Prospects for Agricultural Markets and Income in the EU

Background information on the baseline construction process and uncertainty analysis

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2011
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JRC 67803
EUR 25148 EN

ISBN 978-92-79-22613-7 (print)
ISSN 1831-9424 (pdf)
ISSN 1018-5593 (print)
doi:10.2791/70546

Rome: Food an Agriculture Organization of the United Nations

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Printed in Spain
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Building, maintaining and applying an integrated Modelling Platform for Agro-economic Commodity and Policy Analysis (iMAP) has been a long-term project at the JRC-IPTS (AGRILIFE unit) since 2005, whose aim is to deliver in-house policy support to the European Commission.

An important contribution of the iMAP team to agricultural policy-making and monitoring is the construction of medium-term baseline projections, in close collaboration with the European Commission’s Directorate General for Agriculture and Rural Development (DG AGRI).

In the process of baseline construction, many current and former iMAP staff members have been involved. This report has benefitted from earlier contributions to the baseline process documentation from M. Blanco Fonseca, T. Fellmann, H. Gay, S. Helaine, M. Henseler, M. Himics, A. Kavallari, R. M’barek and J. Michalek.

The current document has been compiled by Z. Nii-Naate with the assistance of A. Burrell and T. Fellmann.
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1 Introduction

An important activity of the European Commission is the production of economic and quantitative studies of the Common Agricultural Policy (CAP) for policy development. One contribution to this activity is the Prospects for Agricultural Markets and Income in the EU (hereafter known as the “outlook”), published annually by the European Commission’s Directorate General for Agriculture and Rural Development (DG AGRI) in the second half of the year and containing medium-term baseline projections. The construction of the agricultural baseline projections involves joint efforts by DG AGRI and the Joint Research Centre–Institute for Prospective Technological Studies (JRC-IPTS). The outlook presents a consistent set of market and sector income prospects elaborated on the basis of specific policy and macroeconomic assumptions. The projections are not intended to constitute a forecast of what the future will be, but instead a description of what may happen given a specific set of assumptions and circumstances, which at the time of making the projections were judged plausible. As such, the outlook projections serve as a reference for policy simulations. They provide the context for analysing medium-term market and policy issues, rather than short-term forecasts for monitoring market developments and addressing short-term market issues.

The projections are based on market statistics, results of state-of-the-art quantitative economic models, and the judgements of commodity market experts, all being subject to specific assumptions regarding further development of macroeconomic conditions, agricultural and trade policy environment, the path of technological change, functioning of international markets, and so forth.

The outlook contains EU-wide projections of supply balance sheets (production, consumption, exports, imports, and change in stocks) for the main agricultural sectors (i.e. cereals, oilseeds, sugar, meat, milk and dairy, and biofuels1) for the next 8-10 years. It provides a description of the most probable medium-term developments in individual commodity markets, and constitutes the main reference scenario (baseline) for further ex-ante evaluations of the assessment of agricultural and trade policies. The outlook assumes status-quo policy and includes future policy changes already agreed and scheduled in the current legislation.

The structure of this document is as follows. Section 2 provides an overview of DG AGRI’s agricultural baseline process. This is followed by a description of the modelling tools used for generating medium-term projections and the OECD-FAO baseline process in sections 3 and 4, respectively. Sections 5 and 6 discuss briefly the macroeconomic setting and short-term outlook process. Calibrating Common Agricultural Policy Regionalised Impact model (CAPRI) and European Simulation Model (ESIM) to the DG AGRI baseline is presented in section 7 and the validation of models is highlighted in section 8. Section 9 briefly discusses uncertainty analysis. Finally, section 10 concludes with some insights for enhancing the baseline process.

1 And, from 2011 onwards, sugar.
2 Overview of the Outlook and Baseline Process

Apart from the European Commission, other institutions also produce a regional or global agricultural outlook every year, notably the United States Department of Agriculture (USDA), the Food and Agricultural Policy Research Institute (FAPRI), and the Organisation for Economic Cooperation and Development in cooperation with the Food and Agricultural Organization of the United Nations (OECD-FAO). In the past, the outlook for agricultural markets in the EU-27 had a seven-year horizon and was predominantly based on the results of one recursive dynamic, partial equilibrium models, namely DG AGRI’s updated AGLINK-COSIMO, model and one comparative static partial equilibrium model, ESIM (European Commission, 2009).

In 2010, the baseline process for projections of the main agricultural and food commodity markets was reviewed and considerably improved, relying on the methodological input and in close collaboration with the JRC-IPTS, by taking advantage of the newly set up ‘integrated Agro-Economic Modelling Platform’ (iMAP). IMAP not only includes AGLINK-COSIMO and ESIM, but also the CAPRI model and various Computable General Equilibrium (CGE) models.

