to production, no longer limited to suckler cows, sheep/ goats and cotton. Production of commodities supported in this way will be higher than it would otherwise. The proposals allow member states to use up to 5% of their national ceilings for direct payments expenditure to provide coupled support under specific conditions, and this can be increased with the agreement of the EC if further conditions are met. Coupled payments have significant impacts on production and therefore trade, but the overall impact of the EC proposal must be evaluated against the scope for coupled payments under the existing CAP regulations. Around 6–7% of the EU's current direct payments are coupled, and the EC proposals do not suggest this percentage will be greatly changed post-2013. The general overall limit of 5% of total direct payments to be coupled would suggest that the intention is to keep the share of coupled payments in check.[8] Payments can be used to maintain production but not to increase it. A higher share of payments can be coupled, but only for those member states that already implement these higher shares. While the scope for coupled payments is extended, it is likely they will continue to be used mainly in the beef and sheep/goats sectors. The implication is that production of these commodities will be maintained at higher levels than would be the case if coupled payments were eliminated after 2013, but the coupling proposals do not provide an incentive to increase production over and above the policies already in place.

Quotas on milk and sugar production will be removed after 2015 (but, as the arable area cannot be increased, any expansion of sugar beet production would be at the expense of other arable crops). There is also a greater emphasis in Pillar 2 on innovation, especially the proposed European

[8] The Annex to the EC's November 2010 Communication (EC, 2010a) notes that this would be equivalent to today's coupled support paid through Article 68 and other coupled aid measures.

Innovation Partnership for Agricultural Productivity and Sustainability, as well as additional resources for agricultural research. Greater emphasis on environmental public goods could lead to longer-term improvements in agricultural productivity as a result of the adoption of more sustainable farming methods (e.g. by helping to improve soil quality, increasing the availability of pollinators or increasing resilience to climate change). On balance, the greater priority given to achieving the delivery of environmental public goods if the EC's proposals were adopted would mean that EU near-term production potential would be lower than it otherwise would be.

2.2.2 World price effects of the CAP2020 scenario

The EC's proposals were accompanied by a detailed impact assessment of their likely effects on supply, producer prices and farm incomes across the EU, but this did not examine potential impacts on world markets. To get a sense of the size of world market impacts, use is made of a PBL (2011) study and the market simulations contained in the accompanying report by Helming and Terluin (2011), collectively referred to as the PHT study. This was completed following the publication of the EC's Communication on the CAP towards 2020 (EC, 2010b), which set out three main options for the future reform of the CAP. The simulations in the PHT study relate to scenarios similar to those contained in the EC's legislative proposals, but with some differences (Box 1 details the assumptions in the PHT modelling). In the absence of published work to date on the world market impacts of the measures contained in the EC's 2011 package, the results of the PHT study are used to give guidance on these effects.

The PHT study makes use of the Common Agricultural Policy Regional Impact (CAPRI) model. CAPRI is an EU-27 PE model for the agriculture sector at different levels of aggregation. In modelling supply, the basic units are regional farms corresponding to the NUTS2[9] regions in the EU. This means that the results of the PHT modelling with CAPRI do not include the impact of a switch from historical to flat-rate payments within regions on production and income.

The study models two CAP scenarios: a baseline and a CAP2020 scenario. The baseline scenario assumes a continuation of the present CAP beyond 2013. The CAP2020 scenario builds on the policy options outlined in the EC Communication. It includes some convergence in the value of direct payments per hectare across regions as well as greening measures.[10] The results are presented in terms of differences in 2020 compared with the baseline scenario.

Box 1: Description of scenarios in the PHT study

The PHT study explores the potential impacts of a CAP2020 scenario compared with a reference (baseline) scenario. The total CAP budget is the same in both scenarios and is assumed to average €59 billion per year (including phasing-in of subsidies for the new member states) over 2014-2020.

The baseline scenario extrapolates past and present trends towards 2020. Price developments are taken from outlook studies such as the Organisation for Economic Co-operation and Development/Food and Agricultural Organization (OECD/FAO) agricultural outlook. The CAP according to the baseline scenario beyond 2014 is similar to that of pre-2014 and includes policy changes approved in the 2008 Health Check agreement involving the full decoupling of income support from farm production and the abolition of the milk quota system by 2015. In addition, the introduction of a regional flat rate (premium per hectare) is considered part of the baseline scenario.

For the CAP2020 scenario, the budget is divided over the three elements of Option 2 of the EC's 2010 proposal, that is, basic income support, greening measures and payments for farms in areas with natural constraints. The CAP2020 scenario consists of six measures in all:

- A reduction in disparities between direct payments in the EU-15 and EU-12 member states modelled by reducing the Pillar 1 budget in the EU-15 by 5% and adding this budget to Pillar 1 payments in the new member states (leading to an increase in the Pillar 1 budget in the EU-12 of 20%);
- Addressing the new challenges named in the Health Check modelled by shifting 5% of the Pillar 1 budget in the EU-15 member states towards agri-environmental measures in Pillar 2 (e.g. Pillar 2, Axis 2, Measure 214) without

[9] NUTS is the Nomenclature of Territorial Units for Statistics.

[10] The Helming and Terluin (2011) study also describes a 'moderate shift' scenario, which mainly concerns the convergence of payments across member states and some further extensification measures in Pillar 2, but these measures are included in the CAP2020 scenario.

national co-financing;

- A maximum payment granted for permanent grassland of €100 per hectare modelled as a coupled payment (this proxies the restriction that permanent pasture cannot be reduced);
- A maximum payment for arable land also of €100 per hectare, on the precondition of 5% ecological fallow for the benefit of biodiversity (crop diversification requirements are not modelled). The maximum budget for permanent grassland and arable land measures together is 30% of the Pillar 1 budget per member state;
- A payment granted to areas with natural constraints subject to a maximum of €150 per hectare; maximum budget is 30% of the member state's budget; payments are allocated to less-favoured areas until the budget is exhausted or farmers in all such areas have received the maximum payment; current such payments from Pillar 2 remain in place, thus new payments for natural constraints add to the existing Pillar 2 payments;
- The remaining budget used for a basic-rate income support (minimum of 40% of the Pillar 1 budget, resulting from the above).

Source: PBL (2011).

EU agricultural production is lower under the CAP2020 scenario compared with the baseline scenario mainly because of extensification of grassland use (agri-environmental measures in the EU-15) and ecological set-aside on arable land. This leads to extra imports (in particular of oil seeds) and fewer exports (in particular of cereals). All EU cereals production is projected to fall by 4% and grass production by 2%, the latter particularly affecting beef production.

Higher EU-27 imports and lower exports of most agricultural products result in higher world prices, leading to increased agricultural production in the rest of the world. The effects of the CAP2020 scenario on average producer prices of agricultural products in the rest of the world are limited, however. This is explained by the rather limited production effects and the size of own production in relation to imports and exports in the rest of the world. In Helming and Terluin (2011), the quoted effects on global producer prices range from about +1.5% for cereals and oilseeds, +0.6% for meat and +0.4% for dairy products, as compared with prices in 2020 in the baseline. In the more complete PBL study, the global price increases are somewhat lower, at 1.5%, 0.4% and 0.25%, respectively.

The study's authors believe there may be some sources of upward bias in their estimate of the world market effects. They note that their EU supply effects could be overestimated, as it is assumed that yield losses on ecological set-aside equal average yields, whereas in actual practice farmers would set aside their least productive land. They also note that the shares of the EU-27 in global imports and exports in 2020 in their baseline scenario are in general much higher than the average in the period 2008–2010. They note that import and export figures in 2020 in the baseline scenario might be overestimated and, as a result, the effects of the different scenarios on world markets might also be slightly overestimated. For these reasons, the lower figures given in the PBL (2011) study are used for the estimated world market effects of the CAP2020 proposals (see Table 3).

2.2.3 Sugar

The PHT study does not take account of the elimination of sugar quotas in either its baseline scenario or its CAP2020 scenario. Thus, the projected impact of eliminating sugar quotas should be added to the PHT results.

In its impact assessment of the single Common Market Organisation (CMO) regulation, the EC projects a rather benign scenario (EC, 2011c). In the baseline, with quotas remaining in place, EU sugar production (including out-of-quota production) would remain unchanged in 2019/20 compared with 2009/10. EU white sugar prices would be supported at the reference level (€404/t) and world prices are projected to fall back from the high levels experienced in 2009/10 (€313/t in 2019/20 compared with €450/t in 2009/10). The no-quota scenario assumes quotas and support prices are abolished with effect from 2016/17, that is, one year later than what the EC now proposes. In its modelling of the impact of quota abolition, the EC compares the projected situation on the EU and world markets in 2019/20 without quota to the baseline scenario with quota.

Limited impacts are foreseen. The sugar beet area is projected to be around 2% higher but yields will be lower owing to lower beet producer prices (which would fall below the current reference price). White sugar production is expected to be 1.7% higher but, with consumption also higher because of the lower prices, little impact on the EU's net trade position is expected. Total gross imports are projected to fall by almost 5% and imports from Everything But Arms (EBA) (least-developed) countries and EPA (African, Caribbean and Pacific) countries would fall by almost 7%. World market prices would be virtually unaffected in this analysis (a fall of 0.2% given the limited transmission between EU and world market prices as a result of the trade regime).

Nolte et al. (2011) project more significant impacts from quota abolition. They compare likely EU production and prices in 2019/20 with quota abolition in 2014/15 under different world price regimes. In their reference scenario, world sugar prices in 2019/20 are very similar to those in the EC's study (€362/t in 2019/20 prices, €297/t in 2009/10 prices) and are taken from the 2010 edition of the OECD/FAO Agricultural Outlook (OECD and FAO, 2010).[11] EU white sugar production is projected to increase to 15.5 million tonnes (excluding out-of-quota sugar) in the non-quota scenario compared with 13.3 million tonnes in the baseline scenario with quotas maintained, or an expansion of +17%. EU domestic prices would fall by 26% to below the EU reference price. If world prices were lower than projected, the expansion in EU production would also be smaller, whereas if world prices were higher than projected in the baseline scenario (€416/t in 2019/20 prices, €341/t in 2009/10 prices), EU production would increase sufficiently to turn the EU into a net exporter again. However, in spite of the greater changes foreseen on the internal EU market compared with in the EC's impact assessment, the world market impacts of sugar quota abolition in the Nolte et al. study are also small, at -0.7% in the low world market price scenario, -1.7% in the standard world market price scenario and -3.5% in the high world market price scenario. Taking both studies into account, a figure of -1.7% is adopted for the Uganda simulations (See Table 3).

2.3. Full liberalisation of the CAP

This scenario is intended to assess the impact that EU agricultural policy has on world market prices, as measured by the elimination of the CAP. To obtain the world price shock to apply to Uganda in the case of full liberalisation, a number of recent studies of CAP liberalisation are reviewed. Studies that report the impact of CAP liberalisation on production and farm income within the EU but do not report world market price effects are discussed briefly because they provide some context in which the specific world market price impacts chosen to represent the impact of CAP liberalisation on Uganda can be evaluated.

