Top Down, and a little Bottom Up: Modelling EU Agricultural Policy Liberalization with LEITAP and ESIM

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Abstract: This paper presents a simulation analysis for EU agricultural policy scenarios based on the combined use of a PE (partial equilibrium) and a GE (general equilibrium) model. In order to draw upon the strengths of both model types, the PE model ESIM (European Simulation Model) and the GE model LEITAP are combined to analyze four agricultural policy scenarios until the year 2020, including a baseline with moderate reforms as well as a full liberalization of EU agriculture. Compared to the pronounced developments of the agri-food sectors under the baseline, the impact of policy scenarios is rather small. Real agricultural prices in the EU fall by about 20% under the baseline, whereas the additional price decrease in case of full liberalization is only 14%. Agricultural supply in the EU is rather stable. Even under full liberalization, agricultural supply will not decline dramatically: it falls by about 10% if compared to the baseline. The contribution of the agricultural and food sector to the overall economy of the EU is rather limited. The full liberalization of the EU agricultural sector results in a decline of the shares of the agri-food sectors in total GDP by 0.11 percentage points and in total employment by 0.08 percentage points. The consideration of a decline of agricultural factor prices for capital and labor matters for the supply response, but not too much. Farm supply for the EU-25 is 0.5% higher when taking into account lower factor prices after liberalization.

1 Introduction

PE models depict markets for a selected set of products. Implicitly, they consider these markets as having no effects on the rest of the economy, and thus the rest of the economy is treated as exogenous. They can provide much product detail and are flexible in representing complex agricultural policy instruments. In contrast, agricultural policies are often modelled in a less detailed fashion in GE models mainly because of the high aggregation of products and less flexibility in the depiction of agricultural policies. But GE models are well suited to depict the manifold interactions between agriculture and other sectors in the economy. This aspect is of relevance in modelling the agricultural sector of the EU especially after accession of the New Member States (NMS) of the EU-10 and Bulgaria and Romania, as the agricultural sector plays a much more important role in some of these economies than in the EU-15.

In order to combine the advantages of both model types, the PE model ESIM (European Simulation Model) and the GE model LEITAP are combined to analyze agricultural policy scenarios in this paper. The paper starts with a review of existing approaches to combine economic market simulation models at different stages of aggregation and a description of the approach chosen for this paper in Chapter 2. Chapter 3 gives an overview of the two simulation models. Chapter 4 describes assumptions and results for a baseline and three policy scenarios for the year 2020. In Chapter 5, experiences from model combination are discussed and Chapter 6 draws summarizing conclusions.

2 Methodological Approach

2.1 Review of Existing Approaches

PE models such ESIM, CAPSIM, CAPRI, AGMEMOD, and others implicitly consider the markets they depict as having no effects on the rest of the economy. Effects of the rest of the domestic and world economy on the agricultural system may, however, be accounted for by a top-down mapping such as the adoption of income or technological progress parameters from other sources.

PE models have the advantage that they are able to provide much product detail and are flexible in representing complex agricultural policy instruments. The main area of application of partial equilibrium models is detailed sector analysis for specific products, which represent only a small portion of the activities of the economy in question. This (small sector) assumption implies that policy-induced effects on the rest of the economy (outside the farm sector) are so small that they can safely be ignored (van Tongeren et al., 2001).

In contrast, agricultural policies are often modelled in a less detailed fashion in GE models mainly because of the high aggregation of products and less flexibility in the depiction of agricultural policies. In many cases policies enter GE models as Nominal Rates of Protection which are endogenous results for example of ESIM.

In addition, PE models allow for a complex modelling of substitution relationships in production of different agricultural products accounting for aspects such as different land qualities. In GE models, in contrast, the depiction of substitution among crops in production is typically limited to a single level or few levels nested CET structure of the substitution of land. PE models have the drawback, however, that they do not explicitly take into account the interactions between the agricultural sectors and the rest of the economy. GE models can capture implications of international trade for the economy as a whole, covering the circular flow of income and expenditure and depicting inter-industry relations. GE models are therefore well suited to depict the manifold interactions between agriculture and other sectors in the economy. This aspect is of increasing importance after the accession of the EU-10 and Bulgaria and Romania, as the agricultural sector plays a much more important role in some of these economies than in the EU-15. The introduction of the EU Common Agricultural Policy (CAP) and its development therefore has significant implications not only for farmers and food consumers in the NMS, but also for other sectors as well as the economy as a whole.

In order to combine the advantages of both model types, it is a promising analytical approach to use GE and PE models in a consistent manner to analyze the same scenarios. The problem, however, is that both model types have a subset of all variables being endogenous in both of the models, which poses the challenge to use models consistently. Their reliance on different behavioral assumptions, parameters and data aggregation results in inconsistent vectors of changes in variables which are endogenous in both models. For example, based on the same vector of domestic price changes, LEITAP would produce a vector of supply quantity changes which would be different from ESIM. Due to this difficulty, the integration of simulation models is typically limited to two different approaches: First, the incomplete consistency of model results and second, the iterative use of two models at different aggregation stages, where one block of equations in the higher level model, typically supply response, is effectively replaced by a block of equations taken from the lower level model.

2.1.1 Joint Use of Models without Aiming at Full Consistency

Due to the difficulties involved in the simultaneous and consistent use of different types of models such a combination has often remained at the level of mapping results down from models of a higher aggregation stage to a lower aggregation stage. For example from market models down to supply models of the agricultural sector (e.g. Cypris et al., 1997; Manegold et al., 1998). Also in the Scenar 2020 study (Nowicki et al. 2007), the joint use of LEITAP and ESIM is based on this approach: variables endogenous in LEITAP are mapped down to ESIM. In addition, the supply response of ESIM and of LEITAP was compared for all scenarios and considered sufficiently consistent.

Other approaches go a step further and include the iterative use of PE and GE models with the mutual exchange of certain solution variables after each iteration, without aiming at a fully consistent set of solution variables. For example Banse, Münch and Tangermann (2000) and Balkhausen and Banse (2005) apply a combined ESIM-GE approach in which macroeconomic variables from the GE model are fed into ESIM whereas nominal protection rates are fed back into the GE models until these variables converge. Other variables, however, which are endogenous to both models, such as prices, production and consumption quantities, are not consistent among models at different levels.

2.1.2 Iterative Use of Models Aiming at Full Consistency

Other studies go further in aiming at a fully consistent set of solution variables by iteratively running models at different aggregation stages. This, however, is typically limited to the coupling of programming supply models with market models (Helming et al., 2006; Kuhlmann et al., 2006; Britz, 2004; Böhringer and Rutherford, 2006). In these cases, the relative supply response of the market model is effectively replaced by the relative supply response simulated by the programming model. In CAPRI (Britz, 2004), the market model is a PE model, in the work of Helming et al. (2006) and Kuhlmann et al. (2006) the market model is a modified GTAP version. Convergence of model results is reached by running models iteratively and mapping the vector of relative price changes from the market model to the programming model and the vector of relative supply quantity changes from the programming model to the market model. In addition, these model linkages apply mechanisms to ensure that solution variables converge, also in case of implicit supply elasticities being higher than demand elasticities. A full integrated approach of a PE model for dairy products and a GE model is presented in Grant et al. (2006). Jansson et al. (2008) present a full integration of CAPRI with a GE model.

