

Combining Global Trade Analysis with Regional Impact Assessment: Effects of Trade Liberalisation under the recent CAP Reform

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Abstract

The objective of this article is to show how regional programming models can be combined with a global multi-commodity trade module in order to improve policy analysis. After a discussion of model components and the mechanism that link these two models together, the EU WTO proposal is taken as an example to highlight the detailed results that can be generated by such an approach. The results show that a number of EU market prices come under pressure whereas only some EU exports benefit from the multilateral trade liberalisation. Income losses in the agricultural sector of around -9% are observed. Regions with a higher share of livestock or fruits and vegetables production in income generation are relatively more affected. The agricultural income losses are offset by increased welfare of consumers and processors, leaving the EU with a considerable welfare gain.

1 Introduction

In November 2001, the Doha Ministerial Declaration set a new mandate for further trade liberalisation following the path of reform started with the Uruguay Agreement on Agriculture. Not at least to comply with the outcome of the Uruguay round, the EU has made a number of significant reform steps since then. The latest accomplishment in this reform process is the Common Agricultural Policy (CAP) Reform of 2003. The expected development towards less supply¹ of key commodities will improve the EU negotiating position in the Doha round. But is the recent reform step sufficient to decrease pressure of European agricultural markets? Will regular market interventions be necessary to defend administrative prices? How will the contribution of agriculture to income in rural areas develop under the price pressure? Will substantial parts of land be abandoned? Answers to

¹ A detailed analysis of this recent reform for EU land use and markets can be found for example in Britz et al. (2005a).

these questions are not easy as they depend on the development of international markets under a more liberal trade environment and the future design of the complex EU agricultural border protection system. The answers are further shaped by internal market developments and the potential use of intervention instruments, since future direct premium payments are now coupled to budget developments due to the new mechanism of financial discipline.

Different aspects of the aforementioned questions have been addressed with a variety of methodological approaches.² With respect to the analysis of the impact of CAP reform on EU markets and regions, for example Chantreuil et al. (2005) use an econometric, dynamic, multi-product model (AG-MEMOD composite model) at EU level to answer part of the outlined questions. Another approach is provided by Jeroen and van Huylenbroeck (2005) who calibrate microeconomic mathematical programming models based on FADN data to execute an impact analysis of the CAP for Belgium farmers. A similar approach, but on an even smaller regional level is provided by Weinmann et al. (2005) who use a comparative static, deterministic programming model to simulated land use in the region Lahn-Dill in Germany. Common to all these modelling approaches is that they provide valuable information on projected impacts of domestic EU reform. However, when focusing on regional or national analysis, the interaction with the world market is either neglected or only partially reflected when represented by an aggregate rest of the world demand and supply function (as in the case of AG-MEMOD). On the other hand, the literature provides examples of modelling systems such as GTAP (Lips 2004, Brockmeier et al. 2005, Yu and Jensen 2005) or the FAPRI/Gold model (Binfield et al. 2004) that analyse the impacts of EU agricultural and trade reform on the global scale. However, these models are not able to reflect the regional diversity of the EU and often lack a detailed, activity-related representation of the Common Market Organisations (CMOs) of the EU. The combination of several modelling systems, as for example done at the FAL in Germany is one way to overcome some of these disadvantages and to provide impact analysis on different regional scales (Bertelsmeier et al. 2002). But even here, differences in data availability, calibration of all models to one consistent baseline and diverging simulation behaviour due to different underlying model parameters are still challenges to overcome.

² Given the countless number of models and modelling systems that have addressed some of these questions over time, we focus in our review only on very recent examples. Good overviews on the state of the art in the European modelling “community” can be found in Heckeley et al. (2001), Tongeren et al. (2001), Arfini et al. (2005), and Antón (2006).

In this article, we present a modelling system that has the unique feature to link regional programming models with a global spatial multi-commodity market model for agricultural products. The objective is to show how these different modelling approaches can be linked into one consistent modelling system and benefit from each other in terms of detailed impact analysis and policy representation on the regional and global scale. For this purpose, the recent trade liberalisation proposal of the EU is used as an example.

The paper is organised as follows. The next section describes in detail the modelling system and the linkage of programming models with a global trade model. In section 3, a brief overview on the WTO EU proposal is provided. Section 4 presents selected model results and the section 5 concludes.

2 Combining Global Trade Analysis with Regional Impact Assessment: The CAPRI Modelling System

The CAPRI (Common Agricultural Policy Regionalised Impact) modelling system is an agricultural sector model linking non-linear mathematical programming models for about 250 regions covering the whole of EU-25, Norway, Bulgaria, and Romania with a global market model for agricultural products.³ Since its first operational version in 2000 (Heckelei and Britz 2001), the model has seen a number of important advancements in scope and methodology reflected in the ever broader use for trade and CAP reform policy scenarios (Wieck and Wahl 2005, Britz et al. 2005a, Adenaueuer 2005), baseline projections for the European Commission, and the calculation of land use, biophysical, environmental and greenhouse gas emission indicators (Kempen et al. 2005, Pérez 2006). The last major revision covered the current implementation strategies regarding decoupling and premium regimes of the CAP, a re-specification of countries, products and policies (tariffs, trade preferences) in the global market module, and an expansion of the model to the new EU member states (MS). In this paper, this thoroughly revised model is applied and its main characteristics as well as the integration of the global trade model with the regional impact analysis are explained in further detail.

³ The CAPRI modelling system is maintained, applied and further developed by a network of European researchers coordinated by the University of Bonn. It is mainly funded by EU research projects. Further information can be found at: http://www.agp.uni-bonn.de/agpo/rsrch/capri/capri_e.htm.

2.1 Global Trade Analysis: The Market Module

2.1.1 Model Layout

Price interactions and bilateral trade flows between the EU-25 countries and 17 other countries or country blocks⁴ are taken into account through the market module, a comparative-static, multi-commodity model for about 40 primary and secondary agricultural products. The behavioural representation of endogenous supply, human consumption, feed, and processing demand is modelled by flexible functions that exhibit all relevant regularity conditions of standard microeconomic theory. Hence, we assume profit maximisation for producers and processing entities and utility maximisation on the demand side. Marketing balances, price transmission functions, and the modelling of a wide variety of trade policies complete the equation system. The most relevant behavioural equations are presented in the following. The data for the market module arise from the supply and utilisation accounts and trade flow matrices of the FAO (see Britz et al. 2005b).

Supply for each agricultural output j and region r is modelled by a supply function derived from a normalised quadratic profit function. Supply ($supply_{j,r}$) depends on producer prices ($Ppri_{j,r}$) normalised with a price index ($Pindex_r$):

$$supply_{j,r} = as_{j,r} + \sum_k bs_{j,k,r} \frac{Ppri_{k,r}}{Pindex_r} \quad (1)$$

where $as_{j,r}$ and $bs_{j,k,r}$ are the constant and slope terms of the function (with $k \in j$).