2.3.1. The Scenar 2020-II study

The objective of the Scenar 2020-II study (Nowicki et al., 2009) was to refine and add to the identification of major future trends and driving factors for European agriculture and rural regions provided by the initial Scenar 2020 study (Nowicki et al., 2006). Two scenarios are modelled. The first is a 'reference' scenario, which assumes that the policies applied currently are carried forward in the time period of the study. It assumes a 20% reduction of CAP budget in real terms, full implementation of the Single Payment Scheme (SPS) as of 2013, full decoupling, the elimination of milk quotas, a 30% decrease in direct payments in nominal terms and a 105% increase of the European Agricultural Fund for Rural Development (EAFRD). A Doha Round agreement based on the December 2008 Falconer paper is assumed in which various livestock products are given sensitive status.

The second scenario is a 'liberalisation' scenario, in which all trade-related measures are discontinued. The CAP budget is reduced by 75% in real terms, all direct payments and market instruments are removed and there is a similar increase of EAFRD to that in the reference

[11] The model used by Nolte et al. is driven by real (2004/05) rather than nominal prices, but in reporting their results the authors convert all prices into nominal euro values in 2019/20 using an average compounded inflation rate of 1.7%. To facilitate comparisons with the price assumptions used in the EC study, their nominal prices are deflated by 18% (1.7% compounded over 10 years) to derive prices in approximate 2009/10 money terms.

scenario.[12] This scenario also assumes full liberalisation of agricultural policy in other countries. This helps to attenuate the effect of CAP liberalisation on EU agriculture, as does the limited amount of reform in the reference scenario. A biofuel target of 10% in 2020 as set out in the EU Renewable Energy Directive is incorporated in both scenarios.[13]

The modelling work employed a CGE (LEITAP) model and PE (ESIM, CAPRI) models. LEITAP is a modified version of the global general equilibrium GTAP model, with particular attention paid to the substitutability of land between different uses. The model can also address biofuels and rural development policies. The ESIM and CAPRI models are EU-27 PE models for the agriculture sector at country and NUTS2 levels, respectively, with a strong focus on the CAP. Results from the models are linked by harmonising scenarios and ensuring consistency between a selected number of model results and parameters.

In the reference scenario, agricultural output increases by just 4% over the 13 years 2007-2020. Under the liberalisation scenario, the increase in output would fall to 3% over the same period (Nowicki et al., 2009, derived from Figure 3.12). Stronger effects are found for livestock products. Under the reference scenario, the volume of production of total livestock increases by 4% between 2007 and 2020 for the EU-27, but under the liberalisation scenario it decreases by 6%. Growth of the main field crops (grains, oilseeds, sugar) would be 13% in the reference scenario but 3% in the liberalisation scenario, largely because of a smaller boost from the biofuels directive as border support is abolished (derived from Figure 3.14).[14]

LEITAP results are reported only for crop and livestock aggregates. Individual commodity projections made with ESIM are deemed to be fairly consistent with the LEITAP results. For example, ESIM shows a similar if rather bigger swing in livestock production (projected growth of 4% in the reference scenario but a reduction of 6% for the EU-27 over the period 2007-2010 in the liberalisation scenario). Liberalisation would lead to some significant price reductions in the EU compared with the reference scenario. Price changes range from more than -33% for beef, -18% for rice and -17% for sheep to about -1% for milk and eggs.

EU cereal production would fall relative to the reference scenario as a result of liberalisation, mainly because of the withdrawal of decoupled payments and the complete abolition of trade policy measures. Coarse grain would show the largest decline relative to the reference scenario owing to the remaining protection through import tariffs, which are reduced only partly in the reference scenario. Liberalisation does not affect oilseed production. Declining beef prices would lead under liberalisation to a strong decline in beef production by more than 30% (Figure 3.18). EU-27 poultry production would be 7% lower and pork production 3% lower than under the reference scenario.

CAP liberalisation would thus reduce the levels of agricultural production in the EU, with a greater impact on livestock products, according to the Scenar-II study. The land and (to a lesser extent) the segmented labour markets help in keeping production levels up as they absorb the negative impact of liberalisation through a decline in land prices and a lower growth rate of agricultural wages. These two factors contribute to keeping European agriculture competitive, along with the expected increase in productivity.

[12] The Scenar-II study also examines the implications of a third scenario, labelled the 'conservative CAP' scenario, in which Pillar 1 direct payments are increased relative to the reference scenario and Pillar 2 payments are significantly reduced (by 45%) to maintain the overall CAP budget constant.

[13] This target was later modified to include all renewable fuels and not just biofuels.

[14] In a separate paper (Prins et al., 2011), the LEITAP model is also used to project a CAP liberalisation scenario in 2030 compared with a baseline in which CAP policy instruments as in 2000 are maintained. LEITAP projects a continuing strong decline in real world market prices in the baseline (2030 relative to 2000) as follows: beef -26%, temperate cereals -24%, sugar -14%, maize -25% and oil crops -17%. However, the impacts of a CAP liberalisation (gradual removal of price support by 2030, full decoupling in 2003 and gradual removal of domestic support by 2030, abolition of production quotas and of set-aside) are very minor. Despite very significant reductions in EU production (figures for EU-15: beef: -22%; temperate cereals -14%; sugar -158%; maize -17%; oil crops -20%), world market prices are hardly affected and are even projected to decrease in the case of sugar, despite the large increase in EU imports (estimated price effects are beef: +2%; temperate cereals +2%; sugar -4%; maize +3%; oil crops +2%, see Figure 4 in the original).

2.3.2. The ABARE 2009 study

Costa et al. (2009) is a GTAP application using version 7 of the GTAP database, which has a base year of 2004. The standard GTAP model is used, so a number of specific elements of the CAP are omitted. Direct payments are treated as partially coupled. The largest share of payments in the crop sectors is allocated as land-based payments, and the largest share in the livestock sectors as capital-based payments. Land and capital subsidies to the livestock sectors (including cattle, sheep, goats and raw milk) are not equalised. The database models decoupling for the crop sectors only. The authors argue that this is consistent with payments to livestock remaining more coupled than those to crops following the move to decoupling from 2005 in the Luxembourg Mid-term Review reform (20% of direct payments in the EU remain coupled to production in their 2007 base year). While direct payment rates are updated to 2007, the border tariff and export subsidy rates are held constant at their 2004 values in the database.

Table 1 summarises the effects of the CAP for countries both inside and outside the EU. According to the modelling results, the CAP leads to higher output of the farm and food processing sectors in the EU, by about 8% and 6%, respectively, but lower output of the EU manufacturing and services sectors. The additional farm and food output in the EU is estimated to depress world prices for these goods by between 1% and 4%, while world prices for manufactured goods and services increase. These price movements induce a contraction in agriculture and food processing in non-EU regions, and an expansion in the manufacturing and services sectors. Some of the largest contractions occur in the livestock sectors in Latin America (12.7%) and Australia/New Zealand (4.9%) and in the food processing sectors in most regions.

Table 1: Effects of CAP liberalisation on economic activity and welfare (%)

	Crops	Livestock	Food processing	GDP	Welfare
World price changes	2.08	3.91	0.83		
	Sectoral output changes				
EU-15	-8.09	-7.64	-6.02	0.44	0.16
EU-12	-1.97	-0.64	-5.61	0.30	0.32
Australia/New Zealand	0.49	4.89	4.30	..	0.19
East Asia	0.96	0.39	1.10	-0.01	-0.03
Rest of Asia	0.23	1.07	0.02	-0.03	0.10
North America	2.30	1.50	1.07	-0.01	0.03
Latin America	2.78	12.70	4.51	-0.06	0.26
Africa	0.81	2.93	6.13	-0.01	0.05
Rest of Europe	1.95	1.94	5.90	-0.09	0.06

Note: The figures in the original study are presented as the effects of the CAP rather than of CAP liberalisation, and the signs have been reversed in this table.

Source: Costa et al. (2009).

According to Costa et al., the CAP results in net welfare costs to the EU itself of about $30 billion. In most regions outside the EU, welfare is also lower and would be higher with CAP liberalisation (East Asia is the exception). Changes in welfare can be decomposed into changes in income associated with changes in efficiency (through changes in GDP when the resources of an economy are held fixed) and changes in the trade surplus. In non-EU regions, CAP liberalisation brings about a small decrease in allocative efficiency but a much larger welfare gain through the positive effect on their terms of trade. For the world as a whole, CAP liberalisation leads gross output (and welfare) to increase by 0.08%, or $45 billion.

2.3.3. Gohin 2009

Gohin (2009) uses a CGE model of the EU-15 to determine the effect of the CAP on world prices. His model disaggregates the agri-food sector (32 primary agricultural commodities, 30 food commodities and 10 animal feedstuffs, with the rest of manufacturing and services included as two further sectors). The model is open to trade with the rest of the world, which is modelled in a reduced form fashion using export supply and import demand functions for two regions, the EU-12 and the rest of the world. This approach implicitly assumes that demand and supply outside the EU-15 is exogenous (i.e., not influenced by what happens within the EU-15), but it does allow for capturing the influence of changes in EU-15 net trade on world market prices.

The model is calibrated to a 2005 social accounting matrix (SAM) for the EU-15, but the simulations are conducted against a baseline in 2015 that takes account of the CAP Luxembourg reforms (decoupling of direct payments) but assumes no agreement on further World Trade Organization (WTO) trade liberalisation. A 'normal' level of world market prices is assumed. The model takes explicit account of EU biofuel targets for 2015 which, in the baseline, are met partly from domestic production, given high tariffs on imported bioethanol.

The simulation assumes the complete elimination of CAP and other agricultural policy instruments in 2015, including export subsidies, import tariffs, tariff rate quotas, the special safeguard mechanism, internal consumption subsidies, production quotas, direct payments and Pillar 2 payments. Direct payments are assumed partially coupled to production based on the results from a literature survey of decoupling effects. Pillar 2 payments are modelled as direct subsidies to labour and capital. The main results are reported assuming perfect competition and thus perfect transmission of price changes prevails in the agri-food supply chain, and the sensitivity of the results to this assumption is assessed.

Gohin finds significant world market price effects from this simulation of the elimination of the CAP, particular on world beef, maize and bioethanol markets (see Table 2). World market prices increase, except in the case of wheat. Although production of wheat decreases in the EU-15, demand falls by even more, resulting in an increase in the EU-15 wheat surplus. The drop in demand for wheat owes partly to lower animal production and thus lower feed demand, but also to lower demand for bioethanol production once trade in bioethanol is liberalised. Domestic demand for maize is maintained, despite the fall in animal production, because of the significant fall in its price, but a sharp increase in imports is necessary given the assumed fall of 33% in domestic maize production. Production of oilseeds is little affected because these products do not benefit from tariff protection, and the lower profitability of competing cereals offsets the impact of the elimination of direct payments. However, there would be a significant drop in imports of soybean meal (-10%) given the lower levels of animal production following liberalisation. Sugar production also falls (by 17%) despite the removal of quotas, and the EU becomes a net importer of sugar. However, the large increase in world sugar prices is influenced more by the increase in bioethanol production in the rest of the world than by the direct change in the EU net trade position.