2.2 General Approach Chosen for this Paper

For this paper, the PE model ESIM and the multi-regional general equilibrium model LEITAP are combined. This approach combines the individual strengths of the two types of models, i.e. the scope for a very detailed analysis of agricultural policy instruments in a multi-country, multi-commodity PE framework, and interaction of the agricultural sector with the economy as a whole and the strong path dependency of economic equilibria in transition economies modelled in a GE model. A similar approach has been applied in the Scenar 2020 study, see Nowicki et al. (2007).

For this paper, the linkage between LEITAP and ESIM is further developed compared to the Scenar 2020 study to reach a more consistent joint use of both models. The mapping down of variables which are endogenous in LEITAP and exogenous in ESIM is pursued as in the Scenar 2020 project. In addition, several steps are undertaken to make supply response more consistent among ESIM and LEITAP:

1. The supply response generated in LEITAP and in ESIM in the reference as well as policy scenarios is compared in detail for core products.
2. In cases where supply response in LEITAP deviates significantly from the supply response in ESIM, and the ESIM generated supply response is considered more plausible, LEITAP parameters are calibrated such that the ESIM supply response is met to a higher degree. Parameters which are calibrated in LEITAP are for example the CET elasticities which depict the substitutability of land among different agricultural production activities and the parameters which determine the mobility of labor between agriculture and non-agriculture.

In addition, world market price changes resulting from countries other than the EU were calculated with LEITAP and included as exogenous changes in the ESIM simulations.

Two other potential options are not pursued for this paper for the following reasons. The approach presented in Jansson et al. (2008) of fully integrating a PE and a highly aggregated GE is not chosen, as LEITAP is used in a disaggregated version in order to depict world market price effects for individual agricultural products.

The option of combining purely the supply component of ESIM with LEITAP is not chosen, as ESIM involves other interesting features such as the Logistic function based price formation mechanism – and their maintenance requires using ESIM as a complete market model. Also, the product by product comparison of supply response is considered a valuable contribution in contrast to a calibration which forces LEITAP to join ESIM mechanically.

3 Characteristics of the Quantitative Tools

3.1 ESIM

ESIM is a world wide comparative static partial equilibrium net trade model of the agricultural sector. Its focus is on Europe and it depicts the EU-27 at member state level with a strong focus on EU common agricultural policies (Banse et al., 2005). It depicts a high variety of policy instruments including specific and ad valorem tariffs, tariff rate quotas, intervention and threshold prices, export subsidies, product subsidies, direct payments for keeping land in agricultural use, production quotas and voluntary as well as obligatory set aside. All behavioural functions in ESIM are isoelastic. Supply at farm level is defined for 15 crops, 6 animal products, pasture and voluntary set aside. Human demand is defined for processed products and each of the farm products except rapeseed, fodder, pasture, set aside and raw milk. Some of these products only enter the processing industry, e.g. rapeseed, and others are only used in feed consumption, e.g. fodder or grass from permanent pasture.

ESIM has a very detailed depiction of the complex system of substitution of land among different products and the relationship between ruminant production and agricultural area. This allows the use of ESIM for example for the simulation of the complex substitution effects between Grandes Cultures and fodder crops resulting from the decoupling of direct payments under the 2003 reform (Balkhausen et al., 2005). Furthermore, ESIM is able to depict subsistence farm production (Banse and Grethe, 2005), the production and demand of biofuels (Banse and Grethe, 2008), and domestic price formation depending on the EU net trade position (Banse and Grethe, 2006).

3.2 LEITAP

LEITAP is a global computable general equilibrium model that covers the whole economy including factor markets and is often used in WTO analyses (Francois et al., 2005) and CAP analyses (Meijl and van Tongeren, 2002). More specifically, LEITAP is a modified version of the global general equilibrium model GTAP (Global Trade Analysis Project). The model, and its underlying database, describes production, use and international trade flows of commodities, services and inputs between regions of the world. Assumptions about population growth, technological progress, and policy framework are the main drivers of the model's results. Based on such assumptions, the model determines production, use and trade flows as a result of market clearing on all commodity and input markets in all countries/regions of the world. Agricultural policies are treated explicitly (e.g. production quotas, intervention prices, tariff rate quotas, (de)coupled payments). Information is used from the OECD's Policy Evaluation Model (PEM) to improve the production structure (Hertel and Keening, 2003). Furthermore, a new land allocation method that takes into account the variation of substitutability between different types of land (Huang et al., 2004), as well as a new land supply curve are introduced (Meijl et al., 2006; Eickhout et al., 2007).

4 Scenarios and Results

Four scenarios for the period up to the year 2020 are analyzed: First, a baseline which comprises current reform plans for the CAP such as full decoupling of direct payments and the abolishment of set aside as well as a successful conclusion of the Doha Round. In addition, the following three policy scenarios are implemented over the period 2009-2013 with equal linear cuts in policies:

a) Full liberalization ("Lib"): This scenario includes the abolishment of all market price support, including intervention prices and border measures, and the abolishment of direct payments. Also production quotas are abolished.

b) Abolishment of agricultural tariffs ("Tariff"): This scenario includes the abolishment of all market price support, including intervention prices which cannot be maintained without border protection. Also dairy and sugar quotas are abolished as there would be no reason for their maintenance. Direct payments, however, are fully maintained.

c) Abolishment of direct payments ("DirPay"): Direct payments are fully abolished. All market price support policies and production quotas are maintained. For the interpretation of this scenario it is important to note, that the fully decoupled payments under the SFP and SAPS regimes in the EU are assumed to have no effect on yield and an effect on area allocation which is 10% of the level of an equivalent price support.

For all scenarios, general equilibrium effects on factor prices and national income generated with LEITAP are included in the ESIM simulations. In the following sections, general equilibrium results are presented only for the baseline and the Liberalization scenario. Partial equilibrium results are presented for four all scenarios.

4.1 The Baseline Scenario

4.1.1 Assumptions for the Baseline Scenario

Table 1: Exogenous Drivers in the Baseline

Drivers	Source of Assumptions
Demographics	Major population trends (based on OECD-FAO, 2007)
Macroeconomic growth	Moderate growth rates (based on OECD-FAO, 2007)
Consumer preferences	More demand for value added and increasing absolute spending per capita
Agri-technology	Continuous trends in cost saving technical progress
World markets	Trends in agri-markets based on OECD/FAPRI studies. Change from these trends due to different assumptions on exogenous and policy-related drivers, especially the demand for biofuels.
EU enlargement	No further EU enlargement until 2020 (i.e., EU = EU-27)

For the baseline, several assumptions are made with respect to variables which are exogenous to this analysis. Many of these are non-agricultural policy drivers, and assumptions are based on the Scenar 2020 project (Nowicki et al., 2007), but updated where necessary. Also the accession of Turkey is not included in the baseline. Table 1 provides an overview of these assumptions.