The system for *feed demand* is identically structured. However, not producer prices but raw product prices determined by the Armington top level aggregator ($Arm1P_{k,r}$) combined with changes in the supply of animal products ($supply_j$) weighed with feed use factors w_j determine feed demand ($feed_{j,r}$):

$$feed_{j,r} = \left(af_{j,r} + \sum_k bf_{j,k,r} \frac{Arm1P_{k,r}}{Pindex_r} \right) \sum_{j(=anim)} w_j \frac{supply_j}{supply_j^{cal}} \quad (2)$$

where $af_{j,r}$ and $bf_{j,k,r}$ are the constant and slope terms of the function, and $supply_j^{cal}$ is the supply of animal products at the calibration point.

⁴ Trade blocks in the model are: EU-15, EU-10, Bulgaria & Romania, Rest of Europe, USA, Canada, Mexico, MERCOSUR countries, Rest of South America, India, China, Japan, Rest of Asia, Australia & New Zealand, Mediterranean countries, Least Developed Countries, ACP countries and Rest of the World. The EU-15, EU-10, MERCOSUR and Mediterranean countries feature behavioural equations at single country level.

Marshallian demand function for product j (alias j') in region r are derived from a Generalised Leontief indirect utility function and used to represent *human consumption* ($hcom_{j,r}$). The demand functions depend on own and cross consumer prices ($cpri_{j,r}$), and per capita income (y_r). They are calibrated to per head consumption, and hence multiplied with the population (pop_r) in each region in order to represent total demand.

$$hcom_{j,r} = pop_r \left[d_{j,r} + \frac{\sum_{j'} bd_{j,j',r} \sqrt{cpri_{j',r} / cpri_{j,r}}}{\sum_{j'} \sum_k bd_{j',k,r} \sqrt{cpri_{j',r} cpri_{k,r}}} \left(y_r - \sum_{j'} d_{j',r} cpri_{j',r} \right) \right] \quad (3)$$

Regularity of the demand functions is ensured in the calibration process with restrictions enforcing adding-up, homogeneity of degree zero in prices, symmetry and the correct curvature of the parameter matrix bd . d represents a shift parameter.

Processing of oilseeds is modelled using behavioural functions that are derived from a normalised quadratic profit function under the assumption of a fixed input/output relation between seeds, cakes and oils. *Processing of dairy products* is also based on a normalised quadratic function that is driven by the regional differences between the market price and the value of its fat and protein content. Additionally, balancing equations for fat and protein are included in order to ensure that fat and protein content of the processing sector's output matches fat and protein contained in the raw milk.

Substitution between non-homogeneous goods is modelled based on the Armington assumption (Armington 1969). This allows reflecting trade preferences for certain regions that cannot be observed in a net-trade model. A two stage Armington system is adopted: on the *top level*, total demand for product j is divided into total imports and domestic sales from origins r ($r=r'$) ($Arm1_{j,r}$) and, on the *lower level*, substitution between different import origins are determined ($Arm2_{j,r}$) using Constant Elasticity of Substitution functions (CES).

$$\text{Arm1}_{j,r} = \text{sp1}_{j,r} \left[dp_{j,r,r'} \text{Arm2}_{j,r}^{-\rho_1} + dp_{j,r,r'} \text{DSales}_{j,r}^{-\rho_1} \right]^{-1/\rho_1} \quad (4)$$

$$\text{Arm2}_{j,r} = \text{sp2}_{j,r} \left[\sum_s dp_{j,r,r'} \text{Streams}_{j,r,r'}^{-\rho_2} \right]^{-1/\rho_2} \quad (5)$$

Arm1 = Armington 1 aggregate for product j and region r (r alias r')

Arm2 = Armington 2 aggregate (aggregate of imported products)

DSales = Domestic production sold

Streams = Imports from different origins

sp1, sp2 = shift parameters

dp = share parameters

ρ_1, ρ_2 = parameters related to substitution elasticities the respective Armington aggregates

As reflected in Table 1, substitution elasticities are in many cases set to rather high values. It is assumed that substitution between imports from different origins is generally stronger than substitution between imports and domestically produced goods. This is rationalized on the basis that consumers are more indifferent toward the different sources of imported goods compared to the choice between imported or domestic products.⁵

Table 1 Substitution elasticities for the CES-nesting in the Armington approach

Product	Substitution elasticity between import flows	Substitution elasticity between imports and domestic sales
Generally	10	5
Meats, Butter	6	4 (beef for the EU-15: 2)
Cheese, Fresh milk products	4	2
Japan, all products	5	2.5
Fruits and vegetables for Mediterranean countries, rice for the EU	0.8	0.5

Source: CAPRI Modelling System

2.1.2 Policy and Tariff Representation

The outlay of the spatial multi-commodity market module allows the integration of all types of market support and trade policy instruments separated by trading blocks and if necessary, on a bilateral basis. For the EU-25, a more explicit representation of intervention sales and subsidised exports under the WTO commitments is realised. Tariff rate quotas (TRQs), intervention sales, and subsidised exports under the WTO commitments are explicitly modelled for the EU-25. TRQs in the model are either allocated to specific trading partners or

⁵ A sensitivity analysis for the Armington elasticities can be found in Britz (2005).

open to any imports. Tariffs and imports under TRQs in the model are endogenous, so that regime switches from underfilled to binding and to over-quota imports and vice-versa along with the resulting changes in tariffs are modelled endogenously. Additionally, the model captures the remaining flexible levies in cereal markets and safeguards for sugar and rice for the EU.

Policy instruments for the other regional aggregates in the market module include bilateral tariffs, TRQs, and producer or consumer subsidy equivalent price wedges (PSE/CSE) to capture domestic policies. Policy information data of these regions is based on OECD data as used in the AGLINK model, WTO schedules, and the AMAD tariff data base⁶. Bound rates and applied rates are available as yearly series up to the year 2004. Applied rates after the year 2004 were set to the minimum of the bound rate and the 2004 rate.

2.2 Regional Representation of the EU Agricultural Sector: The Supply Module

2.2.1 Design of the Regional Supply Models

In the EU supply component of CAPRI, regional agricultural supply of 39 crops and 19 animal activities is modelled by an explicit profit maximisation approach under a limited number of constraints: land, policy restrictions, grass and arable land, crop fertiliser restrictions, and feeding restrictions based on requirement functions. The regional programming models can be seen as representative farms maximising their profit by choosing the optimal composition of outputs and inputs at given prices for the final products and variable inputs:

⁶ In order to arrive at tariffs for the product definition of CAPRI (HS2 to HS3), we use a 50:50 mix of two aggregation algorithms: *import weighted tariff averages* (representing the tariff line in a specific country or trade block) and *world-trade weighted averages* (representing the tariff line in the overall world trade).

$$\begin{aligned} \max_{x_i \geq 0} \pi &= \sum_{i=1}^n mg_i x_i \\ \text{s.t.} \sum_{i=1}^m a_{li} x_i &\leq b_l \quad [\lambda] \end{aligned} \tag{6}$$