Table 2: World price effects of CAP elimination in 2015 (%)

Commodity	%
Bioethanol	54.1
Sugar	37.8
Butter	26.9
Beef	23.8
Corn	22.5
Pork	9.7
Poultry	9.2
Skimmed milk powder	4.4
Oil meals	4.1
Oilseeds	1.1
Vegetable oils	1.1
Whole milk powder	1
Soft wheat	-6.5

Source: Gohin (2009).

Turning to animal products, liberalisation would result in a sharp fall in EU beef production of around 23% and an increase in imports from 0.46 to 2.69 million tonnes. There would also be a small decrease in EU milk production, despite the elimination of milk quotas. This result is due to the sharp fall in the price of cattle following liberalisation, given that most EU-15 beef production derives from the dairy herd. If the cattle price were maintained, milk production would increase. Because milk production falls, so does production of dairy products, but most of the impact would be felt in the butter and skimmed milk powder markets, with little impact on the market for whole milk powder. Production of pork and poultry would also decline, with a sharp increase in poultry imports in particular.

Gohin's estimates of world market price changes resulting from elimination of the CAP are much greater than those in the other studies reviewed. A merit of his study is that it supplies a detailed and comprehensive list of world market price changes, which can be used for the Uganda simulation. The fact that the estimates are at the higher end of the range has the advantage that it allows for the exploration of the impact of significant positive price shocks resulting from CAP reform.

2.4. Biofuels scenario

The first study to investigate the impact of the EU biofuel mandate on food production and prices was Banse et al. (2008), using the LEITAP model (see Section 2.3.1). Subsequent studies have used more sophisticated modelling of the various pathways by which food prices can be affected, notably by taking into account the increased production of co-products of the biofuels industry, such as dried distillers grains with solubles, soymeal and rapeseed meal, which are used as substitutes for feedgrains in livestock production. Co-products lessen the impact of biofuels on food prices because they reduce the need for land reallocation/extension to replace the crops displaced from the feed and food sectors to bioenergy production. Other modellers have also pointed to the positive impact that biofuels demand can have on crop yields, again mitigating the impact of mandates on the world food balance.

A specific issue in modelling the EU renewable fuels mandate is how to interpret it in terms of biofuel demand. The 10% target itself is conditional on the availability of second-generation biofuels, which are assumed to count double towards the target and to amount to 1.5% of transport fuel in 2010. Thus, the biofuel target from first-generation feedstock is at most 7%. Some contribution from other renewable energy sources, for instance through the use of electric vehicles, might also be factored in, reducing the demand for biofuels from agricultural feedstocks even further. Another issue is the assumed division in EU biofuel demand between biodiesel and bioethanol. Most EU biofuel is currently biodiesel, but there is a desire to increase the share of bioethanol as biofuel use increases. Because the feedstocks for the two biofuels differ, so will the world market impacts. Model results are also influenced by the assumed oil price. Other things being equal, the higher the oil price, the greater the incorporation of biofuels in transport fuels under market conditions even in the absence of a mandate, and thus the smaller the impact a mandate will have.

World market impacts are also affected by whether the EU mandate is accompanied by trade liberalisation. The EU biodiesel market is relatively open (imports of biodiesel face a 6.5% tariff whereas feedstock imports for the manufacture of biodiesel, such as palm oil and soybeans, enter the EU duty-free). The EU bioethanol market is protected by a relatively high specific tariff; exporters without preferential access to the EU face a most-favoured nation (MFN) tariff amounting to 19.2€/hl for undenatured alcohol and 10.2€/hl for denatured alcohol, a specific tariff that (depending on the world price for ethanol) is equivalent to an *ad valorem* tariff of between 25% and 50% (Al-Riffai et al., 2010a). If tariff protection is maintained, much of the feedstock to meet the EU demand for bioethanol is produced within the EU using wheat and sugar beet as feedstocks. However, under liberalisation of EU bioethanol imports, EU domestic production of ethanol is mostly replaced by imports from Brazil, produced using sugarcane.

Al-Riffai et al. (2010a) examine the impact of the EU biofuel mandate under two scenarios – one with the continuation of protection for EU bioethanol and the other with free trade in biofuels – using the MIRAGE CGE model. However, the published report does not contain specific estimates of the world price effects of the two scenarios. A report by the same authors using the same model reports the world market impacts of the 'incremental' mandates but not the full mandates in the US and the EU (i.e. the additional effort needed to reach the 2020 targets starting from 2008 levels in both countries) (Al-Riffai et al., 2010b). In this latter study, world prices in 2020 of oilseeds used for biodiesel, such as rapeseed, sunflower seeds, palm fruit and palm oil, increase by close to 5%, whereas those of ethanol feedstocks, such as maize and sugarcane, rise by 2–3% because of the mandates. Ethanol and biodiesel prices increase by 3.9% and 5.9%, respectively. The removal of

biofuel trade barriers results in smaller increases in world commodity prices. While the inclusion of the US in this study exaggerates the impact of the EU biofuel mandate alone, the availability of detailed world price effects makes it possible to use these estimates as price shocks for the Uganda case study. The simulation modelling the existence of mandates in both the EU and the US but without trade liberalisation is used as the basis for the further analysis (Table 3).

2.5. Compilation of the scenarios

Table 3 brings together the assumed price changes for the three scenarios. The price changes in the 'partial' scenarios for changes to the CAP (CAP2020 and biofuels) are small. The price changes assuming full CAP liberalisation are considerably larger (although, in the case of wheat, world market prices would fall rather than rise). These projected price changes from full CAP liberalisation, as noted previously, are significantly higher than those projected in other studies, but provide some extreme values with which to assess the likely impact of further CAP reform on Uganda. Another important difference among the scenarios is the commodity structure of the world market price changes. In the CAP2020 scenario, it is primarily the crops sector that is affected. In the full liberalisation scenario, it is primarily animal production. In the biofuel scenario, the main impact is on vegetable oils. These differences determine the nature of the overall impact of each scenario on Uganda.

Table 3: World price changes under various scenarios

	CAP2020 scenario	Full CAP liberalisation	US and EU biofuel mandates (without trade liberalisation)
Wheat	1.5	-6.5	0.90
Coarse grain	1.5	n.a.	n.a.
Maize	1.5	22.5	2.96
Oilseeds	1.5	1.1	2.00
Vegetable oils	1.5	n.a.	4.00
Sugar	-1.7	37.8	2.21
Beef	0.4	23.8	0.16
Pork	0.4	9.7	0.16
Poultry	0.4	9.2	0.16
Dairy products (milk powder)	0.25	1.0 – 4.4	0.16

Source: See text for derivation.

One omission in this table is price changes for non-agricultural commodities in each scenario. As underlined by the ABARE study (Section 2.3.2), in a general equilibrium framework resources released by a shrinking sector will be absorbed by the expansion of other sectors. If CAP liberalisation leads to fewer resources in EU agriculture, then production and exports in the EU manufacturing and services sectors will expand. CAP reform will put upward pressure on world prices of agricultural goods, but downward pressure on world prices of manufactures and services. Developing countries will experience this as a terms of trade gain or loss depending on their net trade position in manufactures and services. It was not possible to obtain consistent estimates for the likely impact on global markets for manufactures and services given the way the world market price changes in the different scenarios are developed in this study. Instead, as part of the sensitivity analysis of the empirical results obtained, we examine the resource allocation, welfare and poverty effects of stylised shocks to national prices for non-agricultural commodities to obtain a sense of the relative importance of this channel of impact for the Ugandan economy.

3. Quantifying CAP impacts on Uganda

3.1. Price transmission assumptions

The model methodology to examine how CAP reform might affect Uganda conceptually has three stages.[15] First, we assess the world price impacts of different CAP reform scenarios as described

[15] This division into three stages is primarily for pedagogic reasons. In practice, the three stages could be collapsed into a single holistic simulation model using a global model with household disaggregation, or partially collapsed, as in

in Section 0. Second, we estimate the national price-level effects, taking into account the degree of transmission between world market prices and national prices. Third, we calculate the impact of changes in national prices on household welfare and poverty making an assumption about how the Ugandan government reacts to the changed economic circumstances in the second stage.

The welfare and poverty impacts of the world market price changes established in the first stage are determined by the extent to which these price changes are transmitted to the Ugandan border. How these effects are distributed within Uganda depends on how they are diffused to agents within the country. This is an important issue for all developing countries but particularly for Uganda where, as a land-locked country, the correlation between national and world market price changes is weak.

Uganda is not well integrated with international markets, especially for low-value commodities such as cereals (Simler, 2010). Simler's study of the impact of the world food price shock in 2007/08 in Uganda shows that price trends within Uganda deviate from global price trends, and local market conditions figure more prominently in the determination of staple food prices. Benson et al. (2008) also note that trends in food prices in Uganda do not reflect the longer-term global increase in food prices. They conclude that Uganda's food commodity markets are relatively isolated from global markets, although the country is an important provider of food to its neighbours. Several of the principal major foods consumed in Uganda are not traded globally, although the authors do find some evidence of limited price transmission in the case of rice and wheat. For the other major foods, they argue that the effects of global price increases will occur only in a secondary manner as rising prices lead to changes in patterns of demand for the food crops Uganda produces, both locally and regionally.

World price to national price transmission elasticities are implicit in CGE models and are determined by the structure of the database and a variety of model assumptions (Siddiq and Grethe, 2012). In order to mimic the real world where a country imports as well as exports the same good, the Uganda model employs a constant elasticity of substitution (CES) function on the import side and a constant elasticity of transformation (CET) function on the export side. These functions implicitly assume that domestically produced products differ to some degree from their imported and exported variants and therefore changes in their prices can also differ. Thus, as long as the elasticities specified for the CES and CET function are non-infinite, there is imperfect transmission of world market price changes to the domestic market. Moreover, the model accounts for transaction costs including transportation costs, which act as an additional wedge between the world market and domestic price developments.

The main determinants of the size of the implicit price transmission elasticities include structural characteristics such as the size of the commodity in the domestic economy in terms of supply, demand, production and trade, as well as its share in the use of domestic factors of production; model closure assumptions related to the mobility of production factors; model parameterisation, including assumptions related to the substitution possibilities among domestic and traded goods, as well as producers' options to substitute primary factors with intermediate inputs or to substitute different primary factors for one other; and the prevailing exchange rate regime (Siddiq and Grethe, 2012). Siddiq and Grethe show how the price pass-through from international to domestic markets in CGE models can be controlled for by configuring its closure rules, production and trade elasticities, factor market closures and exchange rate regime. In this way, it is possible to target a certain degree of price transmission, empirically estimated using econometric techniques. One conclusion from this study is that the range of behavioural parameter values generally used in CGE models results in a relatively high degree of price transmission that may not correspond with the observed reality.

The model used in this study implies imperfect price transmission from world to national prices determined endogenously by the database shares and model parameterisation, but there is no

this study, where the second and third stages are simulated simultaneously using a single country CGE model with disaggregated households.

assurance that the implicit price transmission elasticities have values appropriate for Uganda. We are not aware of a comprehensive set of world to national price transmission elasticities for Uganda that could be calibrated to using an alternative set of parameter values. This issue should be addressed in future work.