Figure 1 describes the main analytical steps performed during the construction of baseline for agricultural commodity market developments and income.

As illustrated in Figure 1, the baseline construction has three major stages:

1. Stage 1 leads to the first draft medium-term baseline bringing together three elements. First, a consistent and coherent set of medium-term macroeconomic projections is introduced into the latest OECD-FAO Agricultural Outlook. The AGLINK-COSIMO model is used to simulate the most probable medium-term reference scenario for development of individual agricultural commodity markets worldwide and in the EU-27 (including explicit results for EU-15 and EU-12), under specific assumptions concerning developments of exogenously determined variables (e.g. macroeconomic projections and recent policy changes). Second, the Short Term Outlook (6-18 month forecasts of EU agricultural market development

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2 The European Commission publishes economic and quantitative studies of EU agriculture and rural areas as well as short-, medium- and long-term forecasts of EU and world agricultural commodity markets. The reports are accessible via the website link below: http://ec.europa.eu/agriculture/analysis/markets/
3 A multi-period model in which market equilibria in one period depend on some of the outcomes in the previous period.
4 A partial equilibrium model covers only some sectors of the economy. The clearing of markets in the sectors covered takes the prices and quantities demanded and supplied in other sectors as given.
6 The results of any analysis based on the use of the AGLINK-COSIMO model by parties outside the OECD are outside the responsibility of the OECD Secretariat. Conclusions derived by third-party users of AGLINK-COSIMO should not be attributed to the OECD or its member government.
8 CGE models are a class of economic simulation model that depicts all sectors of the economy, and the links between them. Therefore, unlike a partial equilibrium model of the agricultural sector, a CGE model can simulate the impacts of agricultural policy on non-agricultural markets, and the feedback to agriculture of any of these consequences in the wider economy.
that are published in September/October, generated by DG AGRI, based on the latest market and price developments and focusing on EU market balances for arable crops, meat and dairy products) is incorporated into the latest OECD-FAO Agricultural Outlook. The short-term outlook involves statistical analysis of the most recent data on arable crops, meat, milk and dairy, and are combined with numerous and wide-ranging qualitative judgments provided by product and commodity market experts at DG AGRI. Finally, the first draft medium-term baseline is simulated to generate world market and EU prices, and EU commodity balance sheets, that are consistent with a global market-determined equilibrium. The simulated projections may deviate from the incorporated short-term forecasts because (i) the system of equation is solved simultaneously and thus any EU data input may lead to changes in net trade via changes in domestic and world prices; and (ii) the AGLINK-COSIMO modelling system will ensure that any inconsistency in the short-term outlook is removed.

2. Stage 2 starts with a Baseline Review week and consists of three components:
a) The first draft medium-term baseline is reviewed at Baseline Review meetings between market and modelling experts of DG AGRI and JRC-IPTS. Subsequent necessary adjustments are made and a revised baseline is produced. In revising the first draft baseline, the work is broken up into commodity specialisms (arable crops, sugar and biofuels, meat, milk and dairy and agricultural income) of around ten members of DG AGRI and JRC-IPTS staff. Each group’s individual expert adjustments to the balance sheet, policy variables, and elasticities are submitted to the baseline review manager before they are merged and then simulated. This flexible and iterative approach is performed until a preliminary baseline is assembled. A key input into the baseline projections is the up-to-date input of commodity market judgements by DG AGRI experts, especially in the short-term projections. The work of the Baseline Review week is presented to around 30 product and commodity experts and senior officials for their feedback. The presentations are given by model experts and focus on balance sheet projections and areas where the modellers would benefit from the insights of commodity experts and key areas of uncertainty. The comments received are incorporated into the baseline before it is disseminated. The key output at this stage of the baseline process is the preliminary baseline, which is used as the starting point for the uncertainty assessment of the baseline and the calibration process of CAPRI and ESIM models.

b) The CAPRI and ESIM models are calibrated to DG AGRI’s updated AGLINK-COSIMO baseline, with the objective of constructing a baseline scenario for individual EU Member States, and also at more disaggregated (i.e. NUTS-2) levels. A further objective is to perform sensitivity and uncertainty analyses on the outlook projections. The calibration process is important because it allows the Commission to exploit the richer detail of ESIM’s Member State projections and CAPRI’s Member State and NUTS-2 level data that is missing from the AGLINK-COSIMO model but in a way that all simulations and policy support produced by the three models are based on the same underlying vision and consistent set of assumptions.