π = objective function (agricultural income)

x_i = production level of activity i

b_l = level of constraint l (physical or economic)

mg_i = gross margin of activity i (revenues plus premiums minus costs)

n, m = number of activities and constraints respectively

a_{li} = matrix of coefficients which link constraints and activities

λ_l = marginal value or 'price' associated with the constraint l

The interaction of the production activities in simulation is mainly due to resource and policy constraints since the objective function does not comprise inter-activity terms. Hence, in the optimum, the Kuhn-Tucker first order conditions of the programming model ensure that marginal revenue (consisting of market revenues and premiums) are equal to marginal costs. The marginal costs include accounting costs, opportunity costs of binding resources, and a non-linear cost component derived from a PMP based approach (see Heckelei and Britz 2005). The non-linear cost term covers the supply effect of all factors not explicitly handled by the restriction such as capacity constraints, rotational effects, or reduced form risk representation and aggregation errors (Heckelei 2002). The calibration of the cost parameters ensures that observed base year activity levels satisfy the conditions for optimal land allocation given prior information on supply elasticities. Data used in the supply module is based on the NEW CHRONOS and REGIO databases of EUROSTAT and subjected to consistency algorithms which ensure compatibility between regional production activities and national economic account and the allocation of inputs to production activities using prior engineering information (Britz et al. 2002).

2.2.2 Modelling of CAP Domestic Support

A detailed modelling component allows for the definition of payment schemes linked to output or activity levels in combination with ceilings in physical (hectare or head) and/or value terms. Both, output and activity level premiums can be based on current or historic data and payments may differ across MS and NUTS 2 regions. If the updating of the premiums between iterations result in a premium sum or number of eligible hectares/heads that overshoots the ceilings, premiums are cut proportionally in order to meet the obligations. In addition, this activity-based, regionalised approach allows for the introduction of different degrees of decoupling as well as different options regarding the payment base (regional flat

rate, farm specific payments, or combinations thereof for schemes moving towards a regional flat rate over time).

2.3 Linking of the two Modules

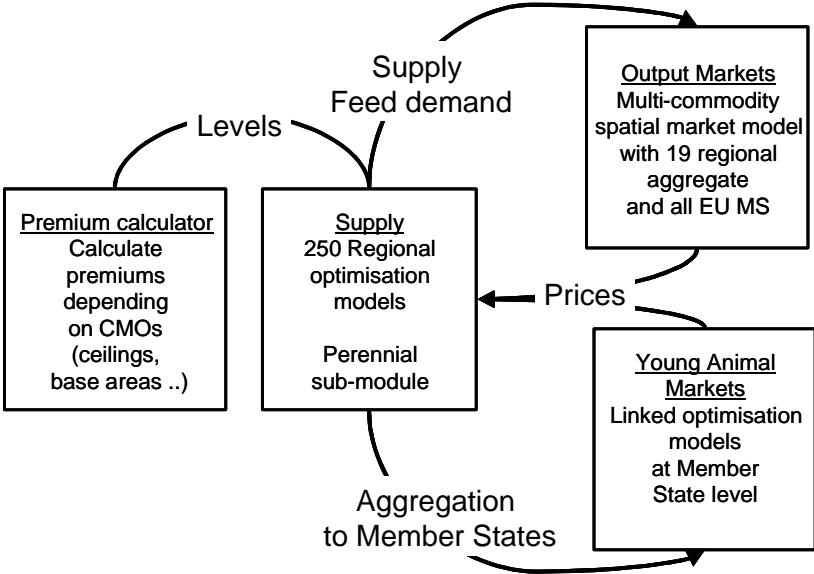
The two modules presented are stand-alone policy models in their own right. However, given the objective of the CAPRI modelling system to provide a rich, regionally differentiated EU policy analysis that accounts for the role of the EU as an important, price setting player in the global market (“large country assumption”), a mechanism has to be found to combine these two models. This is necessary since the simultaneous solution for endogenous supply and prices of an integrated version of the two modules is technically impossible.⁷ Hence, the supply and the market module are linked by an iterative procedure where supply and feed demand as they result from the EU-supply module are approximated in every iteration of the market module. This allows for model convergence to market clearing prices and quantities without compromising the specific features of each module.

In every iteration, all regional programming models are solved with exogenous prices resulting from the previous iteration of the market module (see Figure 1).⁸ In the next step, the supply and feed demand functions of the market model must be approximated in order to reproduce the aggregated feed and supply results from the regional supply models. This is done by adjusting the intercept of the supply and feed demand functions. Finally, the squared spatial equation system of the market module is solved and the resulting producer prices at MS level transmitted back to the supply module for the following iteration.

⁷ The global trade model already contains around 26000 variables. Each of the programming models adds another 1000 variables.

⁸ In the first model iteration, prices from a previous run are used.

Figure 1 Link of modules in CAPRI

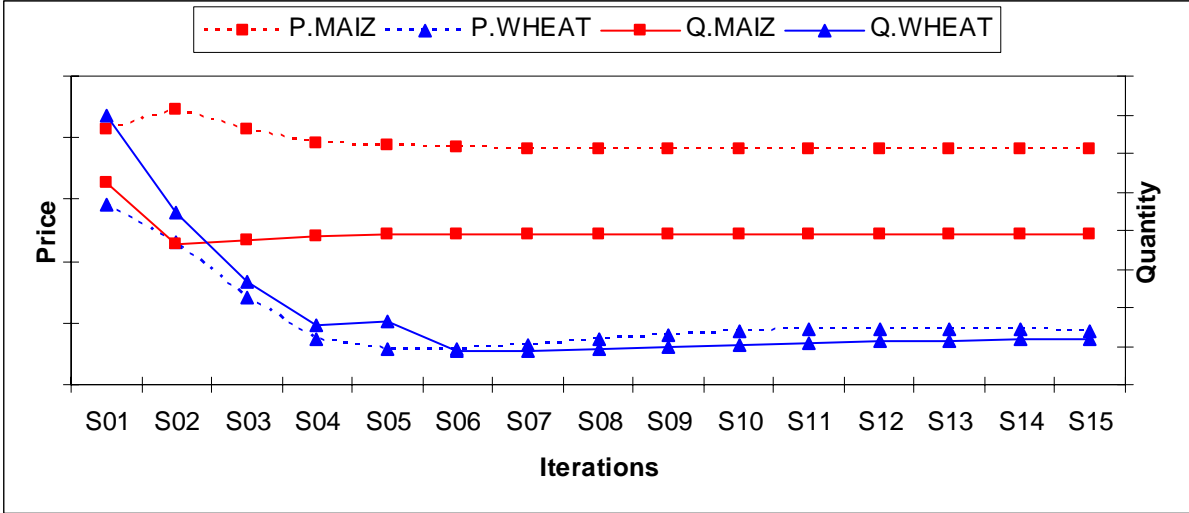


Source: CAPRI Modelling System

In between iterations, premiums for activities are adjusted if ceilings as defined in the CMOs are overshoot. In addition, in an intermediate step, young animal prices are determined. Having solved the regional models, their results (crop areas, herd sizes, input/output coefficients, supply, and demand quantities) are aggregated to MS level programming models and their objective functions calibrated to the results of the supply module using PMP techniques. Young animal prices are determined by linking these calibrated models into a non-spatial EU model with a common market balances for young animals.