Spatial transmission to local markets is influenced by transaction costs, which are particularly high in Uganda as a result of poor domestic transportation and information infrastructure, and also depends on local supply and demand conditions. Hence, changes in price incentives faced by individual producers and consumers might vary widely in spatial terms, including cases where there is no trade and consequently no transmission occurs. Additionally, prices might transmit imperfectly vertically through the different levels of the supply chain. For instance, Kaspersen and Føyn (2010) find that little transmission of an increase in wholesale prices to farm-gate producer prices for coffee in Uganda. In the absence of further information on the extent of domestic price transmission, both vertically and spatially, we assume that all producers and all consumers are affected equally by the domestic market price changes that occur. This should be taken into account in interpreting the results reported below, particularly the household-level effects, and is another area that future work could improve on.

3.2. Outline of the CGE micro-simulation model

The simulations for the second and third stages are implemented using an integrated CGE micro-simulation (CGE-MS) model which enables the quantification of the adjustment impacts on the Ugandan economy as well as the impacts on income distribution and poverty resulting from the world market price changes in the three scenarios.

The CGE model builds on the International Food Policy Research Institute (IFPRI) Standard Computable General Equilibrium Model in GAMS (Lofgren et al., 2002). This choice is motivated by its excellent documentation and public availability, which increase the transparency and the ease of discussing the model and the results. The standard IFPRI model features just one representative household and thus yields information only about the average income effect on households. Disaggregating the CGE model's representative household into as many households as are contained in the Uganda national household survey allows for measuring the impact of price changes across the full range of the income distribution. Following this approach, this study implements an integrated CGE-MS model integrating all 7,426 households of the Uganda National Household Survey (UNHS) 2005/06 as individual agents into the CGE model.[16]

Government real expenditure is held constant so that changes in prices and government revenue are reflected in changes in government savings. Foreign savings are assumed to be constant so that the exchange rate adjusts to balance the current account. Additionally, investment is held constant in real terms. To offset changes in the sum of government savings, the domestic value of the rest of the world savings and the price changes of investments, the propensities to save for all non-governmental institutions (including households) adjust by the same percentage point change. The purpose of this hypothetical and unrealistic assumption is to isolate the impact of changing relative prices and incomes within Uganda as a result of CAP reform. It maintains the income distribution between households but is unrealistic as the poorest households increase their savings together with other non-governmental institutions.[17] The government might well decide to react to the altered terms of trade resulting from CAP reform by changing taxes or altering the terms of social safety net programmes, but then the distributional and poverty effects are a function as much of the changes in government policy as of the CAP reform. Assuming a uniform percentage point change in the marginal propensity to save (implying a proportionate contribution to savings by all households across the income distribution) to compensate for changes in the government

[16] See Annex for details on the Uganda model.

[17] By holding government real consumption, real investments and foreign savings in foreign currency units constant, the economy cannot borrow from the future as no additional debt is accumulated and public expenditure and investment are continued. This formulation is intended to avoid welfare changes not measured within the model.

budget is thus a methodological device to identify the *initial* impact of relative price and income changes owing to CAP reform.

Full mobility of capital at a fixed supply level is assumed. The same assumption is made for skilled labour, so that wages adapt to clear the market. By contrast, surplus labour for unskilled and self-employed labour markets is assumed so that demand changes are countered by changes in labour supply at a fixed wage rate. Therefore, households are able to increase their number of hours worked if gainful work opportunities arise. An excess supply of labour is consistent with Ugandan data: the Uganda Bureau of Statistics (UBoS, 2006) reports an official time-related underemployment rate of 12%.[18] Capital and all labour can move freely between sectors. The reallocation of land between different crop uses is limited by introducing a nested CET land supply function. The Consumer Price Index (CPI) is fixed and serves as the numeraire for the model (Boysen and Matthews, 2011 has a fuller description of an earlier version of the model).

3.3. Data

The SAM used in this study is based on two datasets. The first is the UNHS 2005/06, which comprises, in particular, detailed socioeconomic and agricultural questionnaire modules. The sample includes 7,426 households corresponding to 40,449 individuals and is nationally representative (see UBoS, 2006). Overall, the sample inflated using sample weights represents a population of 28,428,169 individuals.[19] The second dataset is the 2007 SAM for Uganda constructed by Thurlow et al. (2008).

The CGE model is calibrated on the 2007 SAM for Uganda, which is based on the above SAM but extended and modified to include all households from the UNHS. The final extended Uganda SAM comprises 21 agricultural and 29 non-agricultural sectors and 5 factors of production including 3 types of labour plus land and capital, and accounts for an enterprise, the government, household transfers and the rest of the world. The SAM has been substantially modified to incorporate the full household sample of 7,421 households.[20]

Since the sectoral trade structure of the 2007 Uganda SAM used was built using 2002/03 supply-use tables for Uganda (see Thurlow et al., 2008) and the common external tariff of the EAC had not been fully implemented in 2002/03, we conduct a pre-experiment to simulate the impacts of Uganda's implementation of the EAC customs union in 2005, including adoption of the common external tariff and removal of the EAC market's internal tariffs. The tariff patterns before and after the EAC common external tariff implementation are rather different. Imports from the EU and the rest of the world are subjected to much higher import tariffs in many sectors where Uganda previously had low tariffs. Overall, the trade-weighted average import tariffs on imports from the EU and the rest of the world rise by 4.6 and 9.8 percentage points, respectively. The results of this pre-experiment form the starting point for our simulations.

To measure poverty, we employ an absolute poverty line and the measures P_α introduced by Forster et al. (1984, henceforth called FGT).[21] The poverty headcount index P_0 measures the percentage of people falling below the poverty line. The poverty gap P_1 measures how much poor people's incomes fall under the poverty line as a percentage of the poverty line on average. The poverty severity index P_2 squares that shortfall percentage of each person before averaging and thus gives more weight to more severely affected people. Rural and urban poverty lines are used, derived from the adjusted household survey data in order to reproduce the poverty headcounts reported in the UNHS Report on the Socio-economic Survey (UBoS, 2006, Table 6.3.2(a)). This

[18] This includes only employed people who answered in the UNHS 2005/06 that they worked less than 40 hours per week and were both willing and available to work more. The survey did not measure other forms of underemployment.

[19] Five households had to be deleted as a result of missing data, leaving 7,421 households.

[20] For additional details about the SAM modifications, see Annex.

[21] The formula is given as $P_\alpha = \frac{1}{N} \cdot \sum_{i=1}^{N} \left(\frac{z-y_i}{z}\right)^{\alpha} \cdot I_i$ with N: population size, z: poverty line, y_i: income of individual i, and $I_i = \begin{cases} 1 \text{ if } y_i < z \text{ and} \\ 0 \text{ otherwise.} \end{cases}$ Setting the parameter α to 0, 1 or 2 computes the poverty headcount, gap or severity index, respectively.

resulted in poverty lines of UGS244,074 and UGS269,087 for the 34.2% of rural and 13.7% of urban poverty headcounts, respectively.[22] Per capita expenditure is used as the poverty-relevant income measure.

3.4. Modelling the world market shocks

The world price changes derived from the literature as shown in Table 3 are transformed into price changes compatible with the sector classification of the SAM using detailed trade statistics. Corresponding to the model specification, which assumes that imported and exported variants of a product are different, import and export price shocks differ.[23] Table 4 presents the price change scenarios applied in the simulations.

Table 4: Scenarios, percentage changes in world prices

Scenario ➔	CAP2020		Liberalisation		Biofuel mandate	
	Export	Import	Export	Import	Export	Import
Maize	1.5	1.5	22.5	22.5	2.96	2.96
Other cereals	1.5	1.5	5.01	-3.13	1.72	1.14
Oil seed crops	1.5	1.5	1.1	1.1	2	2
Beans	0.1	0.03	0.08	0.02	0.14	0.04
Meat processing	0.32	0.21	13.5	2.36	0.15	0.13
Other food processing	0.23	0.48	8.52	9.69	2.07	2.9

Source: Own calculations.

Because the CGE model regards domestic products as being imperfect substitutes for their internationally traded variants, changes to world prices transmit only partially to the prices faced by Uganda. The domestic price of imported or exported products is the world market price adjusted for trade taxes and transaction costs. The model combines the domestically produced and imported variants of a composite product for sale on the domestic market using a CES function measuring how substitutable these two products are, thereby determining the domestic price via clearance conditions on the domestic market. The initial impact on the domestic price of this combined product is determined by the share of imports in total domestic use. The export side is modelled analogously.

Because all the products for which there are price changes are both imported and exported (see Table 5), the overall effects are difficult to predict *a priori*. The export share in output, the import share in demand and the self-sufficiency index in Table 5 give an indication as to how the shocked sectors might be affected initially. Maize and other food processing have a higher share of exports in production, whereas other cereals, oil seed crops and meat processing have a higher share of imports in demand.

Table 5: Production structure of Ugandan economy and trade share measures by sector (%)

	Share in total production value	Export share in output of the sector	Import share in demand for commodity	Self-sufficiency index
Maize	1.2	17.7	13.1	103.1
Rice	0.3			100
Other cereals	1	22.2	26.3	87.9
Matooke	2.6			100
Cassava	1.7			100
Irish potatoes	0.4			100
Sweet potatoes	1.9			100
Beans	2.2	26.5		136.1

[22] The Uganda Bureau of Statistics (UBoS) poverty lines are based on the *cost of basic needs approach*, which accounts for the cost of meeting physical calorie needs and allows for vital non-food expenditure, such as clothing and cooking fuels, valued using the average consumption basket of the poorest 50% of the population (UBoS, 2006, Section 6.3). The rural and urban poverty lines account for the differences in prices and consumption baskets of the respective subpopulations.

[23] For further details about modeling and deriving world price shocks, see Annex.

	Share in total production value	Export share in output of the sector	Import share in demand for commodity	Self-sufficiency index
Vegetables	0.6	0.7		100.7
Fruits	0.7	4.3	4.3	98.4
Oil seed crops	0.6	3.2	4.5	98
Cotton	0.1	100		
Tobacco	0.4	96.6		2906.5
Coffee	0.7	100		
Tea	0.2	100		
Other export crops	0.2	63.2		272
Cattle	1.3			100
Poultry	0.4	1.9	1.8	100
Other livestock	0.2	12.4		114.2
Forestry	1.8	8.1		108.8
Fish	1.5	38.5		162.5
Grain milling	2		6.3	92
Meat processing	1.4	4.6	6.9	92.5
Fish processing	0.8	63.3	12.8	210.4
Other food processing	2.9	22.3	16.1	101.6
Animal feed processing	0.3			100
Beverages and tobacco	1.1	3.5	10.6	88.5
Textiles and clothing	0.9	11.9	19.4	66.1
Wood and paper products	0.4	2.0	35.2	61.9
Mining	0.2	22.2	34.7	67.2
Fuels	0.0		83	0.1
Chemicals and fertiliser	1.4	6.5	44.9	40.7
Other manufacturing	1.7	6.9	35.4	60.1
Machinery and equipment	1.4	25.5	63.1	21.8
Furniture	0.4	0.9	9.7	88.8
Utilities	2.6	5.3		105.6
Construction	14.1			100
Trade services	10.3			100
Hotels and catering	4.7	65.8		292.1
Transport services	3.5	43.8	58.6	72.5
Communication services	1.9	5.3	3.4	101.9
Financial and banking services	0.9	2.9	25.6	76.6
Real estate	6.3			100
Other private services	1.7	1.8	26.9	74.3
Public administration	4.7			100
Education	8.8			100
Health	4.3			100
Community services	1.2			100

Source: Simulation results from the pre-experiment.