Furthermore, many assumptions are made for the baseline with respect to the development of the CAP. They also reflect the baseline assumptions of the Scenar 2020 study with some deviations as depicted in Table 2.

Table 2: Assumptions on Agricultural Policy Development in the Baseline

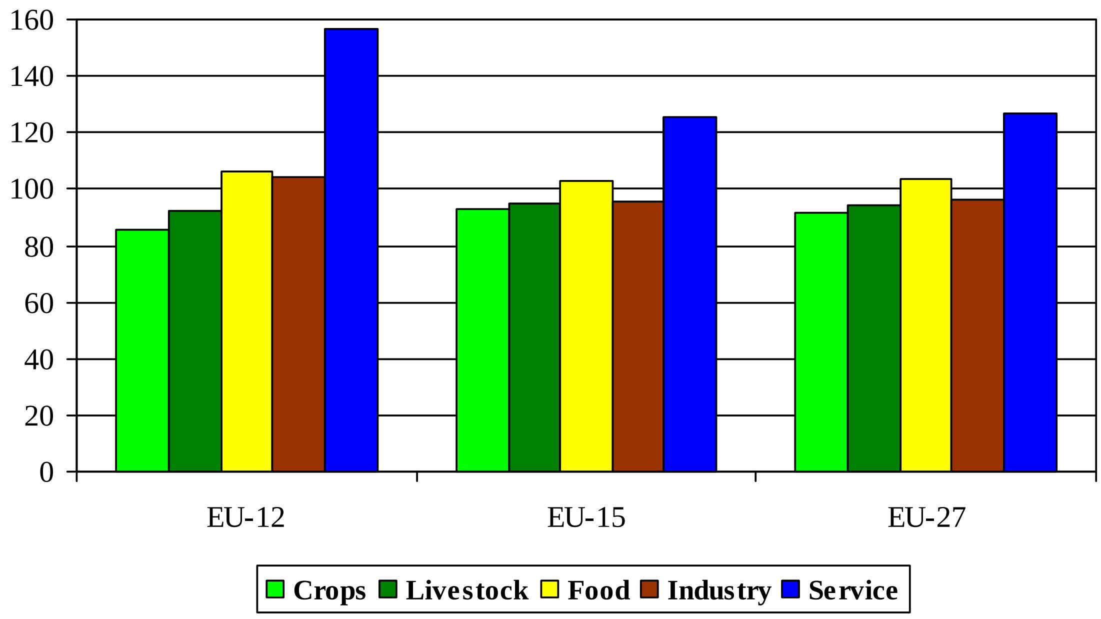
Topic	Assumption
Market Policies	
Intervention	• Current system of intervention prices • Exclusion of maize from intervention in 2009 • Adjustment of intervention prices to balance markets where necessary in order to comply with WTO restrictions on export subsidies: • Intervention price for butter decreases by 15% from 2012 on
Regulations for quota products (milk, sugar)	• Reform of the sugar MO • Maintenance of quotas
Changes in consumption subsidies (skimmed milk powder (SMP), butter)	• Withdrawal of consumption subsidies • Withdrawal of SMP feed subsidy
Changes in biofuel policies	• Extension of the area eligible for crop premium to 2 mio ha (including the NMS) • Human demand shifters set such as to reach a biofuel share of 2% in total EU fuel consumption by 2010
Trade Policies	
Tariffs	• EU offer, no consideration of sensitive products, implementation period 2009-2013
Export subsidies	• EU offer, implementation period 2009-2013
TRQs	• Constant level of current TRQs, no new TRQ
Direct Payments	
Development of direct payments	• SAPS and SFP per ha payments constant in nominal terms (deflated by EU inflation rate)
Modulation rate	• 20%
Distribution of funds from modulation	• 80% within the MS • 20% reallocation among MS
Decoupling of direct payments	• Full decoupling from 2011 on
Application of the Single Farm Payment in EU-10	• Prolongation of the SAPS system until 2011 as recently decided by the Council
Obligatory set aside rates	• Removal of mandatory set-aside in 2011

4.1.2 Baseline Results from LEITAP

In the baseline, the service sector displays the strongest economic growth in the EU-15 and the EU-12. The crop and livestock sectors decline throughout the EU due to the decreasing price level (see below), but the food industry sector increases slightly. In the EU-12, the industrial sector increases slightly relative to the level in 2005 whereas it is falling in the EU-15 (Figure 1). The sectoral terms of trade for agriculture deteriorate over time. This is especially the case for crop production with high productivity growth and low increase in demand. Unlike in the agricultural sector, real value added in food processing, which includes also beverages and tobacco, increases due to lower productivity growth rates and a stronger growth in demand.

The baseline thus displays an ongoing trend of structural change with a declining share of agriculture and industry and an increasing share of services in the economy. This trend is most pronounced for the EU-12, for which industry and agriculture still accounted for more than 42% of the economy in 2005, but also holds for the EU-15. The declining share of agriculture in the economy reflects a global trend, which stems from the fact that the effect of supply shifters (technical productivity) dominates demand shifters (population growth, income). Especially due to decreasing income elasticities in the course of economic development the expenditure share for agricultural products declines with rising income.

Figure 1: Real Value Added in Different Sectors, 2020 (2005 = 100)