c) The preliminary baseline forms the basis of an outlook workshop, which is jointly organised by DG AGRI and JRC-IPTS, gathering high-level policy makers, modelling and market experts from the EU, third countries, international organisations and stakeholders. The workshop offers the opportunity to verify the reliability of the results obtained as well as to discuss how different settings and assumptions regarding macroeconomic factors and other uncertainties may influence the projections of individual commodity markets. The experts are also afforded the opportunity to present and discuss the reasons behind observed and expected market developments, and to draw conclusions about the short- and medium-term perspectives of European agricultural markets in the context of world market developments. Each year, a different special focus is emphasised in the discussions (e.g. key drivers of demand and supply or macroeconomic uncertainties) on the projected market developments. In addition, scenario and uncertainty analysis by JRC-IPTS are presented and discussed. Each year, the set of quantitative uncertainties

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9 Of the three partial equilibrium models, AGLINK-COSIMO is the only one suited to generate a baseline.
Overview of the Outlook and Baseline Process

and sensitivities undertaken varies, depending on the main areas of risk to the baseline using the DG AGRI and JRC-IPTS’s suite of partial and general equilibrium models. As part of the validation procedure, suggestions and comments made during the workshop are taken into account in order to improve the baseline projections. The adjustments to the baseline are made by the baseline review manager at DG AGRI in close collaboration with the modelling subgroups at JRC-IPTS. The simulated results are then passed for comment to the commodity experts on a bilateral basis. This process is repeated until both the modelling subgroups and the product and commodity experts are satisfied with the baseline projections. Furthermore, issues arising from the uncertainty analysis and calibration process may warrant an adjustment to the model and/or the baseline projections. The baseline is finalised after several iterations of the uncertainty assessment, calibration processes and feedback from market experts via bilateral exchanges, converge to a consensus position. At this stage, technical issues (such as the model failing to solve because of model misspecification or extreme values of input data) and expert commodity advice is incorporated into the model and baseline. An innovation that has helped to enhance transparency is the publication of the proceedings of the outlook workshop.

3. Stage 3 consists of publishing the final projections in the DG AGRI’s Prospects for Agricultural Markets and Income in the EU. These projections are then used as the Commission’s initial input into the OECD-FAO agricultural outlook process (see Box 1 for details) at end-December.

The process of creating the baseline implies that the final projections are profoundly enriched and improved by internal and external expert opinion. In producing the baseline and interpreting the uncertainty analyses, there is a very important role for expert judgement. Although expert judgment is not good at projecting actual numbers, it is good at identifying the key factors that will affect commodity balance sheets. Furthermore, by using iMAP’s suite of models for the uncertainty analysis (see section 7 for details), it is ensured that the final baseline is consistent and coherent. The baseline review and workshop ensure that the judgements of participants are taken into account in the behavioural equations of the models. However, the authorship and responsibility of the contents of the projections rest with DG AGRI.

In the following chapters, the process of constructing the baseline is described in detail to provide a better understanding of the analytical steps carried out, including the structure and the main features of modelling tools used for the preparation of the outlook for agricultural commodities.

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10 All Outlook workshop proceedings are accessible at: http://ipts.jrc.ec.europa.eu/publications/index.cfm

11 The 2011 publication is accessible via the link below: http://ec.europa.eu/agriculture/publi/caprep/prospects2011/index_en.htm

12 The reader may want to note that the satellite income module is not made available to the OECD because agricultural income is outside the remit of the OECD-FAO agricultural outlook report.
3 Analytical Modelling Tools Used for Generating Medium-Term Projections

In order to perform quantitative impact analyses of various policy options and provide scientifically sound support for policy analysis, the JRC-IPTS has built up, in close cooperation with DG AGRI, the iMAP consisting of various quantitative tools. In recent years, the three partial equilibrium agro-economic iMAP models, AGLINK-COSIMO, CAPRI and ESIM were used (both separately and also linked sequentially) in the baseline process to provide EU projections for agricultural commodities over a time horizon of 10 years. However, full linkage of the different models has proven to be too technically challenging. The models are methodologically complex and require a permanent update of their general structure, data used, as well as behavioural and technical parameters. Regular updates are an integral part of the policy simulation preparation. In this section, each of the above three models is briefly described.