3.5. Results

The initial impact of higher world market prices for the six product categories shocked is to make corresponding exports and imports more expensive, thus stimulating exports and discouraging imports. In all three scenarios, there is a positive impact on Uganda's terms of trade. However, given the gross imbalance between the value of Uganda's exports and imports (the value of exports is only 60% of the value of imports), the direction of the initial impact on the balance of trade differs across the scenarios. The trade balance (and thus the current account balance, as factor income flows and institutional transfers are not affected) initially worsens in the CAP2020 scenario, but improves in the other two scenarios. This initiates the counteracting mechanisms needed to restore equilibrium in the current account balance. Real GDP falls in each of the scenarios, although the impact on total absorption (which is a better measure of the welfare effect) is ambiguous: it depends on the size of the terms of trade effect as well as on other factors that influence absorption but not production, such as changes in investment costs, changes in the cost of government consumption and revenue and changes in the domestic value of foreign savings.

The CAP2020 scenario results in a small positive terms of trade shock of just under 0.02%. The initial impact of world market price changes in this scenario is a worsening of the trade balance. Higher world market prices create incentives to increase production of exports but also reduce demand for imports. The initial worsening of the trade balance would be expected to put pressure on the nominal exchange rate to depreciate, which would further increase the domestic prices of imports and exports. Import volumes fall and the production of import substitutes increases to such an extent that, despite higher export prices, export volumes also fall. Real exports decrease (-0.04%) together with real imports (-0.03%). Ultimately, there is an appreciation in the nominal but a small depreciation in the real exchange rate.

The increased production of import substitutes is not sufficient to offset the decrease in production of exports and other sectors, as reflected by the fall in real GDP of 0.02%. The assumption of unskilled labour being in elastic supply at a fixed real wage amplifies the contraction of domestic production activity compared with an assumption where wages would be allowed to adapt. Total absorption decreases by 0.02%, solely because of a decrease in household consumption (Table 6), since investment demand and government consumption are assumed to be fixed in real terms. In this scenario, the magnitude of the shock is small, so the resulting effects are also small.

In contrast with the CAP2020 scenario, the initial impact of the biofuels scenario is an improvement of the trade balance, which tends to appreciate the nominal exchange rate, but the scenarios are rather similar otherwise. The positive terms of trade effect is stronger, at 0.11%. Overall, import volumes increase slightly as do export volumes. Despite this increase in export activity, there is a decline in real GDP of the same magnitude as in the CAP2020 scenario. Real absorption does not fall by quite as much as in the CAP2020 scenario, for two reasons. On the one hand, the terms of trade effect, which has a positive effect on consumption, is larger. On the other hand, prices for investment goods, relative to other goods, decrease more than in the CAP2020 scenario, thus requiring less savings in the economy. Thus, households can allocate a larger share of their income to consumption. But the strength of these countervailing mechanisms is not sufficient to prevent a fall of private consumption in this scenario.

The shocks in the liberalisation scenario are more significant. Initially, world price changes improve the trade balance, which tends to appreciate the nominal exchange rate. The improvement in Uganda's terms of trade is stronger (+0.87%). Given higher export prices, there is a relative shift of production towards exports. Import volumes increase more strongly because of the appreciation of the nominal exchange rate by 1.56%. Imports increase in all sectors apart from maize and processed foods, which experience a sharp increase in their import prices in foreign currency terms. GDP falls, reflecting a contraction in domestic economic activity, but in this scenario total absorption increases. This is a result of the much larger favourable terms of trade effect and again reduced investment costs, which leave a larger share of household incomes for consumption. As real investment and government expenditures are held constant, private consumption rises by even more than total absorption. The world market price effects in the CAP liberalisation scenario were selected at the very high end of the scale; it is very unlikely that price impacts of this magnitude would be expected from liberalisation of the CAP in its implementation from 2012.

Table 6: Percentage changes in GDP components (volume changes)

	Base	CAP2020	Liberalisation	Biofuel mandate
	% of GDP	% change		
Absorption	109.8	-0.02	0.21	-0.01
Private consumption	75.7	-0.02	0.30	-0.02
Investments	20.6	0	0	0
Government consumption	13.2	0	0	0
Exports	15.6	-0.04	0.25	0.08
Imports	-25.4	-0.03	1.23	0.08
GDP at market prices	100	-0.02	-0.05	-0.02
Net indirect taxes	9.2	0.00	0.98	0.1
GDP at factor cost	91	-0.02	-0.07	-0.03
Terms of trade	100	0.02	0.87	0.11
Nominal exchange rate (UGS/$)	100	-0.07	-1.56	-0.24
Real exchange rate (UGS/$)	90.1	0.01	-0.71	0.00

Note: A negative sign in the exchange rate rows implies an appreciation of the exchange rate.

Source: Simulation results.

The changes in real domestic activity shown in Table 7 are largely expected. The sectors facing higher world market prices, that is, maize, other cereals, oilseed crops, meat processing (not in the CAP2020 scenario) and other food processing, expand together with some of their downstream intermediate inputs, for example cattle, poultry and animal feed processing. As the nominal exchange rate appreciation lowers the import and export prices of the non-shocked traded manufacturing and services products, these sectors tend to contract. Relative to the prices of these latter sectors, the prices of non-traded sectors increase, resulting in their expansion. These tendencies are largely the same for all scenarios, with differences in magnitudes in agreement with the shocks.

Table 7: Percentage changes in domestic production activity (volume)

	Base	CAP2020	Liberalisation	Biofuel mandate
	% of total domestic production	% change		
Maize	1.2	1.04	23.57	2.28
Rice	0.2	-0.17	1.31	0.2
Other cereals	1	1.47	4.73	2.19
Matooke	2.5	-0.03	-0.23	-0.05
Cassava	1.7	-0.1	-0.58	-0.09
Irish potatoes	0.4	-0.05	-0.11	-0.06
Sweet potatoes	1.9	-0.06	-0.56	-0.1
Beans	2.2	-0.21	-4.88	-0.61
Vegetables	0.6	-0.03	-0.16	-0.05
Fruits	0.7	-0.07	-0.86	-0.15
Oil seed crops	0.6	0.23	3.87	1.09
Cotton	0.1	-1.07	-17.72	-2.68
Tobacco	0.4	-0.47	-11.36	-1.62
Coffee	0.7	-0.19	-4.16	-0.58
Tea	0.2	-0.22	-5.27	-0.73
Other export crops	0.2	-0.08	-3.47	-0.26
Cattle	1.3	0.08	7.78	0.65
Poultry	0.4	-0.05	0.1	-0.16
Other livestock	0.2	-0.08	-1.71	-0.33
Forestry	1.7	-0.09	-1.16	-0.17
Fish	1.5	-0.55	-13.16	-2.28
Grain milling	1.9	-0.17	1.12	0.16
Meat processing	1.4	0.06	3.86	-0.26
Fish processing	0.8	-0.82	-17.78	-3.19
Other food processing	2.9	0.22	27.15	5.17
Animal feed processing	0.3	0.01	3.41	0.19
Beverages and tobacco	1.1	-0.05	0.84	0.08
Textiles and clothing	0.9	-0.04	-1.04	-0.17
Wood and paper products	0.4	-0.1	-1.23	-0.11
Mining	0.2	-0.1	-3.1	-0.44
Fuels	0	-0.1	-3.3	-0.48
Chemicals and fertiliser	1.3	-0.06	-1.46	-0.26
Other manufacturing	1.7	-0.05	-1.76	-0.22
Machinery and equipment	1.4	-0.12	-3.78	-0.51
Furniture	0.4	-0.01	-0.06	-0.03
Utilities	2.6	0.02	0.35	0.03
Construction	13.9	0.00	0.12	0.01
Trade services	10.5	-0.02	1.72	0.22
Hotels and catering	4.7	-0.37	-8.87	-1.45
Transport services	3.7	-0.08	-1.98	-0.28
Communication services	2.0	-0.01	0.45	0.05
Financial and banking services	0.9	0.00	1.96	0.38
Real estate	6.1	0.01	0.36	0.03
Other private services	1.7	-0.02	1.21	0.22
Public administration	4.8	0	0	0
Education	9.0	0.01	0.4	0.03
Health	4.4	0.03	1.04	0.10
Community services	1.2	0.04	1.02	0.10

Source: Simulation results.

Table 8 shows the way that factor returns, which ultimately determine household income, are affected in the different scenarios. All labour types, that is, self-employed, unskilled and skilled labour, as well as capital lose income, whereas land gains. Because of the model closure chosen, these decreases in returns are increases in unemployment rather than decreases in the real remuneration in the cases of self-employed and unskilled labour, where wage rates are held constant in real terms. The gains to land reflect the fact that world price changes benefit agri-food sectors, which expand at the expense of other sectors. Land is specific to agriculture and thus returns to land increase, whereas the factor units released from the shrinking sectors can only be absorbed in the agriculture sector at a lower price in the case of skilled labour and capital or become unemployed in the case of self-employed and unskilled labour, where wages are fixed. Summing over all factors, factor returns decrease in all scenarios, as indicated by the GDP at factor cost figures presented in Table 6.

Table 8: Percentage changes in factor returns

	Base	CAP2020	Liberalisation	Biofuel mandate
	% of total factor returns	% change		
Labour self-employed	21.7	-0.05	-0.17	-0.09
Labour unskilled	15.8	-0.03	-0.15	-0.05
Labour skilled	13.1	-0.05	-0.34	-0.1
Land	8.0	0.39	6.49	0.77
Capital	41.5	-0.07	-0.29	-0.09

Source: Simulation results.

In addition to the economy-wide effects on GDP, resource allocation and welfare, the impact on food security is also of interest. Food security, in the well-known FAO definition, has three dimensions: availability, access and utilisation. Based on our simulation results, we can say something about how EU agricultural policy affects the first two of these. The context is provided by the domestic price changes for both producers and consumers in the various scenarios presented in Table 9. Comparing the results with the world price changes in Table 4 clearly shows the damping effect of imperfect price transmission into the domestic market. For example, in the liberalisation scenario, where the price changes are greatest, the producer maize price increases by 8.66% and the consumer maize price by 5.33% relative to the world price shock of 22.5%. There is no obvious pattern linking changes in producer and consumer prices: in some cases, the producer price increase is greater; in others, it is the reverse. As consumers substitute non-traded staple crops for the price-increased traded staples, producer prices for non-traded staple crops also increase as a consequence of the shift in demand.