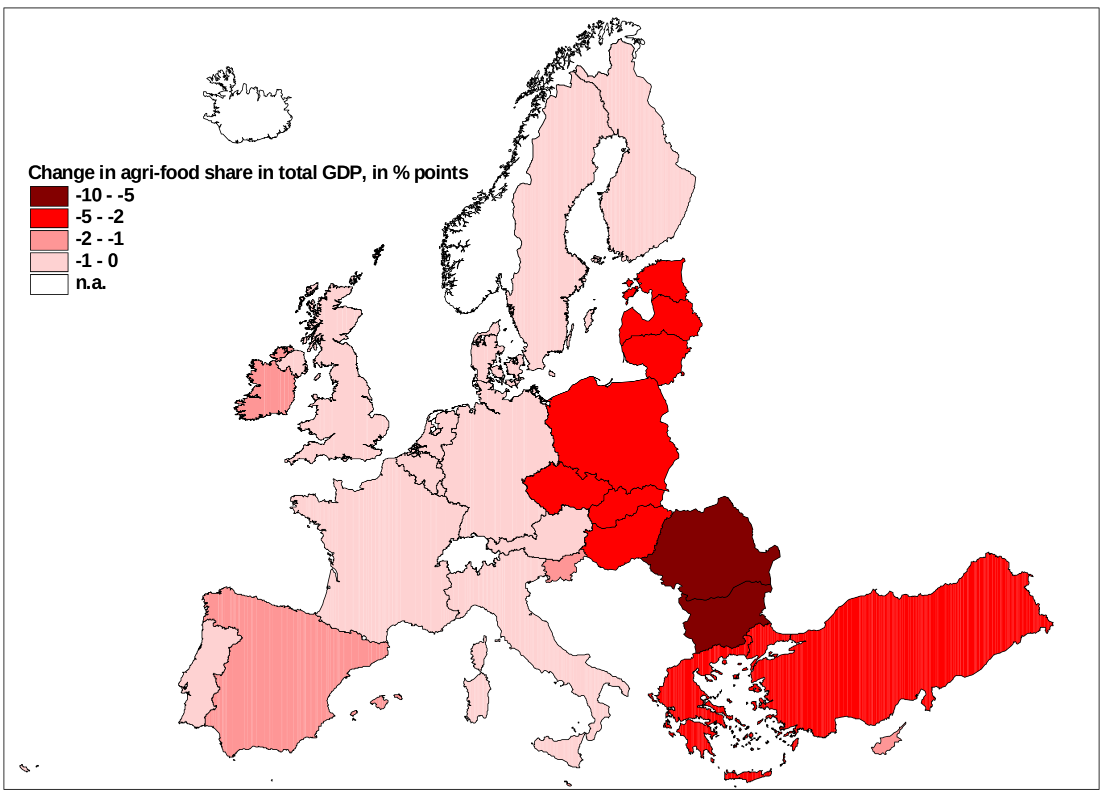


Source: Own calculations.

In order to illustrate the development of the contribution of the agri-food sectors to total national income between the base period and the year 2020, Figure 2 displays the change in the agri-food share in total GDP in percentage points. Generally, the share of the agri-food sectors in GDP is declining in all member states. This decline is most pronounced in Bulgaria and Romania, where the share of agriculture falls from 25.5% to 18.9%. The decline is also high in the EU-10 with up to 5 percentage points. With the exception of Spain, Ireland and Greece, the decline of the agri-food share in GDP is less than 1 percentage point in the EU-15.

The main reasons for this development are the differences in the supply and demand response under the conditions of a growing economy. A relatively strong growth in agricultural supply with a relatively low growth in food demand (due to low income elasticities for agri-food products) leads to a deterioration in the sectoral terms of trade for agriculture. Hence, the higher the initial contribution of the agri-food industry the stronger typically is the decline in shares of agri-food in total income or employment. When looking at agriculture and food industries separately it becomes clear that the decline in agriculture dominates the development under the baseline. In the EU-27 the agricultural part in the decline of GDP shares of the agri-food sector is more than 60% while for the EU-12 this share is even more than 70%. Within the agricultural sector there is also a tendency towards specialization in livestock production which creates a higher value added compared to crop production. In the EU-12, where structural change is faster compared to the EU-15, the share of livestock production in total agricultural output increases by more than 5 percentage points.

Figure 2: Change in Agri-food Share in Total National GDP, Baseline in 2020 (percentage points change relative to the share in 2005)



Source: Own calculations.

This development is also mirrored by the development of employment in the agri-food industries. In order to show the development between the base period and the year 2020, Figure 3 displays the change in the agri-food share in total employment between 2005 ad 2020 in percentage points. As for the share in GDP, the share of the agri-food sector in employment is declining in all member states. This decline is most pronounced in Bulgaria and Romania, where the share of agriculture falls from 24.4% to 19%. The decline is also high in the EU-10 with up to 2.6 percentage points. With the exception of Ireland, the decline of the agri-food share in employment is less than 1 percentage point in the EU-15. The baseline results of a continuous decline in the contribution of the agri-food sector to overall employment is a continuation of the trends in the past. With the exception of some of the EU-12 countries, in which the agricultural sector served as a social buffer stock during the first years of economic transition, agricultural employment declined during the past two decades. Increasing wages outside agriculture contributed to this development.

Figure 3: Change in Agri-food Share in Total Employment, Baseline in 2020 (percentage points change relative to the share in 2005)

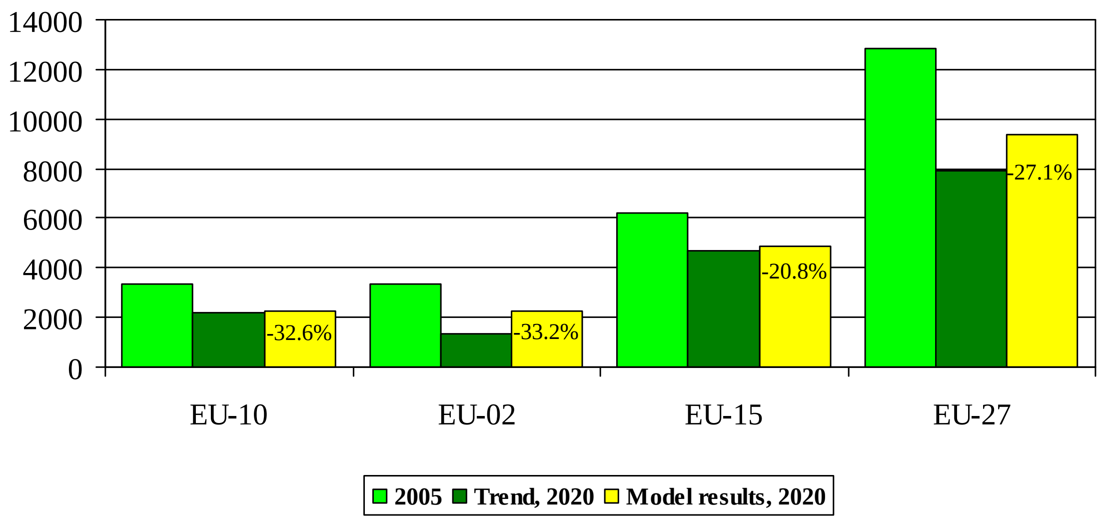
Source: Own calculations.

The change in agricultural employment in absolute figures is presented in Figure 4. Due to the deterioration of the agricultural terms of trade and the decline in agricultural support under the baseline (implementation of the EU WTO offer and a cut in direct payments due to 20% modulation) agricultural employment declines in all regions of the EU. To calculate absolute figures the relative change in employment as an outcome of the LEITAP simulations has been multiplied by agricultural employment in 2005 published by the European Commission (2007a).

These employment projections heavily depend on the way labor markets for agriculture and for the rest of the economy are presented in the model. We assume that factor markets for agriculture are not fully integrated with the rest of the economy. This presentation leads to a 'stickiness' in the reaction of employment with regard to changes in wages inside and outside agriculture. Reasons for such labor market segmentation can be differences in skill levels and professional education which do not allow farmers to enter new jobs outside agriculture easily. If the degree of segmentation between agricultural and non-agricultural labor markets is high there is almost no option for agricultural workers to leave farming when agricultural wages relative to wages outside agriculture decline. Under such conditions there is almost no structural change in the pattern of employment.

However, due to the fact that this study focuses on the medium to long-term effects of structural change over a period of 15 years, we allow for some structural adjustment in terms of employment pattern, which is reflected in the level of transformation elasticities of labor between the agricultural and the non-agricultural sectors.[1]

Figure 4: Employment in Agriculture 2005 and 2020 in the EU (1000 persons)



Source: Numbers of workers in 2005 and Trend, 2020 derived from European Commission (2007a). Projection for 2020: Own calculations.