This iterative procedure is repeated until convergence of price and quantity developments between market and supply module is achieved. Figure 2 shows that this takes usually between 8-10 iterations, however the standard iteration choice is 15. Hence, it is safe to assume that convergence of the final solution is achieved. In order to underpin this argument, Table 2 presents some convergence statistics for selected variables. We see that for the presented model variables the respective price or quantity deviations resulting from the iteration between supply and market module over the last three iterations was less than 0.5% in terms of the variable level.

Figure 2 Example for convergence



Note: Quantities have been scaled with a constant. P = Producer price, Q = EU Total Production.
 Source: CAPRI Modelling System

Table 2 Convergence measures for selected variables

		P.MAIZ	P.WHEAT	Q.WHEAT	Q.MAIZ
Average of first three iterations	abs diff	0.03	0.36	89.06	0.95
Average of last three iterations	abs diff	0.00	0.01	-0.74	0.00
Final difference relative to variable magnitude	%	0.00	0.01	0.00	0.00

Note: P = Producer price, Q = EU Total Production.
 Source: CAPRI Modelling System

2.4 The Construction of the Baseline

The aim of a baseline is to provide a reference point for counterfactual analysis. Ideally, the baseline scenario should capture the most probable development of all exogenous elements of an economic model, and the economic model should create a set of endogenous results in response to these exogenous elements. For large systems as CAPRI, complex interrelations between technological, structural and preference changes for agricultural products worldwide, in combination with changes in policies, population, and non-agricultural markets render that a demanding exercise.

In CAPRI a combination of two approaches has been selected: Expert data on future trends are obtained from well-known sources (see Table 3) and own trend projections using time series from the current CAPRI database are fed into a Highest Posterior Density estimator (Heckeley et al. 2005) which chooses the most likely combination of forecast value subject to

a larger set of consistency restrictions ensuring mutual compatibility of time series and expert trend data. Some key results are lined up with the latest available market outlook for agricultural products by the European Commission.

Table 3 Exogenous drivers considered for the baseline construction

Exogenous drivers	Assumptions
Inflation	1.9 % per annum
Growth of GDP per capita	2.0 % nominal per annum for the EU10, 5 % for India, 1.5 % for USA, 4 % for Russia, 1.5 % for Least Developed countries and ACPs, and 1 % for the rest.
Demographic changes	EUROSTAT projections for Europe and UN projections for the rest of countries in the world
Technical progress	0.5% input savings per annum (affecting exogenous yield trends), with the exemption of N, P, K needs for crops where technical progress is trend forecasted
Domestic Policy	National decisions on coupling options and premium models, with their expected implementation date for the EU-25 MS (Massot Martí 2005)
Common Market Organisations	Supply and demand shifted according to the expert forecasts (European Commission 2005a)
Trade policy	Final implementation of the 1994 Uruguay round plus some important bilateral/regional agreements (NAFTA, ACP, etc.)
World markets	Supply and demand forecasts (FAO 2003).

Source: CAPRI Modelling System

For the regions represented by regional supply models (EU-25, Bulgaria&Romania, Norway) the consistency restrictions cover land balances, market balances, animal feed restriction, policy instruments (milk quotas, set-aside restrictions), and dairy processing fat and protein balances. After these projection results on production activity levels and supply and demand quantities are available, a second step defines developments in all other world regions that are in line with the projections generated in the first step. The restrictions in the second step cover all quantity and price transmission equations comprised in the market model. These second step projections hence cover production, demand (feed use, processing, human consumption) for all countries not mentioned above, and bilateral trade, and prices for all country blocks included in the market module.

3 Application of the Modelling System: Market Access

Liberalisation of the EU

3.1 WTO Proposal of the EU

With the approaching of the 6th Ministerial Meeting in Hong Kong in December 2005, the negotiation process gained speed. After the presentation of a proposal that was criticised for

the lack of ambition (FT 2005), the EU submitted a second revision at the end of October (European Commission 2005b). Market access remains the most contentious pillar where additional significant pressure on EU agricultural markets and income could arise from.

Table 4 presents the numerical targets for tariff reductions laid out by the EU for developed and developing countries. The “July framework agreement of 2004” allows each WTO member to designate an appropriate number of tariff lines as “sensitive products” (WTO 2004). For these products lower tariff reductions but larger tariff rate quota (TRQ) expansions shall hold. However, the specific tariff lines compensated through TRQ expansion and reduction commitments for in- and over-quota tariffs still have to be negotiated. In its proposal, the EU requires around 8% of total tariff lines to be designated as “sensitive” and link the associated TRQ expansion to the deviation of the tariff reduction from the overall reduction commitment. Hence, products with tariffs that are cut by a lower percentage will see a higher increase in the TRQ quantity.

Table 4 EU Proposal for tariff reduction (28th of October 2005)

Band no.	Developed countries		Developing countries	
	Thresholds (%)	Cuts %	Thresholds %	Cuts %
1	>90	60	>130	40
2	>60<=90	50	>80<=130	35
3	>30<=60	45	>30<=80	30
4	0<=30	35	0<=30	25
Implemented average cut		47.5	32.5	
Proposed average cut		46	36	
Proposed tariff cap		100	150	

Note: All tariff cuts are linear cuts. Thresholds are based on ad valorem equivalents (AVEs). The deviation of our implemented cut from proposed tariff cut results from the flexibility within the each band that cannot be considered in the approach here.

Source: Own compilation based on European Commission (2005b)

3.2 Scenario Description

Our simulation approach follows the targets laid out in Table 4. The EU proposal leaves some scope for interpretation given that a “line-by-line” cut together with some flexibility in the different tiers is proposed. Without any further knowledge, we rely on a line-by-line cut according to the product definitions represented in the model. The ad valorem equivalents (AVEs) used to define the tariffs cuts for specific tariffs are calculated as a 25%-75% weighted average of region specific and global import prices.⁹ Tariff cuts are applied to bound

⁹ Given the prices available in this modelling system, this approach remains as close as possible to the final outcome of the decision on AVEs by WTO members (see ICTSD 2005).

rates only, hence a change in a bound rate may not provoke an equal change in the applied border protection, since the model uses the lower of applied and bound rates.

The system incorporates all relevant TRQs. The EU proposes that the increase in the TRQ volume is inversely related to the reduction of in- and over-quota TRQ tariffs, i.e. countries that decide to reduce the TRQ tariffs only by the least percentage possible have to compensate this through a TRQ volume increase. The EU proposes to allow a minimum deviation of one third and a maximum deviation of two thirds from the tariff cuts set out in the respective tariff bands. Hence, we have chosen to reduce in- and over-quota tariffs by 50% of the tariff cut in the band in which the line falls. The TRQ expansion is then calculated according to the methodology provided by the EU (European Commission 2005c). Finally, given that decisions on the number and designation of “sensitive products” are pending, and acknowledging the relatively high product aggregation in the model, no additional assumptions about sensitive products were introduced in the scenario set-up. This could mean that tariff reductions are overestimated for some products.¹⁰

4 Selected Results

In order to underline the feasibility of the presented modelling approach and to gain insight into the type of information generated, we present selected results from the market and supply module. Given the modular structure of the CAPRI modelling system, a relative large number of indicators are available (e.g. prices, supply, demand, trade flows, input use, herd sizes, environmental indicators). However, due to space limitations, we only present a brief overview on market developments and welfare, and selected disaggregated regional results.