AGLINK-COSIMO is a recursive-dynamic, partial equilibrium, supply demand model of world agriculture. The model merges the OECD’s AGLINK and FAO’s COSIMO models. It is managed by the OECD Secretariat in close co-operation with the FAO and some of OECD member- and non-member countries. The model is used to simulate development of annual supply, demand and prices for the main agricultural commodities produced, consumed and traded worldwide in each of the regions it covers. In its current version (2011), AGLINK-COSIMO covers about 40 agricultural primary and processed commodities and over 50 countries and regions. The AGLINK-COSIMO country and regional modules and projections are developed and maintained by the OECD and FAO Secretariats in conjunction with country experts and, in some cases, with assistance from other national administrations.

The AGLINK-COSIMO behavioural model undergoes constant review. The last major review was carried out in 2009-10. In addition, the Commission has recently updated the EU module to improve medium-term simulations and scenario analyses of commodity outlooks in EU-27. The general and EU-27 specific key revisions are reported below:

- The representation of national policies was standardised within AGLINK-COSIMO and the market closure mechanism was changed (e.g. domestic market clearance was introduced; imports and exports became functions of domestic and world prices and trade policies, etc.). Concerning the EU module, the crop commodities have been further disaggregated and the respective behavioural parameters have been revised. The revision of livestock and dairy markets as well as the introduction of a specific consumer price responsive module was concluded.

- Specific attention was paid to improving the representation of current agricultural policies in the model in order to obtain more robust scenario analyses. The model reflects the CAP after the Health Check decisions of late 2008, and includes:
  - phasing-out of milk quotas;
  - sugar quota abolition from 2015;
  - reduced intervention for wheat, butter and skimmed milk powder;
  - further decoupling until 2012;
  - maintenance of Single Area Payment Scheme (SAPS) until 2013 (inclusive);
  - abolition of mandatory set-aside; and
  - increased modulation.

International trade policy is assumed to remain in conformity with the Uruguay Round Agreement on Agriculture, and no further assumptions are made.
about the potential outcome of ongoing bilateral, regional or multinational trade negotiations.

The three models (AGLINK-COSIMO, CAPRI and ESIM) have different degrees of disaggregation over individual countries and regions. AGLINK-COSIMO represents a large number of countries and regions, ESIM covers only EU Member States, Croatia and other Western Balkan countries, Turkey, the USA and the Rest of the World (RoW). CAPRI distinguishes more individual countries and trading blocks than ESIM, but fewer than AGLINK-COSIMO. Concerning disaggregation within EU-27, AGLINK-COSIMO differentiates only between EU-15 and EU-12; ESIM covers all EU Member States, while the CAPRI model distinguishes not only Member States but also NUTS 2 regions and even farm types within each region. In order to maintain consistency of projections across models, the CAPRI and ESIM models are calibrated to the DG AGRI updated AGLINK-COSIMO baseline, using similar macroeconomic assumptions. This enables DG AGRI and JRC-IPTS to present scenario results not only for EU-27, but also at Member State level and even more disaggregated levels.

The CAPRI model is a global agricultural sector model iteratively linking a supply module with a market module. The latter is represented by a spatially linked, global multi-commodity model for agricultural products. CAPRI\(^{13}\) follows a scenario-driven approach, with three scenarios forming the backbone of the analysis:

- the baseline or reference scenario, where the model is calibrated with information coming from historical time series, other models (AGLINK-COSIMO) and expert knowledge;
- the ex post scenario, where the calibrated model replicates the base year (using historical data and past policies); and
- the policy scenario, where a specific policy shock is simulated.

ESIM is a partial equilibrium, multi-country model covering agricultural production, consumption of agricultural products, and some first-stage processing activities, with lagged price responses on the supply side in the dynamic version of the model. World market prices are endogenous. The model depicts a wide range of policy instruments, including specific and ad valorem tariffs, tariff quotas, intervention and threshold prices, export subsidies, product subsidies, direct payments for keeping land in agricultural use, production quotas and voluntary set-aside. The DG AGRI has used ESIM as a comparative static simulation model.

In most quantitative scenario analysis, researchers normally choose a specific model and try to incorporate as many dimensions of interest as can be accommodated within that particular modelling approach. As a result, the researcher is limited by what the particular model can and cannot allow for, and is often forced to make very broad assumptions about the other dimensions of the larger socio-economic picture that cannot be directly addressed. The new approach undertaken for DG AGRI’s outlook projections attempts to overcome these limitations by implementing the three models sequentially and according to harmonised assumptions, so that the different regional coverage and methodological advantages of each model can be exploited. Combining the models in this way also allows the socio-economic “drivers” that are consistently significant in all three models to be identified. To increase understanding of the various advantages stemming from the combined use of the three models, the major characteristics of ESIM and CAPRI models are provided in Chapter 7.