Table 9: Percentage changes in domestic prices for agricultural goods

	Producer price			Consumer price		
	CAP2020	Liberalisation	Biofuel mandate	CAP2020	Liberalisation	Biofuel mandate
Maize	0.43	8.66	0.9	0.31	5.33	0.65
Rice	0.01	0.85	0.09	0.01	0.75	0.07
Other cereals	0.42	2.82	0.67	0.51	-0.2	0.51
Matooke	0.03	0.91	0.08	0.02	0.71	0.06
Cassava	0.15	2.36	0.3	0.12	2.03	0.26
Irish potatoes	0.06	0.98	0.11	0.04	0.79	0.09
Sweet potatoes	0.10	1.65	0.2	0.09	1.44	0.18
Beans	0.12	1.49	0.20	0.12	2.07	0.25
Vegetables	0.05	1.09	0.11	0.00	0.21	0.00
Fruits	0.07	1.38	0.15	0.04	0.90	0.09
Oil seed crops	0.13	2.16	0.37	0.13	1.82	0.33
Cotton	-0.07	-1.59	-0.24	-	-	-
Tobacco	-0.07	-1.49	-0.23	0.01	1.09	0.11
Coffee	-0.07	-1.59	-0.24	-	-	-
Tea	-0.07	-1.59	-0.24	-	-	-
Other export crops	-0.05	-0.87	-0.12	0.00	0.29	0.10
Cattle	0.06	3.3	0.28	0.05	2.92	0.24
Other livestock	0.01	0.8	0.06	0.02	0.97	0.09
Poultry	0.05	0.99	0.12	0.05	0.95	0.11
Fish	-0.04	-0.22	-0.06	-0.02	0.52	0.04
Grain milling	0.22	2.00	0.35	0.14	1.23	0.21
Meat processing	0.04	2.53	0.21	0.01	0.55	0.08
Fish processing	-0.01	0.22	0.02	0.02	1.17	0.19
Other food processing	0.09	0.17	0.12	0.1	-0.47	0.16
Animal feed processing	0.13	2.01	0.26	0.13	1.97	0.26
Beverages and tobacco	0.02	-0.20	0.00	0.00	-0.36	-0.04

Source: Simulation results.

Table 10 presents some indicators relevant to food availability. In general, food self-sufficiency ratios increase for traded products.[24] There are increases in self-sufficiency ratios for commodities such as maize, other cereals, meat processing and other food processing, with the increases much more marked in the liberalisation scenario. There is no impact, by definition, on self-sufficiency

[24] The self-sufficiency index is the ratio between the value of production and that of the product's total domestic use.

ratios for non-traded products such as potatoes, cassava, matooke and cattle, and competition for resources implies a fall in the self-sufficiency ratios for some traded sectors not affected by the CAP, such as fish.

Increases in food self-sufficiency ratios do not necessarily translate into increases in household consumption of food products. The right-hand columns of Table 10 show the changes in projected real consumption of different commodities under the various scenarios. In general, food consumption declines, although the changes are relatively small, reflecting the limited significance of the world market price shocks. Higher domestic prices for food products resulting from CAP reform, in the absence of countervailing government action, lead to poorer access to food among Ugandan households, despite the increase in self-sufficiency ratios and the reduction in poverty in the liberalisation scenario.

Table 10: Changes in self-sufficiency ratios and household consumption indicators

	Self-sufficiency index				Household consumption			
	Base	CAP2020	Liberal-isation	Biofuel mandate	Base	CAP2020	Liberal-isation	Biofuel mandate
	%				% in total consumption	% change		
Maize	103.1	104.8	136.1	106.2	0.2	-0.21	-3.05	-0.43
Rice	100	100	100	100	-	-	-	-
Other cereals	87.9	89.8	88.4	89.4	0.4	-0.54	0.75	-0.52
Matooke	100	100	100	100	2.3	-0.05	-0.52	-0.09
Cassava	100	100	100	100	1.2	-0.10	-1.11	-0.19
Irish potatoes	100	100	100	100	0.3	-0.07	-0.54	-0.11
Sweet potatoes	100	100	100	100	0.8	-0.06	-0.65	-0.11
Beans	136.1	135.9	128.1	135.2	1.7	-0.08	-0.98	-0.16
Vegetables	100.7	100.7	100.5	100.6	2	-0.01	0.10	-0.01
Fruits	98.4	98.4	97.5	98.3	0.8	-0.05	-0.50	-0.09
Oil seed crops	98	98.4	97.3	98.4	0.9	-0.12	-1.11	-0.27
Other export crops	272	271.2	253.5	268.5	-	-	-	-
Cattle	100	100	100	100	-	-	-	-
Other livestock	114.2	114.1	112	113.9	0.4	-0.03	-0.45	-0.09
Poultry	100	100	99.7	100	0.4	-0.09	-0.89	-0.17
Fish	108.8	108.8	107.6	108.6	3.8	-0.05	-0.24	-0.06
Grain milling	101.6	101.8	124.3	106.1	5.9	-0.13	0.83	-0.18
Meat processing	162.5	162.2	154.3	161.3	1.2	0.00	-0.11	-0.04
Fish processing	92.5	92.6	99.6	92.4	4.9	-0.03	-0.25	-0.11
Other food processing	210.4	208.8	171.7	203.4	0.9	-0.03	-0.5	-0.14
Beverages and tobacco	92	92	91.7	91.9	3.8	-0.16	-0.88	-0.23

Note: Cotton, coffee and tea are not consumed domestically and thus are not included in this table.

Source: Simulation results.

Table 8 presented the aggregate changes in factor returns in Uganda as a result of CAP reform. This leaves open the question as to how losses or gains are distributed across households and how changes in producer and consumer prices affect households to assess the impact on poverty. Table 11 compiles the associated FGT poverty indices as calculated from individual household consumption patterns from the simulation outcomes. The change in the poverty headcount follows the direction of change in private consumption (Table 6) in each scenario; all changes are only fractions of a percentage point. Compared with the initial situation, the poverty headcount is higher in the CAP2020 and biofuel mandate scenarios, but lower in the CAP liberalisation scenario. The situation for the already poor deteriorates, as indicated by the poverty gap in both the CAP2020 and biofuels scenarios, but improves in the CAP liberalisation scenario. There is very little impact in any scenario on the severity of poverty.

The differentiation of households by rural and urban location highlights some contrasts in impacts. In the CAP2020 and biofuels scenarios, the poverty headcount increases in rural households but decreases in urban households. In the CAP liberalisation scenario, the positive impacts in reducing

the poverty headcount and the poverty gap are felt mainly in rural areas; the poverty headcount, the poverty gap and poverty severity actually increase in urban areas. These findings underline that the size and structure of the terms of trade changes that result from a CAP reform scenario can result in very different impacts and incidence of poverty within Uganda.

Table 11: Percentage point changes in FGT poverty indices

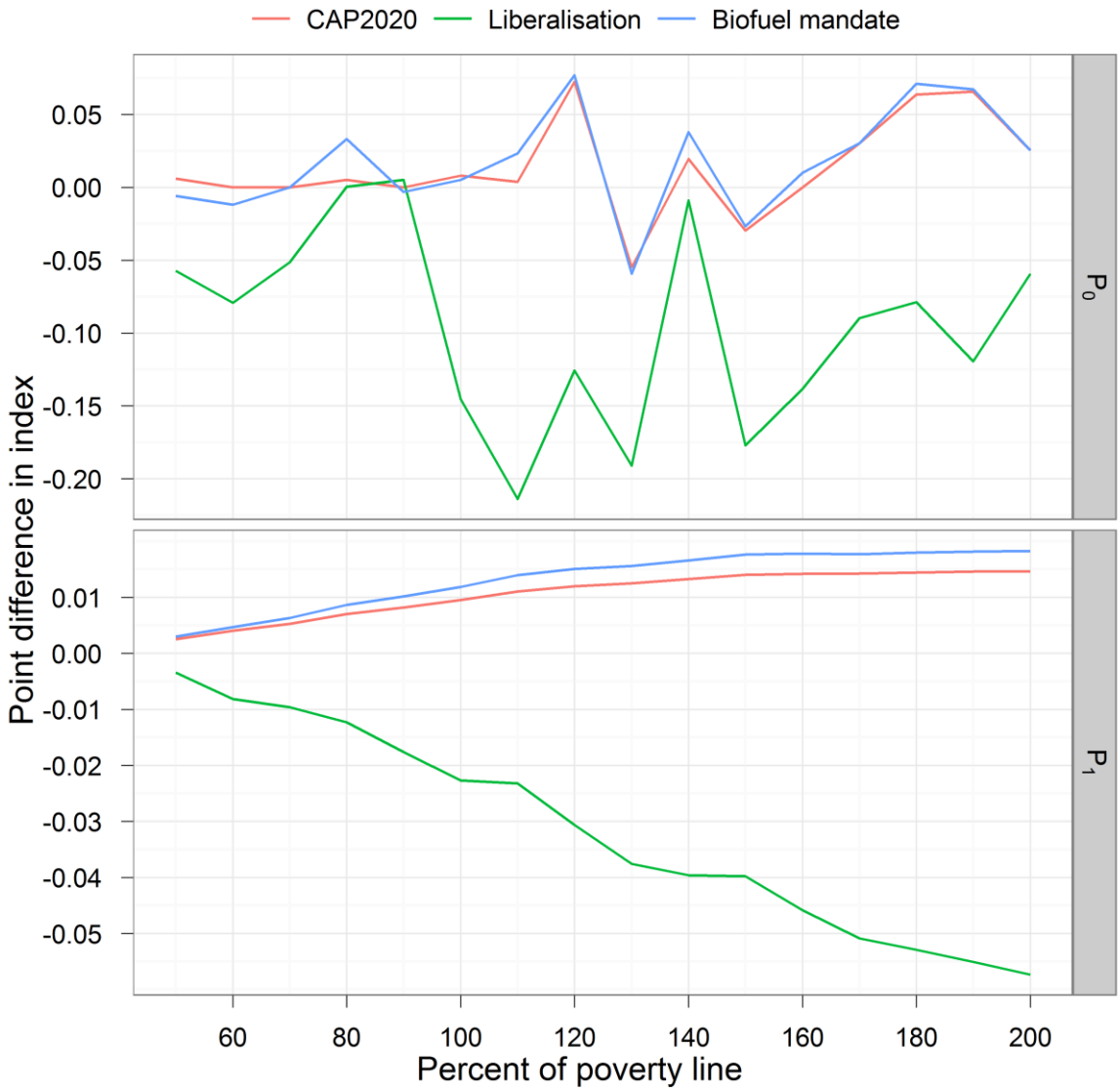
	Base	CAP2020	Liberalisation	Biofuel mandate
	%	Percentage point change		
National				
Headcount	30.1	0.01	-0.15	0.01
Gap	8.9	0.01	-0.02	0.01
Severity	3.7	0.01	-0.01	0.01
Rural				
Headcount	33.2	0.02	-0.17	0.01
Gap	9.8	0.01	-0.03	0.01
Severity	4.2	0.01	-0.01	0.01
Urban				
Headcount	13.4	-0.04	0.01	-0.04
Gap	3.6	0.01	0.02	0.01
Severity	1.5	0.00	0.01	0.00

Note: A positive figure means a rise in the numbers affected and hence a deterioration in the poverty status of the population.