As presented in Figure 4, about 3.5 million persons will leave agriculture until 2020 in the EU-27 in the baseline. The relative change in the EU-12 is stronger compared to the projected release in the agricultural workforce of the EU-15. In the EU-12, around 1/3 of persons currently employed in agriculture will leave until 2020. Figure 4 also displays

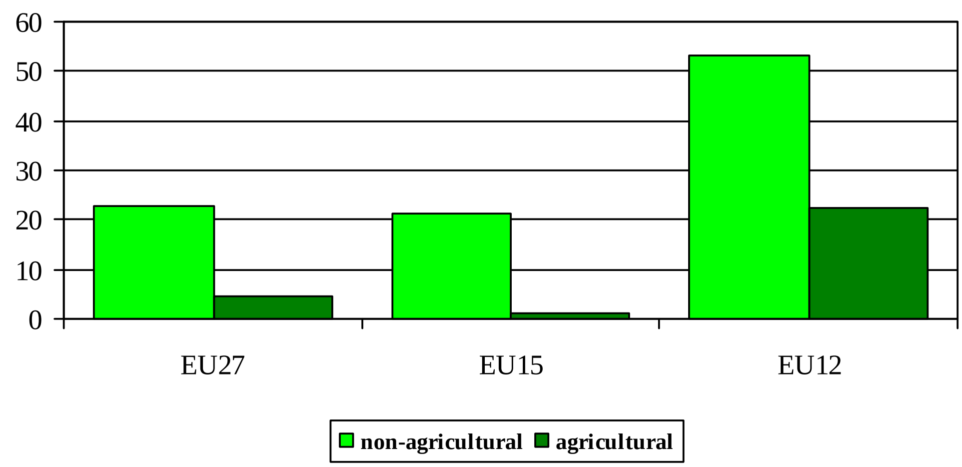
[1] The impact of effect of different levels of transformation elasticities on changes in factor prices and employment in agriculture is presented in the Annex. The systematic sensitivity analysis shows that the level of transformation elasticities affects the decline of the agricultural labour force only slightly.

numbers which would result from a continuation of the current decline in agricultural employment. The numbers in the second column (Trend, 2020) are derived from a trend projection where the average annual change of agricultural employment between 1999 and 2005 is assumed to remain constant until 2020.

Simulation results for the EU-10 and the EU-15 are in line with the projected continuation of the trend of the last six years. For the EU-02 (including Bulgaria and Romania), however, model results differ significantly from the change in the past years. The observed annual rate of decline in the agricultural employment in Bulgarian and Romanian agriculture was -5.8%, and it seems questionable whether this strong decline will remain constant until 2020.

The main driver for the decline in the agricultural workforce is the change in the ratio between agricultural and non-agricultural wages. Under fully integrated factor markets the wage rates for both types of labor would develop similarly. However, under the current modelling of labor markets in LEITAP factor markets are segmented. Therefore, wages within agriculture and outside agriculture develop differently. In the EU-12 wages increase under the baseline by 22% within agriculture and by 53% outside agriculture with a difference of more than 30 percentage points, see Figure 5.

Figure 5: Change in Agricultural and Non-Agricultural Wage Rates, 2020, Relative to 2005 (in %)



Source: Own calculations.

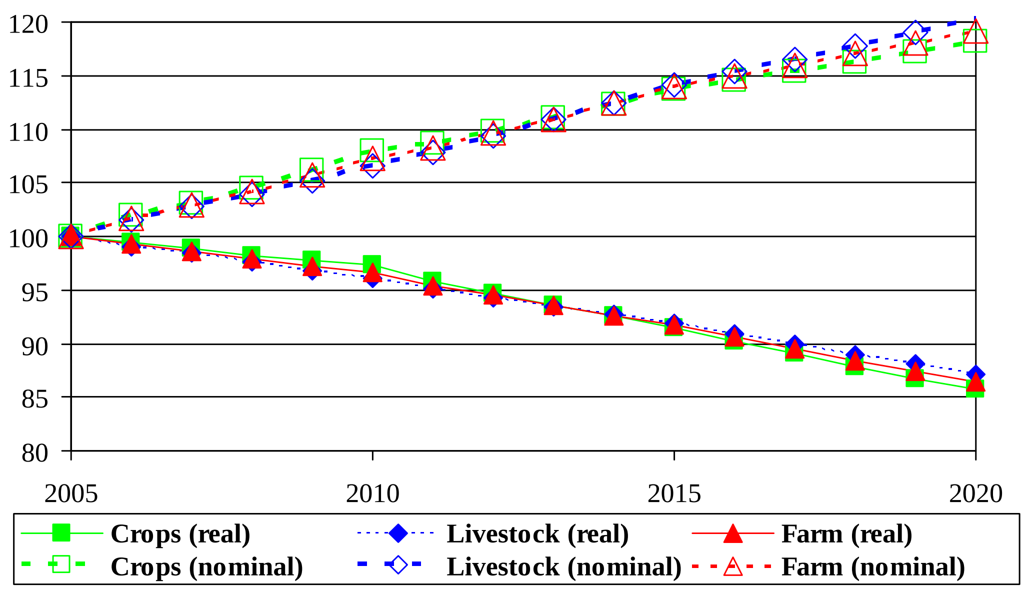
In the EU-15, where economic growth is lower, non-agricultural wages increase only by 21% while agricultural wages remain almost constant. Thus, the gap between wages in- and outside agriculture widens under the baseline in both regions. However, farmers in the EU-12 face a stronger divergence in labor income compared to employees working outside agriculture. These results indicate that, even with a strongly declining agricultural workforce, structural change will have to continue under the baseline if farmers are not willing to accept an increasing divergence in labor income. Measured in percentage points, the largest differences are in the EU-02. Here the projected growth rate in agricultural wages will be more than 48 percentage points below the non-agricultural growth rate. This gap in the development of wages inside and outside agricultural can be explained by a very dynamic growth outside agriculture and a slow structural change within agriculture keeping agricultural labor productivity low.[2]

The sustainability of a higher wage gap in the EU-12 than in the EU-15 seems plausible if looking at the structure of agricultural employment. In 2003 only 7.4% of all agricultural labor force (in terms of AWU) in the EU-12 were non-family members and thus employed as paid workers (European Commission, 2007a). However, there are large regional differences with a share of 5.8% in Romania and 93.9% in Slovakia. In comparison, in 2003 as much as 33.8% of the agricultural labor force in the EU-15 was paid employment with a maximum of 49.6% in The Netherlands and a minimum of 5.4% in Greece. It seems plausible that family labor would more easily accept a significant agriculture/non-agriculture wage gap than paid farm workers, and therefore a higher wage gap may prevail in the EU-12.

4.1.3 Baseline Results from ESIM

The decline of the agricultural contribution to overall GDP, employment and capital demand is in part caused by the global trend of declining real prices for agricultural products which was observed in the past and is projected to continue in the future. Figure 6 displays the projection of world market prices in the baseline in real and in nominal terms assuming an annual rate of inflation of 2.0% across all EU countries.