4 The OECD-FAO Baseline with AGLINK-COSIMO

The modelling part of the baseline work starts with the annual update of the current year’s AGLINK-COSIMO model by the OECD-FAO to construct a worldwide agricultural outlook. The process of the OECD-FAO baseline construction is set out in Box 1.

Box 1: AGLINK-COSIMO baseline projections produced by the OECD and the FAO

The AGLINK-COSIMO baseline starts with a coordination meeting between the OECD and FAO in September/October. OECD countries/regions and some non-OECD countries/regions provide information on medium-term agricultural market developments and on the evolution of their agricultural policies by means of annual questionnaire returns to the OECD. The country modules are then calibrated to this information. The simulated baseline results for the countries under the OECD Secretariat’s responsibility are compared with those obtained from the questionnaire replies and issues arising are discussed in bilateral exchanges.

For the rest of non-OECD countries/regions, the COSIMO initial projections are a combination of expert judgements from FAO commodity market analysts and model-driven projections. External sources, such as the World Bank and the United Nations, are also used to complete the macroeconomic settings that will impact on market developments.

Individual country models can be solved in stand-alone mode by maintaining all links to the world market (in particular world market prices) as exogenous.

Next, the country modules are merged to form the entire AGLINK-COSIMO model. The model is then solved simultaneously. At this stage, the global projections become relevant and additional expert judgements are adopted to obtain a consensus view shared by the Secretariat and external advisors. Based on these discussions, a second baseline is produced and discussed. The information generated from the baseline is used to prepare market assessments of the biofuels, cereals, oilseeds, meats, dairy products and sugar, which are discussed at the annual meeting of the Group on Commodity Markets of the OECD Committee for Agriculture. The final AGLINK-COSIMO baseline and storylines are agreed by the OECD, the FAO and member governments, and is made available to the public via their annual publication entitled “OECD-FAO Agricultural Outlook”.

14 Information on the OECD-FAO agricultural outlook can be found on the OECD website at http://www.agri-outlook.org
5 Macroeconomic Setting

Projections of agricultural market developments depend on three key drivers, namely macroeconomic, policy and technological developments. This section briefly focuses on the topic of macroeconomic settings. The main macroeconomic variables that affect agricultural commodities in the medium term are economic growth and population affecting demand growth, exchange rates affecting trade flows and oil prices influencing both supply and demand.

Projections of macroeconomic variables depend on the assessment of the economic situation. Therefore, as the macro-economy evolves, updates to the macroeconomic setting over the baseline process are quickly incorporated into the projections. It should be noted that non-agricultural markets are not modelled. Hence, hypotheses concerning the paths of key macroeconomic variables are predetermined with no accounting for feedback from developments in agricultural markets to the economy as a whole. Europe being a developed economy, agriculture plays a small part of the economy, thus the impact of the simplification is negligible. Incorporating feedback mechanisms would add a degree of complication to the model that is not warranted by gains in terms of accuracy of the projections.

In producing the DG AGRI baseline, the latest set of consistent macroeconomic forecasts and projections is imposed on the model. In particular, the most recent projections of population, gross domestic product (GDP), inflation rate, crude oil price and exchange rate developments are included into the model for over 20 major developed and developing countries. The in-year and year-on macroeconomic forecasts are acquired from the Directorate General for Economic and Financial Affairs at the European Commission. The medium-term macroeconomic projections are sourced from IHS Global Insight.
The short-term commodity outlook prepared by the DG AGRI is a fundamental element of the medium-term projections. The short-term outlook is undertaken periodically, covers arable crops, meat and dairy markets and consists of estimates of commodity supply balance sheets, i.e. production, consumption, trade and stocks for the current marketing year as well as projections for the following marketing year.

The DG AGRI short-term commodity outlook report is published three times per year (February, June and September) and is based on the observations and judgements of market experts within DG AGRI. Preliminary results are discussed in several interdisciplinary groups (‘outlook groups’). The various outlook groups are set up as a horizontal and interdisciplinary platform for analysing short-term developments of respective agricultural markets. Experts involved in the outlook group belong to market analysis, policy management, budget and economic and policy analysis units in DG AGRI. Results and views expressed are those of the authors only and may not in any circumstances be regarded as stating an official position of the European Commission.

As from October 2011, the short-term outlook is published in the Commission website, thus promoting transparency in both the baseline process and related policy analysis.