Source: Simulation results.

These changes in poverty headcount and poverty gap indicators are sensitive to where the poverty line is drawn. This is because the distribution of households in proximity to the poverty line can be very different. Figure 1 shows the poverty headcount and depth of poverty indicators for different poverty lines ranging from 50% to 200% of the standard poverty line. Although the percentage point changes do vary, there are some regularities. The impact of the CAP2020 and biofuel scenarios is very slight, regardless of where the poverty line is drawn. In the case of the CAP liberalisation scenario, however, the impact on the poverty headcount varies dramatically depending on whether the poverty line is drawn at 90% or 100% of the poverty line as previously defined. At the 90% level, CAP liberalisation has almost no impact on the poverty headcount, whereas at the 100% level there is a 0.15 percentage point reduction. The poverty gap is a more robust measure with respect to the choice of the poverty line. The graph shows that the incomes of people below the poverty line decline in the CAP2020 and biofuel mandate scenarios but increase in the CAP liberalisation scenario, irrespective of the choice of the poverty line.

Figure 1: Response of poverty indicators to changes in the poverty line



Three analyses of the sensitivity of results to changes in the model closure and behavioural assumptions were undertaken, and Tables 12–14 present the results. In each case, only the macroeconomic results are presented, given the finding that there is a close positive correlation between changes in aggregate household consumption and changes in poverty.

The first analysis checks the sensitivity of the results to the exchange rate closure used. In the results presented previously, the trade balance was held fixed and the nominal exchange rate was allowed to vary to maintain this equilibrium. A new simulation was run holding the nominal exchange rate fixed and allowing the trade balance to vary. In this closure, all scenarios show an increase in the volume of exports and a decrease in the volume of imports in response to the positive terms of trade shock. GDP at factor cost is stable or increasing in all scenarios, but total absorption and household consumption fall.

The second analysis varies the trade elasticities used in the model simulations for the CAP liberalisation scenario. In Table 13, scenarios SA1 and SA2 divide and multiply, respectively, the elasticities of substitution between imported and domestic products (Armington elasticities) by 2.5. The lower elasticity makes it more difficult for Ugandan purchasers of imports to shift to lower-priced domestic substitutes, where they exist. The increase in import volumes is greater than in the

'base' scenario shown in Table 6, and the reduction in GDP is greater. Absorption and private consumption increase, but by less than in the base scenario. In scenario SA2, where the Armington elasticities are increased, the increase in imports is less (although still greater than in the base scenario), GDP declines (but by a smaller amount) and there is a bigger increase in absorption and private consumption than in the base scenario. Scenarios SA3 and SA4 apply the same multipliers to the elasticities of transformation between products produced for the domestic and export markets (CET elasticities). Again, the higher the elasticity, the easier it is for Ugandan producers to shift production to the export market to take advantage of higher prices, and the more favourable the impact on total absorption and private consumption.

Finally, the potential impact of lower world market prices for manufactured goods and services is explored. This is a possible impact of CAP reform which, by releasing resources, would contribute to greater output in EU manufacturing and services sectors, leading to lower world market prices of manufactures and/or services. Two scenarios are explored for illustrative purposes. In Table 14, the MFSRV1 and MFSRV2 scenarios apply -0.1% and -0.2% shocks, respectively, to the prices of manufacturing and services imports from the EU on top of the liberalisation scenario (so both agricultural and non-agricultural prices are altered). Imports grow by a little more and exports by a little less than in the base scenario, and total absorption and private consumption are both higher than in the base scenario as a result. Taking account of possible changes in the prices of non-agricultural goods and services as a result of CAP reform improves poverty outcomes in Uganda.

Table 12: Changes in GDP components (volume), exchange rate fixed and trade balance flexible

	Base	CAP2020	Liberalisation	Biofuel mandate
	% of GDP	% change		
Absorption	109.8	-0.12	-2.00	-0.34
Private consumption	75.7	-0.17	-2.90	-0.49
Investments	20.6	0	0	0
Government consumption	13.2	0	0	0
Exports	15.6	0.52	12.74	1.93
Imports	-25.4	-0.13	-0.70	-0.23
GDP at market prices	100	-0.02	-0.03	-0.01
Net indirect taxes	9.2	-0.10	-1.25	-0.24
GDP at factor cost	91.8	-0.00	0.22	0.02
Terms of trade	100	0.02	0.87	0.11
Nominal exchange rate (UGS/$)	100	0	0	0
Real exchange rate (UGS/$)	100	0.09	0.95	0.25

Source: Simulation results.

Table 13: Sensitivity of GDP component changes to trade elasticity values

	Base	SA1	SA2	SA3	SA4
	% of GDP	% change			
Absorption	109.8	0.12	0.24	0.16	0.27
Private consumption	75.7	0.18	0.35	0.23	0.39
Investments	20.6	0	0	0	0
Government consumption	13.2	0	0	0	0
Exports	15.6	1.07	0.35	-0.60	1.72
Imports	-25.4	1.68	1.43	0.32	2.97
GDP at market prices	100	-0.12	-0.04	0.00	-0.18
Net indirect taxes	9.2	1.06	0.19	0.32	2.24
GDP at factor cost	91.8	-0.17	-0.07	-0.06	-0.27
Terms of trade	100	0.87	0.87	0.87	0.87
Nominal exchange rate (UGS/$)	100	-1.43	-1.65	-0.78	-2.68
Real exchange rate (UGS/$)	90.1	-0.46	-0.93	0.178	-1.91

Source: Simulation results.

Table 14: Sensitivity of GDP component changes including changes to EU import prices of manufactures and services

	Base	MFSRV1	MFSRV2
	% of GDP	% change	
Absorption	109.8	0.22	0.24
Private consumption	75.7	0.33	0.345
Investments	20.6	0	0
Government consumption	13.2	0	0
Exports	15.6	0.24	0.24
Imports	-25.4	1.27	1.30
GDP at market prices	100	-0.19	-0.04
Net indirect taxes	9.2	2.24	0.99
GDP at factor cost	91	-0.27	-0.07
Terms of trade	100	0.91	0.95
Nominal exchange rate (UGS/$)	100	-1.59	-1.58
Real exchange rate (UGS/$)	90.1	-0.73	-0.76

Source: Simulation results.

4. Conclusions

4.1. Impact of further CAP reform on Uganda

Uganda is a net food exporter, and the three scenarios modelled in this study all lead to an improvement in Uganda's terms of trade. However, the gross imbalance in the value of the country's exports and imports means that its balance of trade is affected differently by the different terms of trade shocks. An improvement in Uganda's position vis-à-vis the outside world leads, via an appreciation in the nominal exchange rate, to a reduction in the level of domestic activity in the Ugandan economy as measured by real GDP. Whether overall welfare and household consumption increase or not depends on the strength of the terms of trade effect, the closure rules and the elasticities of substitution. In the basic CAP2020 and biofuel scenarios, total absorption and household consumption fall; in the CAP liberalisation scenario, both absorption and household consumption rise.

The change in the poverty headcount follows the direction of change in private consumption in each scenario, although all changes are only a fraction of a percentage point. The simulations measure the poverty effects of world market price changes resulting from the CAP taking into account producer and consumer responses within Uganda; government responses are designed to be neutral with respect to the distribution of income and thus do not allow for differentiated tax and/or public expenditure policies that might be undertaken to offset or mitigate increases in poverty. In the CAP2020 and biofuels scenarios, rural households benefit but urban households are worse off. In the CAP liberalisation scenario, the positive impacts in terms of reducing the poverty headcount and the poverty gap are felt mainly in rural areas; the poverty gap and poverty severity actually increase in urban areas. These findings highlight that the nature and composition of external price changes determines the initial impacts on poverty within Uganda, underlining the need for context-specific empirical analysis and the difficulties of making generalisations.

The absence of a correlation between greater food availability, reductions in poverty and food consumption can also be highlighted. Higher domestic prices for food products owing to CAP reform result in poorer access to food among Ugandan households, despite the increase in production self-sufficiency and the reduction in poverty in the liberalisation scenario, although the higher national income in the liberalisation scenario would permit government redistribution to mitigate this.

If CAP reform also influences activity in the EU manufacturing and services sectors and lowers the world price of commodities produced in these sectors, the resulting terms of trade gain would lower the poverty headcount in Uganda. This is an important and often overlooked way in which the CAP affects developing countries.

This study has found different impacts on Uganda of changes to the CAP, some negative, some positive. That these changes are small is what we expected, given Uganda's economic structure and trading access to the EU. Relative to the year-on-year volatility in world food markets, or to the poverty impacts from additional public investment in agricultural public goods, EU agricultural and trade policy plays only a minor role in the Ugandan case. Greater effects might be observed for a different case study country; this points to the importance of empirical work taking into account individual country specificities.

This study illustrates that apparently similar world market price changes arising from CAP reforms or non-CAP policies that raise world market prices of CAP commodities have very different quantitative impacts on Uganda, in terms of both macroeconomic effects and household poverty effects. Although all three scenarios modelled in the study give a positive terms of trade impact on Uganda (which is a net food exporter), the impacts on GDP and poverty levels are different even under the same model closure assumptions. Both the size and the commodity composition of the terms of trade changes are important for the poverty impacts observed. This characteristic has important implications for the modelling of CAP reforms on developing countries.

4.2. Limitations of study and further work

Make use of an integrated model to improve consistency of results. Multi-regional CGE models would normally be used to assess the first and second stages together. That is, by representing the developing country of interest separately in a multi-regional CGE model, both the impact of CAP reform on world markets and the effect of these changes on national structures of production and consumption and economic welfare would be estimated simultaneously. For this pilot study, it was not possible to make use of one of the existing multi-regional CGE models to run customised simulations of specific CAP reforms and evaluate their impact on Uganda. Instead, we relied on our best interpretation of the likely world market price effects using a range of studies in the literature. Inevitably, these studies reflect a variety of reform scenarios, use a baseline that no longer reflects existing CAP protection and often provide a limited range of results (in the published version of the papers). But there is no obstacle in principle to undertaking a consistent and integrated analysis of the first and second stage impacts using a multi-regional CGE model.[25] A further advantage of using an integrated model is that the specific scenarios of CAP reform investigated are under the control of the analyst and not dependent on what can be found in the literature. If a common set of price shocks were implemented by a monitoring body following expert review, this would facilitate the comparison of CAP impacts across developing countries.

Take account of the current CAP. Because it takes time to put together the necessary data to construct a global database, the policies embedded even in the latest release of a global database may not reflect current policies. It is therefore important to update the database for known policy changes since the database was put together. In this study, use was made of world price impacts from studies that modelled the CAP as it was in the mid-2000s. These studies do not account for the significant reduction in the trade-distorting impacts of the CAP that has occurred since that date. To be of use to developing country policymakers, analysis of the impact of future CAP reforms should start from the base of the distortions to world markets resulting from the current CAP, and not the CAP as it was a decade ago. On the other hand, using estimates of CAP protection at a time when world prices are high may underestimate the contingent nature of that protection. There is also a risk that higher protection could re-emerge under less favourable world market conditions.