Figure 6: World Market Price Indices for Agricultural Products 2005-2020



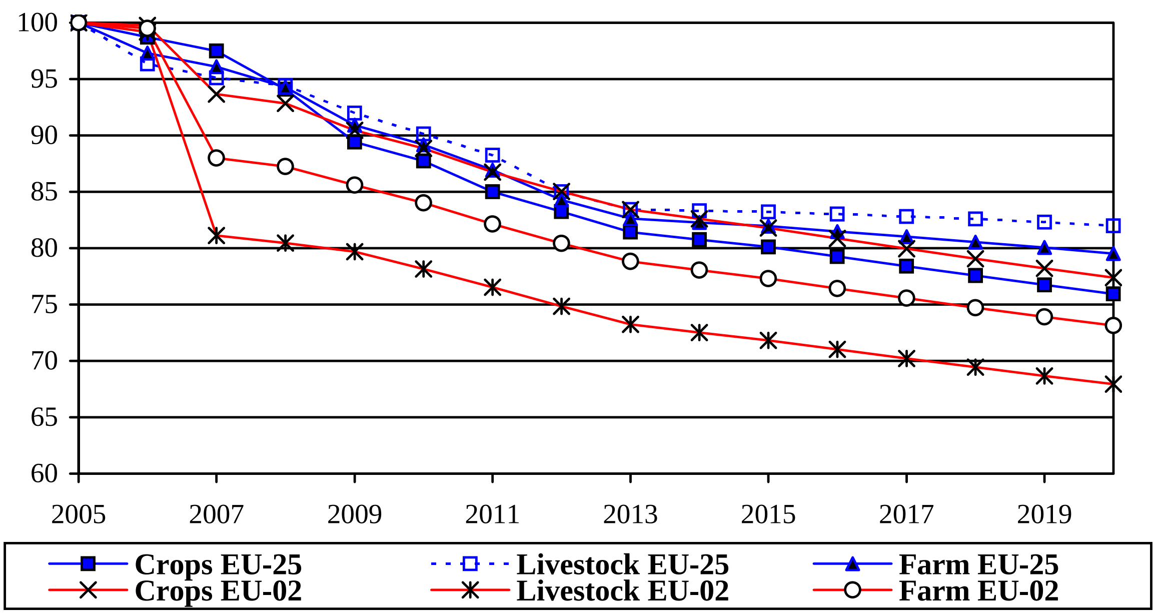
Source: Own calculations.

[2] The sensitivity analysis presented in the annex shows that higher transformation elasticities between agricultural and non-agricultural labour significantly reduce the wage gap.

The overall trend of world market prices under the baseline is based on projections published by FAPRI for the year 2015 (FAPRI, 2006). For the ESIM model, technical progress and demand shifters in the rest of the world are programmed such as to approximate FAPRI projections. An exception is price projections for biofuels, plant oils and oilseeds, for which the implementation of human demand shifters for biofuels in the EU – in order to meet projections of the European Commission (2007b) – leads to significantly higher prices which apply in the baseline.

Figure 7 shows the development of EU farm price indices over the period 2005 to 2020. A distinction is made between the EU-25, for which the price development is homogeneous due to the single market, and Romania and Bulgaria, which acceded in 2007 and therefore have relative price changes compared to the model base (in which they were not yet EU members) which differ from the EU-25.

Figure 7: Development of EU Price Indices for Agricultural Products 2005-2020 (in real terms)



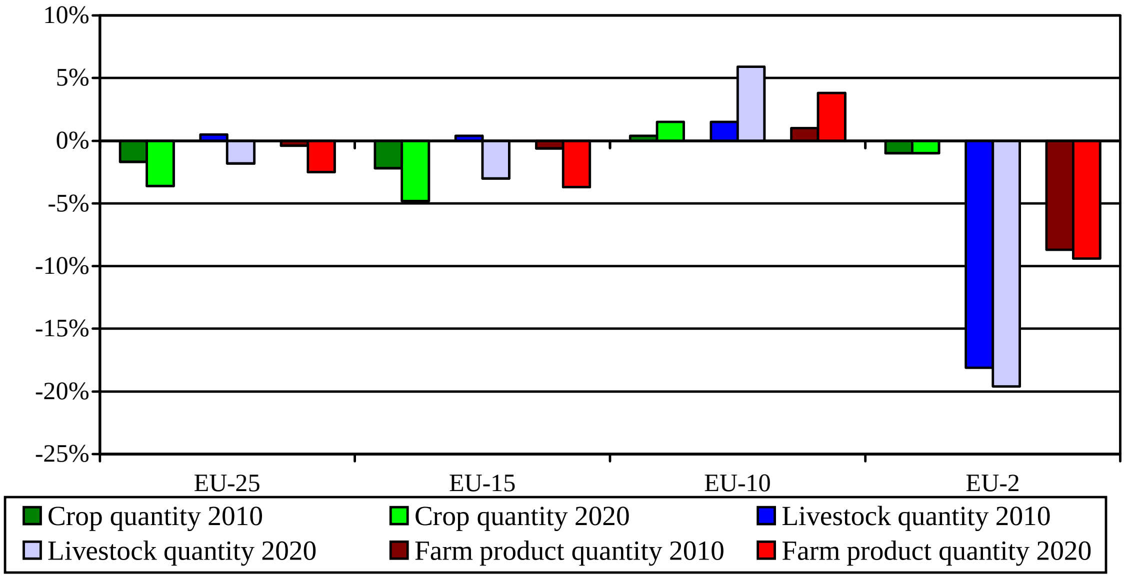
Source: Own calculations.

Figure 7 shows that real EU prices by and large join the development of world market prices and decline by about 20% on average over the projection horizon. The EU-02 experiences a strong decline in prices for animal products in 2007 and joins the trend of EU prices from accession on.

Part of the EU price decline stems from the reduction of political price support. For agricultural products on average, the EU price declines from almost 120% compared to the world market price in 2005 to about 106% in 2013. Most of this decline is due to the implementation of the tariff reductions being part of the EU offer in the Doha Round which is included in the baseline. From 2013 on, EU crop prices remain rather constant relative to the world market level. This reflects the fact that the EU is at world market price level for most crop products over this period, and no other policy changes are implemented except a deflation of remaining institutional prices and specific duties. For animal products, however, the EU price rises compared to the world market level due to an increasing net import situation.

Figure 8 depicts the development of agricultural supply in the European Union in the baseline in quantity terms (base price weighted).

Figure 8: Development of EU Indices of Agricultural Production Quantity 2005-2020



Source: Own calculations.

Figure 8 shows that agricultural supply quantities on aggregate are relatively stable. For the EU-25, the total agricultural production quantity decreases by about 0.5% by 2010 and 2% by 2020. For the EU-15, crop as well as livestock production declines whereas for the EU-10 both increase. By 2020, agricultural production in the EU-10 is 4% above 2005 level. For the EU-02, both crop and livestock production decrease due to heavily declining prices for some products. On aggregate, agricultural production in the EU-02 is about 8% below 2005 in 2010 and 9% below 2005 level in 2020. Apart from declining agricultural prices farmers in the EU-02 are also hit by increasing prices for non-agricultural inputs and increasing labour and capital prices.