The latest version of the outlook (October 2011) is based on information and data available up to 15 September 2011. Production data for the 2008-2010 period come from EUROSTAT, and trade data (live and meat exports, imports) from the COMEXT database. The 2011 and 2012 short-term outlooks are based on the most recent macroeconomic and market developments and expectations. In particular:

- latest animal herd and Gross Indigenous Production forecast figures (EUROSTAT);
- latest monthly trade data and trends;
- analysis of agricultural policy environment; and
- result of trend analysis from economic models.
7 Calibrating CAPRI and ESIM

Box 2 describes how CAPRI is calibrated to the DG AGRI baseline.

Box 2: CAPRI's baseline construction process

The CAPRI baseline reflects the likely developments in agricultural markets with an 8-10 year time horizon, from global to farm type, under various assumptions concerning exogenous macroeconomic drivers (e.g. population growth, technological change, GDP growth, inflation rate, exchange rate, crude oil price) and a status-quo policy setting. The CAPRI baseline is updated in close-cooperation with DG AGRI and JRC-IPTS and an update of the CAPRI baseline is usually provided on a yearly basis. The baseline definition process builds on historical trends, expert knowledge, calibration of parameters and consistency checks.

The baseline is constructed in two main steps and distinguishes between regions represented in the supply module and those covered by the global market model. The supply models are built following a Positive Mathematical Programming (PMP) approach while the market model is a system of behavioural equations. Therefore the calibration includes both the calculation of the so-called PMP terms in the objective function of the supply models and the parameterisation of the behavioural functions in the market model.

The steps for constructing the baseline are as follows:

1. for all EU regions, trends are projected from the base year to the last projection year (simulation year). These trends are built upon historical time series, the output of the DG AGRI baseline, expert knowledge available at the MS level, and the shifts in policies foreseen from the base year to the simulation year. A Bayesian estimation framework is used to guarantee a consistent set of projections (activity levels, yields, production, feed and processing demand, human consumption);

2. the projection results at aggregated EU-27 level are taken as given when calibrating the global trade model. The respective developments in production, feed use, processing and human consumption for the different regions of the world not covered by the EU projection tool, as well as bilateral import and export flows from all trading blocks in the model have to be defined using other sources. These developments are currently almost entirely based on projections by the FAO and FAPRI. The calibration of the CAPRI market module is based on a highest-posterior-density estimator that minimises the deviations of all variables in the market module from support values while satisfying all equations of the module.
Box 3 describes how ESIM is calibrated to the DG AGRI baseline.

**Box 3: ESIM’s baseline construction process**

ESIM is calibrated annually to the DG AGRI baseline. Currently, the ESIM base-year is a two-year average (2006-2007\(^{16}\)). For the most part, the base data originates from EUROSTAT, complemented by data from other sources (including DG AGRI and FAO). The current projection horizon is until 2020. The ESIM baseline is defined at the Member State level and is based on a set of exogenous assumptions (mostly regarding the economic, technological and policy environment) as well as baseline projections from AGLINK-COSIMO.

ESIM’s baseline work starts with an update of the macroeconomic assumptions. The development of the oil price is directly imported from AGLINK-COSIMO. For population growth, GDP growth and GDP deflator, ESIM uses the same data sources as AGLINK-COSIMO but the yearly rates are calculated at Member State level. Then new information relating to the common agricultural policy or the trade policies is incorporated in the model.

Once DG AGRI makes the baseline available, real world market price projections are taken exogenously from the baseline projections to calculate relative real price changes between the base year and the last year of the projection period. Then, world market prices in ESIM are calibrated to these relative price changes. This is done by shifting commodity-specific parameters for technical progress or human demand in the “Rest of the World”\(^{17}\) aggregate until in ESIM the world market price changes are equal to those of the DG AGRI baseline.

After calibrating to world prices developments, the main ESIM results for the EU-27 aggregate (production and net trade) are compared to the DG AGRI baseline. When a major difference is detected, the source of the difference is checked and discussed within the ESIM team and with DG AGRI and JRC-IPTS’s AGLINK-COSIMO model experts. This may lead to further adjustments of the ESIM model. For example, human consumption in the EU may be shifted to follow the trends projected by the DG AGRI baseline, similarly technical progress in animal production may be added or the technical progress in yields may be adjusted to the underlying assumptions of the DG AGRI baseline.

In addition, it should be noted that the price developments of the DG AGRI baseline may not be precisely met for certain products in cases where a strong increase of prices between the base year and the end of the projection period would result in a large increase in EU-27 production that is not in line with the DG AGRI projections.

Reliability of the analytical tools applied for impact analysis of CAP related policies requires the relevant model specifications (e.g. policy instruments) to be detailed enough to represent adequately various aspects of current CAP policies, including the most important and/or sensitive impact areas. Furthermore, areas that are likely to be impacted by the same policy may be closely linked to each other (e.g. environmental policy, energy, trade, etc.). Therefore, it is especially important to adjust the analytical tools to the current situation despite the difficulty due to the fact that the CAP is continuously changing and is still subject to numerous adjustments and further reforms.