4.1 Selected Results at EU Level

4.1.1 Market Developments

Table 5 provides an overview on market developments for selected commodities. A picture of the tariff reductions and TRQ expansions is presented in the Appendix. *Cereals* tariffs are cut by -30% and the respective TRQs are increased by around 13% compared to the baseline. Given the low tariffs in the existing border protection system, the additional reduction of tariffs does not significantly increase the price pressure. Producer prices in the EU decrease

¹⁰ We work towards a solution where it will be possible to simulate tariff reductions on individual tariff lines. This will allow implementing the EU proposal which foresees that up to 8% of the tariff lines may be designated as “sensitive” and where lower tariff cuts will apply (European Commission 2005b).

by around -3% with wheat showing the most pronounced decrease (-3.4%). The tariff reductions lead to import increases for wheat (+13%/+408,040t) and barley (+14%/67,601t), however in absolute terms the import penetration in the European market still remains low, and consequently production is only slightly affected (around -0.4% in average). Main beneficiaries of increased market access are Bulgaria&Romania and the USA for wheat and “Rest of Europe¹¹” for barley.

For the *other crop outputs*, the most pronounced developments can be observed in the potatoes market. The strong import surge (+261%/7,026,450t) reflects the tariff cut of -60%, however, export gains (+74%/3,112,140t) and stimulated demand (+1.5%) contribute to a producer price stabilisation at 74 €/t (-9%). Import increases originate mainly from “Rest of the World¹²” and the Mediterranean countries. EU’s export gains result from increased trade flows to these two destinations as well.

The market for sugar¹³ shows only slight changes in market balance and price due to its reduced tariff cut (-25%) and the TRQ system with high over-quota tariffs still in place. Oilseeds production displays a modest increase (+1.1%/238,380t) which is mainly associated with export gains (+5%) resulting from the multilateral tariff reductions.

The *fruit and vegetable* market is significantly affected by the tariff reductions: strong import increases for tomatoes (+2,946,880t), apples, pears and peaches (+9,896,110t), and citrus fruits (+1,733,410t) follow the tariff developments and depress producer prices significantly (around -13% for these products). Given that exports and EU demand of these products shift upward, the net effect on production is less drastic with changes in the range of -1.4% (citrus fruits) to -2.8% (tomatoes). The EU tariff reduction is in particular beneficial for imports coming from Bulgaria&Romania and the Mediterranean countries (tomatoes), and for Mercosur countries and “Rest of the World” for apples, pears and peaches and citrus fruits. The EU, on the other side, can increase exports of these products to its main export destinations USA, “Rest of the World”, and “Rest of Europe”.

¹¹ Contains e.g. Ukraine, the Balkan states, Switzerland, Iceland.

¹² Contains e.g. Russia, South Africa, countries in the Middle East, Saudi Arabia.

¹³ Note that the decision of the recently passed EU sugar market reform are not implemented in this scenario.

Table 5 Market balances and price developments (EU proposal / CAP Reform in %; year 2012)

	Net production	Demand	Imports Non EU	Exports Non EU	Producer price
	1000 t	1000 t	1000 t	1000 t	Euro / t
Wheat	126725.43	114165.95	3541.06	16100.54	106
% change	-0.4%	0.4%	13.0%	-3.2%	-3.4%
Barley	55092.82	52835.67	539.43	2796.58	102.73
% change	-0.2%	0.5%	14.3%	-10.2%	-3.2%
Grain maize	55981	56402.73	4252.19	3830.46	114.09
% change	-0.6%	-0.9%	-0.3%	4.7%	-2.4%
Oilseeds	22724	53373.49	30930.93	281.44	230.12
% change	1.1%	0.4%	-0.1%	4.6%	-0.6%
Sugar	19513.92	16338.93	1855.98	5030.97	604.31
% change	-0.6%	1.2%	5.9%	-3.9%	-6.9%
Potatoes	53298.72	55717.48	9718.97	7300.21	74.38
% change	-5.4%	1.5%	261.0%	74.3%	-9.3%
Tomatoes	25975.3	25703.87	3682.02	3953.45	380.62
% change	-2.8%	2.8%	400.9%	61.7%	-12.4%
Apples, pears, peaches	17101.43	17752.5	4275.89	3624.82	393.26
% change	-1.6%	1.9%	109.7%	80.3%	-13.0%
Table grapes	2567.8	3337.88	1417.14	647.06	916.83
% change	-0.4%	-4.6%	-3.4%	18.4%	-3.3%
Citrus fruits	10717.3	17838.73	11319.63	4198.2	341.78
% change	-1.4%	-2.8%	18.1%	99.9%	-13.4%
Table wine	18397.9	19788.54	2064.41	673.77	973.45
% change	-0.4%	0.5%	14.6%	17.8%	-3.2%
Olive oil	2564.12	2346.86	104.86	322.12	3310.87
% change	-0.2%	0.1%	23.4%	4.0%	-3.8%
Beef	7710.1	8333.42	628.39	5.07	1912.71
% change	-0.7%	0.7%	19.7%	-42.3%	-6.0%
Pork meat	21179.4	20707.09	135.65	607.96	1352.55
% change	-0.2%	-0.6%	21.1%	21.2%	-1.3%
Poultry meat	11202.4	11004.1	83.94	282.24	1161.24
% change	-0.6%	-0.6%	0.7%	-1.6%	-1.7%
Eggs	7484.81	8024.27	556.25	16.79	854.89
% change	-2.0%	-0.8%	20.2%	19.0%	-2.5%
Butter	2034.09	2091.91	167.06	109.24	3177.21
% change	-0.8%	0.8%	26.8%	1.9%	-5.3%
Skimmed milk powder	2077.57	3136.81	1109.69	50.45	1898.05
% change	-1.8%	2.1%	12.8%	93.9%	-7.6%
Cheese	8607.55	8358.6	20.23	269.18	4970.26
% change	0.2%	-0.1%	13.7%	9.9%	-3.7%
Fresh milk products	57352.36	56111.07	1156.65	2397.94	492.21
% change	-1.3%	0.0%	424.1%	7.7%	-4.6%

Source: CAPRI Modelling System

Markets for *animal outputs* in the EU are mostly protected by TRQs where lower tariff cuts are compensated with a TRQ increase. The most notable developments take place on the beef market where an 18% increase of the TRQ still does not lead to a TRQ underfill. However the continuing high over-quota tariff prevents over-quota imports into the EU. Nevertheless, the increased imports (+20%) are sufficient to depress producer prices by -6% and reduce

production by around -52,210t. For poultry and pork meat lower tariffs and TRQ expansion stimulate imports, however the import penetration ratio remains low and we observe only very modest impacts on prices and production. For eggs, production is reduced by -2% given that imports increase by +20% (+93,530t) but the price impact remains light with -2.5%. The Mercosur countries are the main source for beef import increases whereas for pork meat the origins are Canada and the USA.