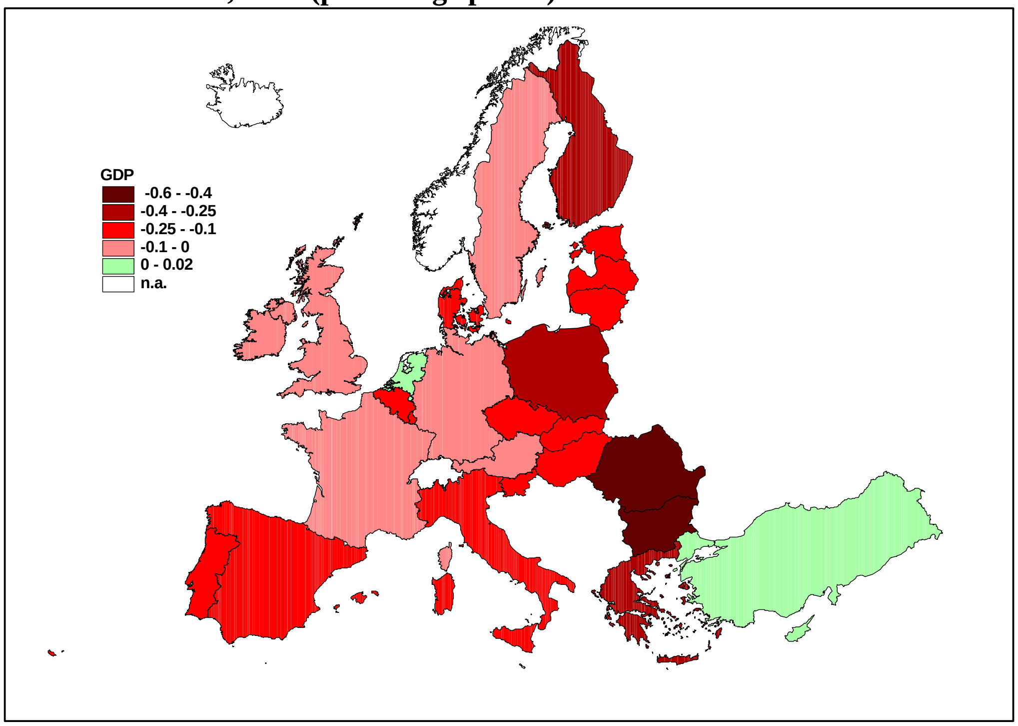
4.2 The Liberalization Scenario

Before presenting the results for the agricultural markets coming from ESIM for all three scenarios compared to the baseline, general equilibrium effects are presented for the full liberalization scenario, i.e. the change of the contribution of the agri-food sectors to total GDP and factor use. All results are presented relative to the baseline scenario.

4.2.1 Liberalization Results from LEITAP

The following figures display the change in the agri-food share in total GDP, employment and capital demand, and the agri-food share of private households in their total expenditure in percentage points under the Liberalization Scenario for 2020 relative to the baseline results in the same year.

Figure 9: Liberalization Scenario Relative to Baseline: Change in Agri-food Share in Total GDP, 2020 (percentage points)



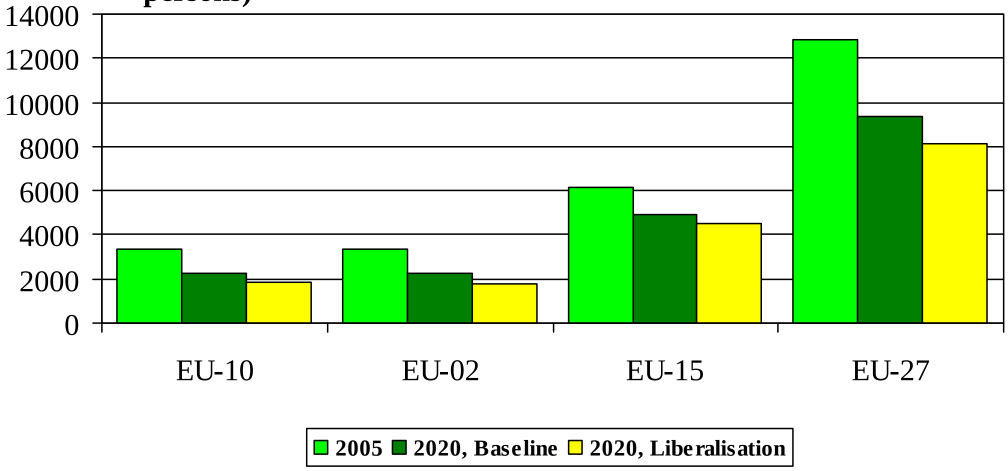
Source: Own calculations.

In most Member States the agricultural contribution to total GDP is lower under the Liberalization scenario than under the baseline (Figure 9). The strongest effects occur in Bulgaria and Romania (-0.5 percentage points, equivalent to -3.1% in agricultural GDP) and in Poland (-0.4 % point, equivalent to -3.6% in agricultural GDP) but also in Finland (-0.4%, equivalent to -11% in agricultural GDP). Only in the Netherlands does the contribution of the agri-food sector increase due to the abolition of the milk quota. These relatively small changes can be explained by the fact that Figure 9 presents changes in GDP for the agri-food sector measured at market prices, i.e. changes in direct payments which affect the income of farmers are not taken into account. The results for the agricultural sector without food processing show a stronger decline in value added: the agricultural GDP declines by 5.6% relative to the baseline in the EU-27, by 5.3% in the EU-15 and by 6.5% in the EU-12.

If direct payments – modelled as subsidies to land use – are added to agricultural GDP as an indicator for agricultural income, the relative changes are much stronger, with -31% for the EU-27, -30% for the EU-15 and -39% for the EU-12.

In terms of total employment under the liberalization scenario the agricultural workforce is continuing to decline. Figure 10 shows that after liberalization an equivalent of 1.2 mio AWU are laid off relative to the baseline scenario. In the NMS agricultural employment declines by 20%, while the relative decline in the old EU-15 Member States is only 8% relative to the baseline. The reason for this moderate decline is due to segmented factor markets where the disparity between agricultural and non-agricultural wage rates continues to rise under the liberalization scenario.