The process of calibrating the CAPRI and ESIM baselines, which is undertaken at the JRC-IPTS, is less resource intensive than creating the

\(^{15}\) As a result of high commodity prices in 2007, the base-year for some commodities is 2006.

\(^{16}\) The “Rest of the World” corresponds to all other countries less the EU-27, the USA, Turkey and the Western Balkans.
DG AGRI updated AGLINK-COSIMO baseline. The calibrated models are internally validated but no external review is undertaken. As CAPRI and ESIM are calibrated to the DG AGRI baseline, the specific market expert knowledge for the EU aggregates embedded in the AGLINK-COSIMO baseline is transferred. A set of validation checks is undertaken on the CAPRI and ESIM baselines to ensure their internal coherence, and their consistency with the DG AGRI baseline.
8 Limited Validation of the Models

The medium-term projections exploit theoretical restrictions, equilibrium assumptions and assumptions about functional forms. These technical features are combined with expert judgement to generate a set of non-stochastic\textsuperscript{18} projections that are consistent with perceived market expectations, benchmark data and economic theory.

Validating iMAP’s suite of partial equilibrium models is not possible. Each model contains a combination of empirically estimated parameters and quantitative information from the literature and there is no benchmark alternative with which to compare it. The evaluation criteria may also depend on the type of application that the model is used for. Therefore, there is no one statistic that can indicate to what extent such a model is valid. Statistics on the accuracy with which the model predicts outcomes in previous time periods (‘backcasting’) would indicate how well a given model reproduces historical numbers for specific variables of interest. However, because the model is constructed for forward-looking policy analysis, modifications to policies are continuously incorporated. As a result, performance over the historical period is less meaningful as the policy framework in the model at any particular point in time will be different from the one that prevailed in previous years.

Parameters based on past observation, whether econometrically estimated or obtained from data in other ways, summarise past behaviour in the conditions prevailing in the past. If either the behavioural reactions or the prevailing conditions are different in the future, these parameters may not capture the response of the system to future policy changes. When modellers or policy makers know that behaviour or conditions will be different, it is logical that the parameters of the model are adjusted to incorporate this information. In this context, “validation” should be judged in terms of what the information generated by the model contributes not only to the creation of the baseline but also to specific analysis of policies and markets.

\textsuperscript{17} ‘Non-stochastic’ here means that the uncertainty inherent in the assumptions about exogenous trends, on which the baseline rests, is ignored and the baseline is treated as the projected outcome, given these assumptions.
9 Uncertainty Analysis

The published baseline of the DG AGRI’s *Prospects for Agricultural Markets and Income in the EU* assumes normal weather conditions, steady demand and yield trends and no disruptions caused by factors like animal disease outbreaks or food safety issues. As such, the baseline projections depict rather smooth market developments, while in reality markets tend to move along a more volatile path as observed in the past and particularly over recent years. Part II of the Report addresses a number of uncertainties underlying the baseline projections. The main objective of the uncertainty analysis is to assess and quantify how alternative assumptions about the main drivers of demand and supply, the general macroeconomic setting, and prospects for biofuel markets could influence the projected agricultural market developments. The uncertainty analysis carried out at the JRC-IPTS makes use of different agricultural sector models, namely the DG AGRI’s updated AGLINK-COSIMO model and other models included in the iMAP platform (CAPRI, ESIM and a general equilibrium model, GLOBE).

In 2010 and 2011, a number of uncertainty analyses were undertaken covering a wide range of topics on the key drivers of uncertainty, some of which are listed below:

- changes in yield growth;
- changes in input costs;
- macroeconomic uncertainties; and
- uncertainty about the crude oil price.

The uncertainty analysis undertaken at the JRC-IPTS aims to describe how much the baseline is affected by changes in model input values via what if analysis. It investigates the importance of uncertainty in model inputs as part of the decision-making and modelling process. In 2011, the analysis of uncertainty was extended through the use of partial stochastic simulations. This method was used to assess the degree of sensitivity of the baseline projections to the macro-economy and weather fluctuations. To run these simulations, 500 sets of correlated macroeconomic variables or arable crop yields were incorporated into the modelling system and a baseline was simulated for each of them. The result was two sets of 500 alternative baseline projections that lie within the boundaries of what might be possible, given past levels of uncertainties. It is important to note that the main reason for running partial stochastic simulations is not to improve the macroeconomic projections or arable crop yield development but to ascertain the degree of uncertainty in the baseline projections due to those uncertainties.