Except for cheese, tariffs for *dairy products* are reduced according to the highest tariff reduction tier and the market development showing significant import increases and price reductions reflects this. However, butter and skimmed milk powder markets are still protected by binding TRQs so that the import surges are kept to +27% and +13%, respectively, with the additional imports mainly originating from Australia&New Zealand and “Rest of Europe” (only skimmed milk powder). The market for fresh milk products is not regulated by a TRQ system and here, much higher imports are recorded (+935,940t). However, the import penetration ratio remains low, and exports are slightly stimulated (+171,320t), so that a production decrease of only -1.3% (+750,730t) is observed. Cheese production and trade follows a different pattern where exports (+10%/+24,300t) benefit from the trade liberalisation worldwide (mainly directed to “Rest of the World”, “Rest of Europe”, and the USA). Hence, the production is somewhat increased (+0.2%) and we observe a more modest producer price decrease of only -4%.

4.1.2 EU Welfare

The effects of the WTO proposal on EU welfare are presented in Table 6. The overall welfare gains of the EU from the multilateral trade liberalisation are positive (+8002 Mio € or +0.03%). However, these welfare gains are unevenly distributed: we note a strong reduction in agricultural income (-13604 Mio € or -8%), whereas consumers benefit from lower prices (+19258 Mio € or +0.07%).

Table 6 Change in EU welfare (EU proposal / CAP Reform; year 2012)

	Welfare	
	absolute change (Mio €)	% change
Agricultural Income	-13604.03	-7.92%
Consumer Surplus	19258	0.07%
Tariff Revenues	-2466.01	-18.89%
FEOGA Budget Outlays	-603.36	-1.33%
Processing Profits	4210.72	3.56%
Total Welfare	8002.04	0.03%

Source: CAPRI Modelling System

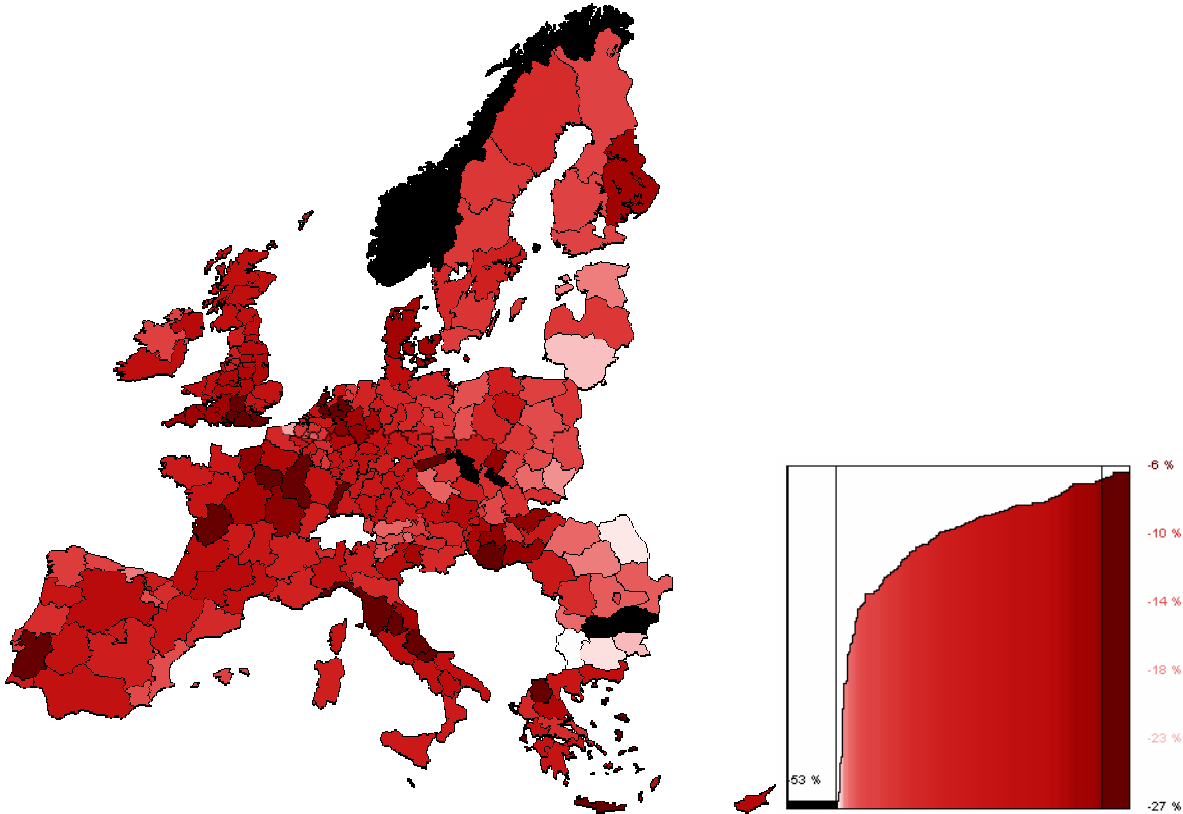
Tariff revenues decrease, while profits from the processing industry increase. The FEOGA budget outlays benefit from the elimination of export subsidies (-987 Mio €). However, the expenditures for intervention measures increase by nearly 18% (+163 Mio €). Overall, public expenditure on the first pillar of the agricultural budget decrease by -603 Mio € or -1.33%, a rather small budget relief compared to around 40 Bio € allocated in the baseline.

4.2 Selected Results in EU Member States at Regional Level

4.2.1 Agricultural Income

The following map shows changes in agricultural income (measured as gross value added plus premiums) of the EU WTO proposal compared to the baseline. Losses in agricultural income can be observed in all EU regions depending on the production structure and market price developments.