Test the sensitivity of results to different model assumptions. Model results are dependent on the behavioural parameters and theoretical assumptions embedded in the model. While a source of frustration to policymakers who are looking for the single 'right' answer, having a range of results makes clear how the measured impacts of CAP reform may change depending on one's view of how the world works. Is competition in global food supply chains perfect or imperfect? How do consumers really allocate their consumption expenditure? What degree of substitutability should we assume between land uses of different types, or between imports and domestic production of similar goods? What assumptions are made about how governments will react to changes in government or rest of world balances? How mobile are factors between alternative uses and how responsive is the availability of factors to changes in their price? Different assumptions about model specification and parameter values will influence the measured impacts of CAP reform on developing countries. Of particular importance for CAP impact studies is the way EU direct payments are modelled, as this determines their presumed coupling factor and thus the effect of changes in the direct payments regime on world markets. Sensitivity analysis plays an important role in evaluating the output of quantitative models for monitoring purposes.

Take account of imperfect price transmission. Assumptions on price transmission enter at two stages, in converting world market price changes to national changes and in calculating how these national changes affect households. CGE modellers often use the Armington specification, which assumes consumers have different preferences for imported and domestic goods. This implies some degree of imperfect transmission of world to domestic prices. The size of the implicit price

[25] The main requirement is that the developing country of interest is identified separately in the global database the multi-regional CGE model uses. GTAP, the main global database used for modelling of this kind, has gradually been increasing its country coverage in successive database releases.

transmission elasticity is determined by the database shares, behavioural parameter values, closure rules and exchange rate regime. There is evidence that the standard range of behavioural parameter values used in CGE models may overestimate the price transmission elasticities appropriate to some developing countries. Further, the common practice of applying national-level changes in factor and consumer prices to all regions and households is likely to overstate the resulting poverty impacts and could also influence their direction, for example if price changes transmit well to urban households that may become worse off but there is poor transmission to rural households that might potentially benefit. As some markets and households are shielded to some degree from international price signals, their economic actions differ from those under perfect price transmission, and thus also affect aggregate national results. Integrating better information on observed price transmission behaviour in developing countries into quantitative models would be highly desirable.

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Annex: Further details of the Uganda CGE model and database

The CGE model

In the model, final commodity outputs are produced by combining quantities of value-added and aggregate intermediate outputs according to a CES function. Value-added, in turn, combines primary factors according to a CES function. The aggregate intermediate outputs are combined from commodities according to a Leontief function.

The institutions of the model are households, an enterprise, the government and the rest of the world. Households receive their income from the factors of production and from transfers from the enterprise, other households, the government and the rest of the world. They consume commodities according to Linear Expenditure System (LES) demand functions. Own produce is consumed at producer prices. The government receives income through the collection of taxes on income, commodities and imports as well as through transfers from the rest of the world. The government consumes a fixed quantity of private and public services, and investments. Additionally, it transfers CPI-indexed amounts to households. Finally, the rest of the world institution receives payments from imports to Uganda and spends on exports from Uganda, transfers to Ugandan households and investments. The difference between rest of the world incomes and spending defines foreign savings.

Commodity output is allocated to domestic sales and exports assuming imperfect transformability using a CET function. The production designated for domestic sales and the corresponding imported variety of a commodity are perceived by consumers as imperfect substitutes. The model employs a CES aggregation function to combine domestic products and their imported substitutes according to consumer preferences into one final composite commodity. This Armington function prevents unrealistic total shifts towards either imports or domestic production following a relative price change. The model distinguishes imports from three regions of origin, namely, the EAC, the EU and the rest of the world, utilising a second-level CES function. Following from the small country assumption, international supplies and demands are infinitely elastic at given world prices. The price domestic suppliers of exports receive is equal to the world price in domestic currency minus transaction costs to the border. The domestic supply prices are given by producer prices plus domestic transaction costs. Domestic demand is composed of household and government consumption, investment, intermediate inputs and transaction inputs. Demands and supplies on the various markets are required to equilibrate through adjustment of prices.

Modification of the SAM

Since the SAM modification is a rather cumbersome procedure, only the main cornerstones are outlined. We have been partly guided by papers of Fofana and Cockburn (2003) and Cockburn et al. (2010).

For reasons relating to incompleteness and inconsistency, the survey data are cleaned and values imputed. Then, income for each household is scaled to match expenditures plus savings. In the next step, the household values are multiplied by their sample weights and the aggregate values are compared with those from the SAM. Assuming that the aggregate values of income, expenditures and savings from the SAM are more reliable, the household values are adapted to match the aggregates of the SAM. The procedure maintains the structure of income and expenditure of each household as well as the income distribution. The value-added of the initial SAM is split into the factor returns determined from the household data, which are then used to modify the activity to factor payments as well as the factor to household payments. The total value added is maintained. As there is more certainty about factor to household payments than about activity to factor payments as derived from the household survey, only these rows and columns are rebalanced, keeping the factor to household payments fixed and adjusting the activity to factor payments. To rebalance the now unbalanced SAM, the information theory-based cross-entropy

approach implemented and documented in Robinson and El-Said (2000) and Robinson et al. (2001) is employed.

Since our analysis focuses on household income distribution, we impose the consumption structure for each household from the survey on the SAM. Hence, the production data of the SAM must be adapted to be consistent with the new final commodity demand data derived from the household survey. To this end, the SAM is rebalanced by letting only the activity and commodity columns adjust while holding fixed the import and tax rows, as these are assumed to be reliable. Since the factor to household payments remain constant, total payment to each factor also remains fixed during the process. In the initial Uganda SAM, households did not receive any transfers from other households or remittances from abroad, although these are an important source of income for many. As sources and destinations of the transfer flows between households are not known, they all pay to and receive from a common transfer account. In the model, the transfer outflows of households are fixed shares of their net disposable incomes and then the households receive fixed shares of the transfer account total. Home and market consumption are kept separate and in the model only market consumption is subject to transaction costs and taxes.

The CGE model distinguishes imports from three regions of origin, namely the EAC, the rest of the world and the EU. The original rest of the world import values are distributed across these three regions using 2003 values of imports for each region to Uganda taken from the TRAINS database (UNCTAD, 2010). The import tax revenue shares are calculated by trade-weighting the tariffs taken from this same database.

Model parameters

The model requires additional parameter data that cannot be derived from the SAM. For all agricultural and food products as well as for forestry and fish the CET elasticities are set to 5; for all other goods and services the CET elasticities are set to 2.5. The Armington elasticities of substitution between domestic and imported goods are taken from Hertel et al. (2007), and it is assumed that the elasticity of substitution between imports from different origins is twice the corresponding Armington elasticities.[26] The elasticities of factor substitution have been adopted from the GTAP project (see Dimaranan et al., 2006, Table 20.2). For the reallocation of land between different uses, the CET elasticities selected are 0.25 between different perennials, 1.1 between annual crops, 20 between livestock uses and 0.25 for the reallocation between the above three groups.

For the LES, the expenditure elasticities are taken from demand system estimations in Boysen (2012). Expenditure elasticities of item groups in the demand system are matched to the SAM commodities. The Frisch parameters are set to -1 so that there is no fixed subsistence consumption share in the demand system.

Poverty measure in the CGE-MS model

Per capita expenditure is used as the poverty-relevant income measure. To facilitate the poverty analysis from the CGE-MS results, household income is measured as the sum of the values of market and home consumption, both valued at market prices and deflated by the household-specific CPI. As real government expenditure, real investment and foreign savings in foreign currency are held constant, households are also affected by changes in required savings to finance price changes of those three items and changes in government revenue. It should be noted that our poverty classification is not directly comparable with the classification in the official UBoS report (2006), given differences in data adjustments.

Modelling and deriving the world market price shocks

CAP reforms transmit to other countries primarily through their effect on world market prices. Because a single country CGE model for Uganda is used, world market shocks owing to the CAP reform need to be given exogenously. Ideally, the behaviour of the models generating the world market shocks and the single country model should be identical. This is generally not the case.

[26] A short discussion of this 'rule of two' can be found in Hertel et al. (2007, footnote 16).

Horridge and Zhai (2005) developed one approach to narrow this gap when aligning the GTAP multi-regional CGE model and a single country model. They suggest that only applying the world market price changes to the single country model can result in export quantity changes that are inconsistent with those arising in the GTAP model. This is attributable to the fact that the GTAP model determines world market price and quantity changes simultaneously. Instead, the authors propose to adapt the single country model by introducing a downward-sloping export demand curve and shifting this curve according to the shift observed in the GTAP model. Apart from the price changes, this approach requires only the Armington elasticities and the export quantity changes from the GTAP model results as additional data. With respect to the import side, they argue that the single country model behaviour is sufficiently close to the GTAP model and hence an equivalent modification is unnecessary. Because synthetic price shocks derived from a variety of models are used in this study, this approach cannot be followed here. The Uganda model is shocked directly, without further modifications, with the world prices changes.

A second problem in linking a global with a national model is that the definitions of commodities for which the world price shocks are given may differ.[27] A concordance must be developed to link the global market shocks to the sectors used in the national SAM. To shock the Uganda model, the world price shocks have to be converted so that they are consistent with the Uganda SAM definitions. For example, the scenarios assume a price shock for sugar, which is included in the processed food sector in the SAM. As sugar is only a small share of this sector, it would not be justified to apply the sugar shock to the entire sector.

In this study, detailed trade statistics are used to identify the shares of the commodities in the imports and exports of the SAM sectors in which they are included. The calculation utilises data from the UN Comtrade database, which include values for Ugandan import and export trade for highly disaggregated products categorised according to the Harmonised System on the six-digit level (HS6). The HS6 categorisation differentiates roughly 5,000 products. To calculate the price change scenarios as applied in the model and presented in the commodities from are mapped to the detailed products of the HS6 categorisation and the price changes are applied to the 2006 trade value of the associated HS6 products, keeping values of non-affected products unchanged. Then, the HS6 products are mapped to the sectors of the SAM and, for each SAM sector, the ratio of the value of all included HS6 products after applying the price changes to that value before price changes is calculated. This ratio is taken as the price shock for the respective scenarios as shown in. As trade is composed very differently on the import and export sides and the CGE model assumes that imported and domestic products as well as exported and domestic products are imperfect substitutes, separate price shocks are calculated for imports and exports. Consequently, the derived price shocks to imports and exports for the same SAM sector can differ. As a result of the different product aggregations, the price shocks to coarse grains and wheat are included in the shock to other cereals in Table 4. Similarly, the shocks to vegetable oils and sugar are included in the shocks to other food processing, and the beef, pork and poultry meat and dairy products shocks in the shocks to meat processing.

[27] In a first step, we complete the initial by assumption. Missing shocks for coarse grains are assumed to equal those of maize and the one for vegetable oils of the liberalisation scenario to equal the oilseeds shock. Also, the shock for dairy products in the liberalisation scenario is taken as the middle of the interval given.