19 In 2011, the partial stochastic analysis of macroeconomic variables included: EU GDP growth, EU and US GDP deflator, EU Consumer Price Index, brent crude oil price and the USD-Euro exchange rate.

20 In 2011, the partial stochastic analysis included soft wheat, durum wheat, barley, maize, other cereals, oats, rye, soya bean sunflower, and rapeseed yields in EU-15 and EU-12.

21 However, from time to time re-specification of model equations was undertaken to improve the properties of the behavioural equations given simulation output.
10 Conclusions

This report brings into the public domain information on the process whereby the DG AGRI currently derives its agricultural outlook. The final product of this process is an annual publication, Prospects for Agricultural Markets and Income in the EU, which presents baseline projections and analysis of EU agricultural commodity markets (cereals, oilseeds, biofuels, sugar, meat, and milk and dairy products), based on specific assumptions about agricultural and trade policies and the macroeconomic environment. The process relies heavily on the use of agro-economic and trade simulation models. However, the modelling approach is greatly enriched by expert knowledge from a wide range of specialisms and organisations (policy makers, modellers and market experts from the EU, third countries, international organisations and stakeholders). The user should bear in mind that the baseline figures are projections (assuming no changes in policy, and conditional on a set of exogenous assumptions) and should not be treated as forecasts.

The information generated by the baseline contributes to a better understanding of agricultural markets and their dynamics, helps identify key issues for market and policy makers in the development of national, regional and international policies, and provides a benchmark for use in the ex ante assessment of medium-term impacts of future market and policy developments.

A key innovation in the 2011 baseline process was the introduction by the JRC-IPTS of stochastic analysis, which supplements the baseline with information on the implications of the uncertainty underlying the exogenous assumptions, particularly macroeconomic variables and weather, for the degree of uncertainty inherent in the baseline projections of EU agricultural market and price projections. This innovation was warmly received by participants at the DG AGRI/JRC-IPTS agricultural outlook workshop.

Implementing stochastic analysis had the additional benefit of providing insights into the stability of the modelling system. As a consequence, the model was adapted and augmented to deal more robustly with specific anticipated exogenous and endogenous shocks.

Over the years, although a number of innovations have been incorporated into the baseline process, such as increasing the number of market and modeling experts involved, there are some issues that need more attention and development in the future. First, the latest AGLINK-COSIMO projections may not reflect the best information at the start of the outlook process. As well as updating the macroeconomic variables and policies, some additional adjustments may be required to ensure that the starting values of the DG AGRI simulations are realistic at the world level. Second, imposing DG AGRI’s short-term forecasts onto the modelling system may lead to unintended consequences. The short-term environment will include market sentiment that may be atypical of future years but which may be carried forward into the medium-term projections. Finally, the information gathered from calibrating CAPRI and ESIM to the DG AGRI updated AGLINK-COSIMO projections is not formally fed back into the baseline process.

To improve the information gathered in the production of baseline and uncertainty analysis, a number of initiatives will be investigated and introduced if they are deemed beneficial to the baseline process. Some of these initiatives are listed below:
10 Conclusions

• explicit adjustments (over and above what is already done) should be made to the latest AGLINK-COSIMO baseline if it is felt that world market prices have moved significantly from the published projections. This will help ensure that the transmission from world markets to the EU is in line with market expectations;

• to achieve greater information transfer between and within iMAP’s suite of partial and general equilibrium models, the scope for further sequential linking of the models should be explored, in the sense of making more use of the projection outputs of one model as inputs into another model. This will help to achieve greater consistency between models and start the longer-term work on model validation; and

• embedding a forward-looking mechanism in the stochastic baseline should yield useful information. The clear gain comes when uncertainty looking forward is greater or less than in the past.
Abstract

This report brings into the public domain information on the process whereby the European Commission currently derives its agricultural outlook, consisting of baseline projections and market-related analysis of EU agricultural commodities (cereals, oilseeds, biofuels, sugar, meat, and milk and dairy products). The baseline is conditional upon specific assumptions about agricultural and trade policies and the macroeconomic environment. The process relies heavily on the use of three complementary agro-economic simulation models, which are used sequentially to produce harmonised projections up to 2020 at different levels spatial disaggregation globally and within the EU. However, the modelling approach is also greatly enriched by expert knowledge from a wide range of specialisms and organisations (policy makers, modellers and market experts from the EU, third countries, international organisations and stakeholders). Opportunities to develop the baseline methodology are also discussed.
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