Figure 3 Change in agricultural income per hectare (EU proposal / CAP Reform in %; year 2012)



Source: CAPRI Modelling System

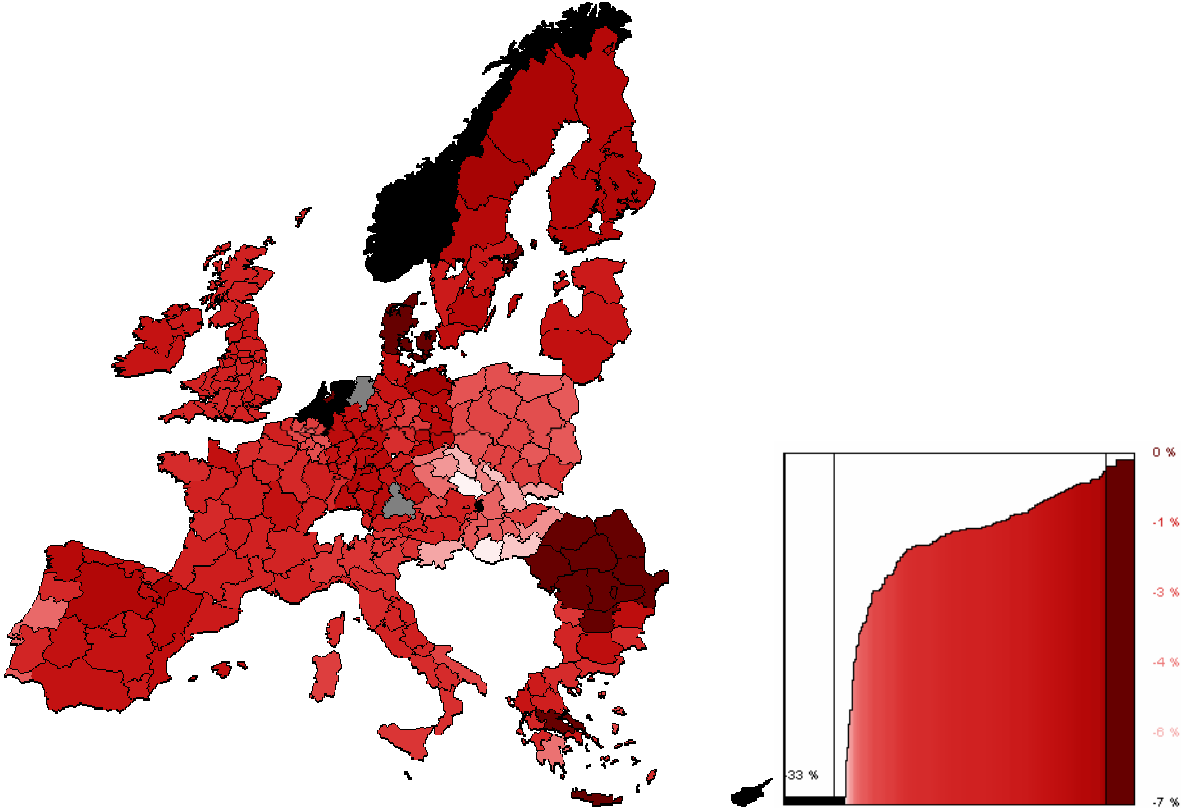
The average regional income reduction is around -9%. Income decreases of more than the EU average are shown in lighter red colours and the regions with the strongest income reductions (around -27%) in black. These income losses are significant in areas where the weight of

cattle or fruit and vegetable production in income generation is high. This is the case in Sweden, the new EU members, and parts of Ireland, Finland, and Spain. Lower income losses compared to the EU average are shown in dark red and can be found in regions with a focus on cereals and oilseed production (parts of France, Spain, Germany, and Italy, Denmark) where unaffected premium payments represent a large share of income.

4.2.2 Production Development for Selected Activities

Given the significant price decreases in the beef sector and related losses in agricultural income compared to the baseline, we want to show how these losses are mapped into changes in herd sizes across EU regions. In Figure 4, changes in activity levels for intensive male cattle fattening are presented.

Figure 4 Change in herd size of intensive male cattle fattening (EU proposal / CAP Reform in %; year 2012)



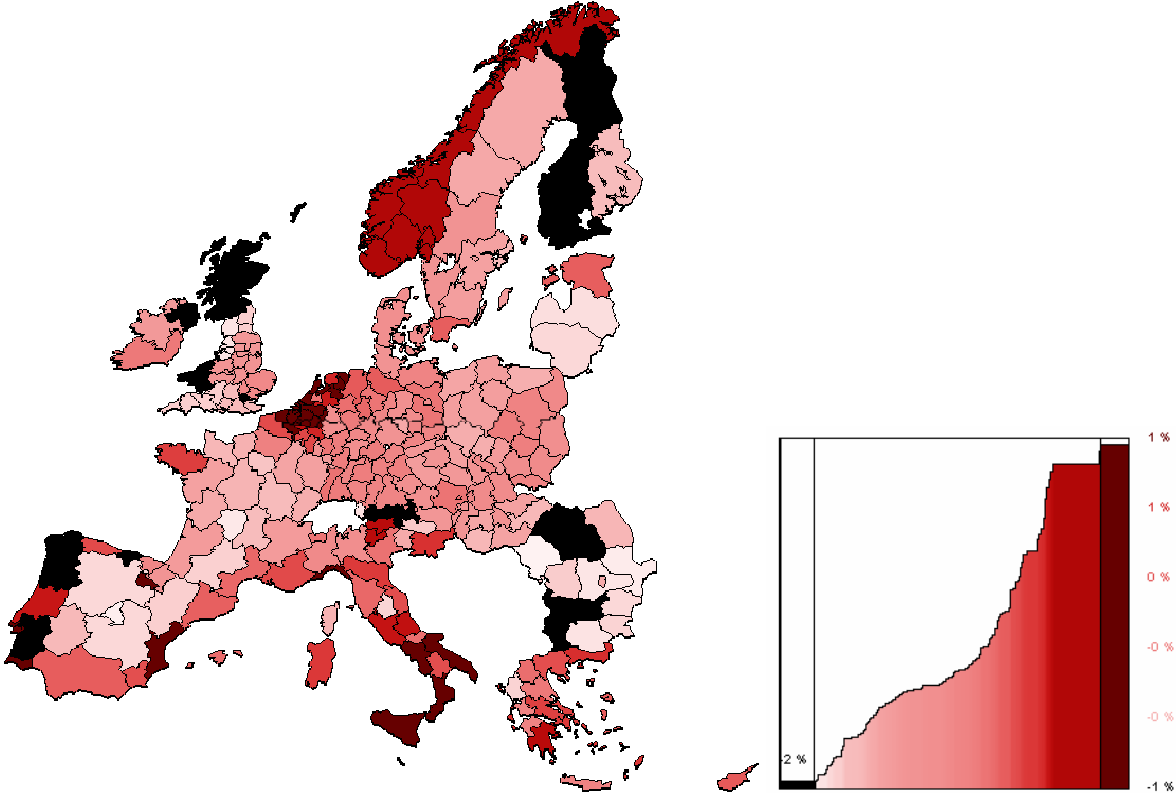
Source: CAPRI Modelling System

In most regions, male adult cattle herd sizes are reduced by around -1% with some regions showing slightly stronger developments (e.g. regions in the Netherlands, Belgium, Italy, Poland, and Hungary). The lower herd size reductions of around -0.5% for the EU average in less intensive adult cattle fattening (not represented here) indicate that we may observe a shift to more extensive productions systems. Reductions in the input costs of male cattle fattening,

in particular for the main inputs remonte and fodder, are main factors for these small herd size changes.

The small reduction of cereal prices as indicated in Table 5 is reflected in the small impacts on land allocation to cereals (see Figure 5). We observe average regional changes of around -0.19%, with slightly stronger reduction of -2% to -3% in central Spain, central France, northern UK, and central Europe. Within the cereals aggregate, most reductions relate to the production of soft wheat and grain maize.

Figure 5 Change in cereals area (EU proposal / CAP Reform in %; year 2012)

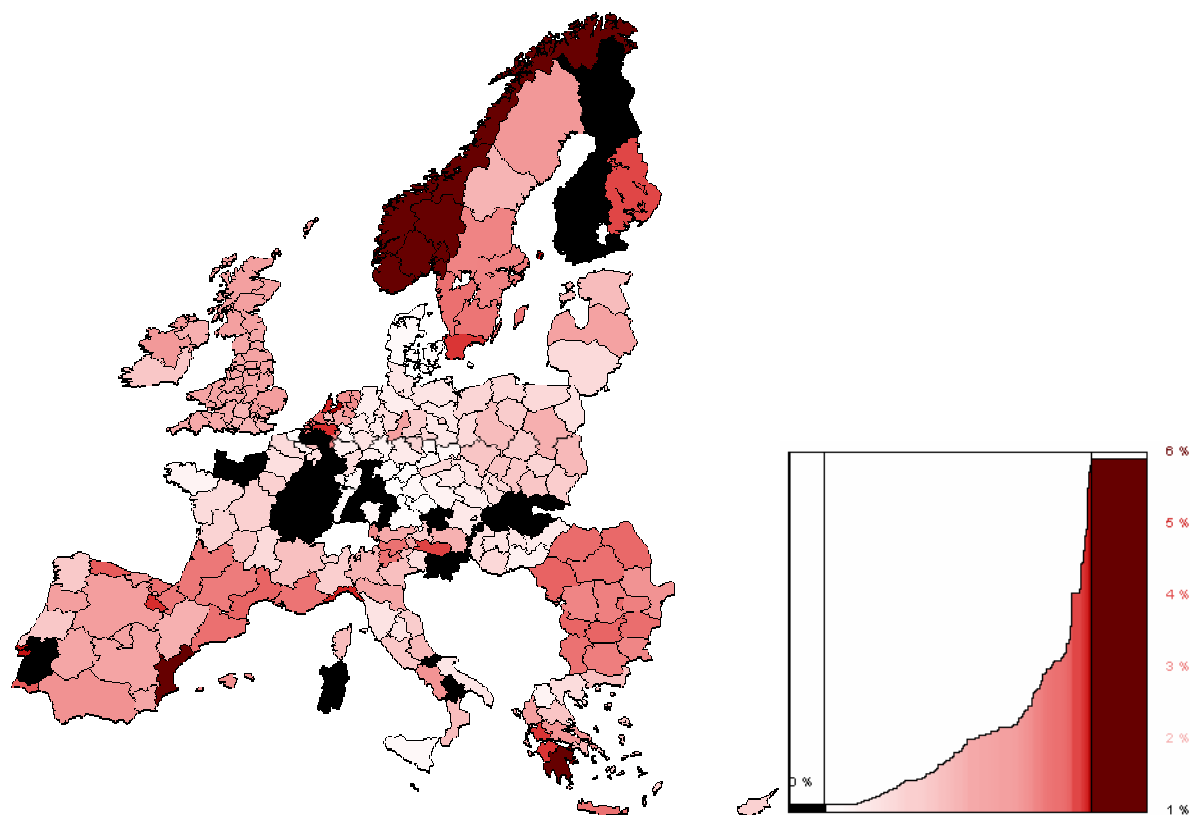


Source: CAPRI Modelling System

4.2.3 Development of Marginal Land Use

Finally, we analyse how the use of marginal land is affected by trade liberalisation. Contrary to the reform of the domestic CAP, premium payments remains unchanged in a trade policy scenario. However, given the overall decrease in producer prices marginal land (set-aside and fallow land) increases by +1.48% or +219,320 ha. The distribution across regions is shown in Figure 6. Increases in land abandonment that are above the European average can mainly be observed in Spain, southern France, Hungary, Sweden, and northern UK.

Figure 6 Change in fallow land and set-aside areas (EU proposal / CAP Reform in %; year 2012)



Source: CAPRI Modelling System

5 Résumé: The regional impact of trade liberalisation

The objective of this article is to show how regional programming models can be combined with a global multi-commodity trade module in order to improve domestic and trade policy analysis. After the discussion of the model components and the mechanism that link these two models together, the EU WTO proposal for trade liberalisation is taken as an example to show the detailed results that can be generated.

Given the still high level of EU's border protection in many agricultural markets, significant reductions in prices cannot be avoided when market access is improved. The global results indicate that the EU market prices for selected products such as beef, butter, or citrus fruits still come under significant pressure and that EU exports show only minor gains from the more liberal trading environment. Thus, in overall, we observe income losses in the agricultural sector in the range of -6% to -16%. Using the regional breakdown of the modelling system, we analyse how these losses are distributed across regions. Regions where the share of livestock activities or fruits and vegetables production in income generation is high are relatively more affected than other regions. Additionally, a larger part of the income

losses will show up in lower land rents. That effect could help to offset the impact on farm income as significant part of the land rents go to non-agricultural land owners. Furthermore, lower land rents may speed up structural change, softening the income loss per labour unit. But clearly, rural areas would lose both income and labour in the agricultural sector compared to the status quo. In conclusion, the CAP reform with the decision to move on with the decoupling of even more premium categories and additional reduction of intervention prices set the right price signals for the agricultural sector. In addition, further trade liberalisation within the WTO framework will still increase the price and income pressure farmers already face. However, the agricultural income losses are offset by increased welfare of consumers and processors that, overall, leave the EU with a considerable welfare gain.

6 Appendix

Table 7 Overview on tariffs and TRQ instruments of the EU

	Tariff cut according to band #	TRQ Base year	TRQ Expansion by	TRQ Simulation year
Wheat (global)	1	binding TRQ	13%	over-quota imports
Barley	1	binding TRQ	14%	over-quota imports
Grain maize	1	over-quota imports	13%	over-quota imports
Oilseeds	no tariffs		no TRQs	
Sugar	2	binding TRQ	6%	binding TRQ
Potatoes	1		no TRQ	
Tomatoes	1		no TRQ	
Apples pears, peaches	2		no TRQ	
Table grapes	3		no TRQ	
Citrus fruits	2		no TRQ	
Table wine	3		no TRQ	
Olive oil	3	over-quota imports	5%	over-quota imports
Beef (global)	1	binding TRQ	18%	binding TRQ
Pork meat (global)	3	underfilled TRQ	6%	underfilled TRQ
Poultry meat (global)	4	binding TRQ	2%	underfilled TRQ
Eggs	2	underfilled TRQ	8%	underfilled TRQ
Butter (global)	1	binding TRQ	15%	binding TRQ
Skimmed milk powder (global)	1	binding TRQ	12%	binding TRQ
Cheese	3	underfilled TRQ	7%	underfilled TRQ
Fresh milk products	1		no TRQ	

Note: "Global" means that the information provided in the table refers to a quota open to all importers. In addition, there may be bilateral quotas in the respective markets that are not represented here.

Source: CAPRI Modelling System

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