Figure 10: Employment in Agriculture, Liberalization relative to Baseline, 2020 (1000 persons)



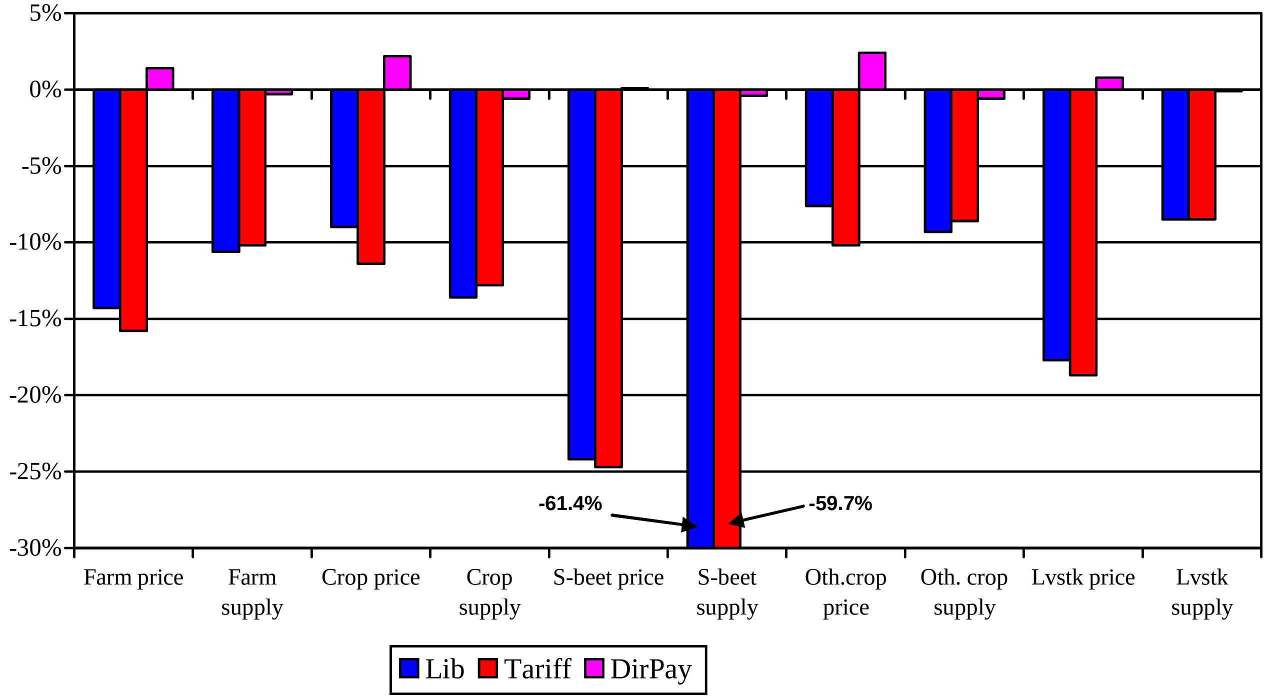
Source: Own calculations.

4.2.2 Liberalization Results from ESIM

The remainder of this section looks into the more sector and product specific results under the three policy scenarios compared to the baseline. Figure 11 displays changes in prices and quantities under the three scenarios Lib, Tariff and DirPay for the EU-25 relative to the baseline and for the year 2015.

As a first observation, the Liberalization and the Tariff scenario show similar results. This is because direct payments are modelled in ESIM as having only a minor effect on production, and the Liberalization scenario is therefore dominated by the abolishment of market policies. Under the liberalization scenario, agricultural prices in the EU decline by 14%. This decline is mainly due to the policy induced reduction of the margin between world market prices and EU domestic prices, as world market prices on average change only little and increase by 2% in the case of full liberalization.

Figure 11: Scenario Results Relative to Baseline: EU-25 Indices of Agricultural Prices and Supply Quantities (2015)



Source: Own calculations.

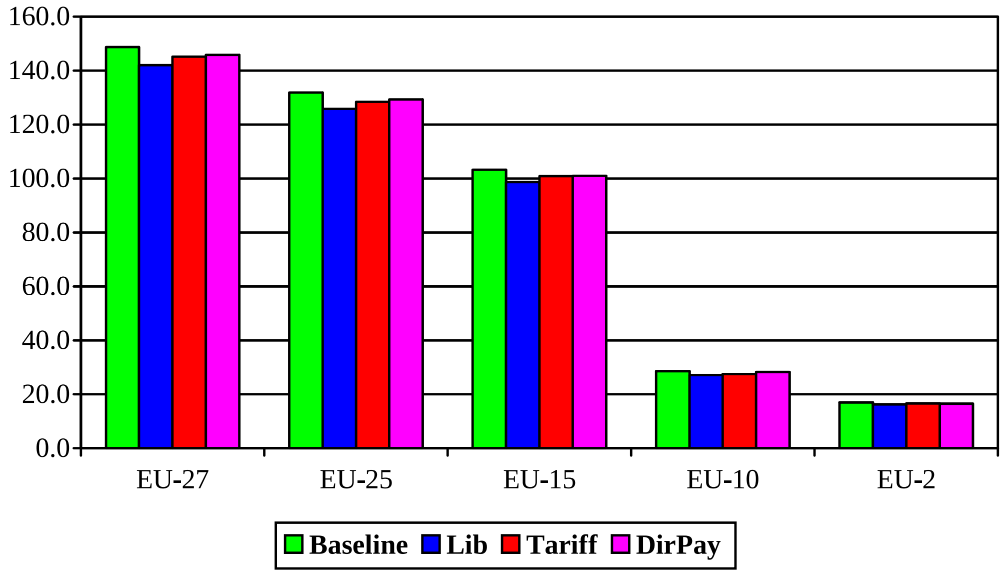
The decline of the EU price level is stronger for livestock products than for crops except, for sugar beet, as they experience a higher protection under the EU baseline. Under the Tariff scenario, prices decline by about 16%. This is different under the DirPay scenario, which includes the full abolition of direct payments. Direct payments are modelled as a subsidy on area use for agricultural production. Thus, direct payments result in higher production and lower market prices. As a consequence, the abolishment of direct payments results in slightly higher prices in the EU. The effects are only small, because a significant share of direct payments is assumed to capitalize into land prices and the aggregate supply response of land used for agriculture to changes in land prices is assumed to be very small.

Surprising at a first glance is the strong decrease of crop production (weighted with prices of the base period) under the liberalization and the tariff scenario, as typically aggregate crop supply is quite inelastic. The reason is that in many EU member states sugar beet production, which has a high weight in the crop supply basket due to the high support price in the model base period, decreases heavily or ceases completely in case of full market liberalization. For the EU on average, sugar beet production declines by about 60% in case of full market liberalization. Crop production other than sugar declines by 9% in case of full liberalization. This is mainly due to the strong decline in animal production and the related decline in feed demand which results in lower fodder production. Cereal and oilseed production is stable compared to the baseline even in case of full liberalization.

Also surprising at a first glance is the modest reduction of livestock supply (-8%) in the case of full liberalization, when prices decrease by almost 18%. This is due to two reasons. First, the quota rent for milk, which allows for significant price reductions before supply starts to decrease in many EU member states. Second, market liberalization goes along with a strong reduction in animal feed prices. On average, the feed price declines by 12.5% for ruminant production and by 2.5% for pork, poultry and egg production. This has a production stimulating effect of about 5% for ruminant production and about 2% for pork, poultry and egg production.

Effects on total area allocated to agricultural production are low. Figure 12 shows that the variation in total area used for agricultural production is less than 6% for all scenarios and groups of member states.

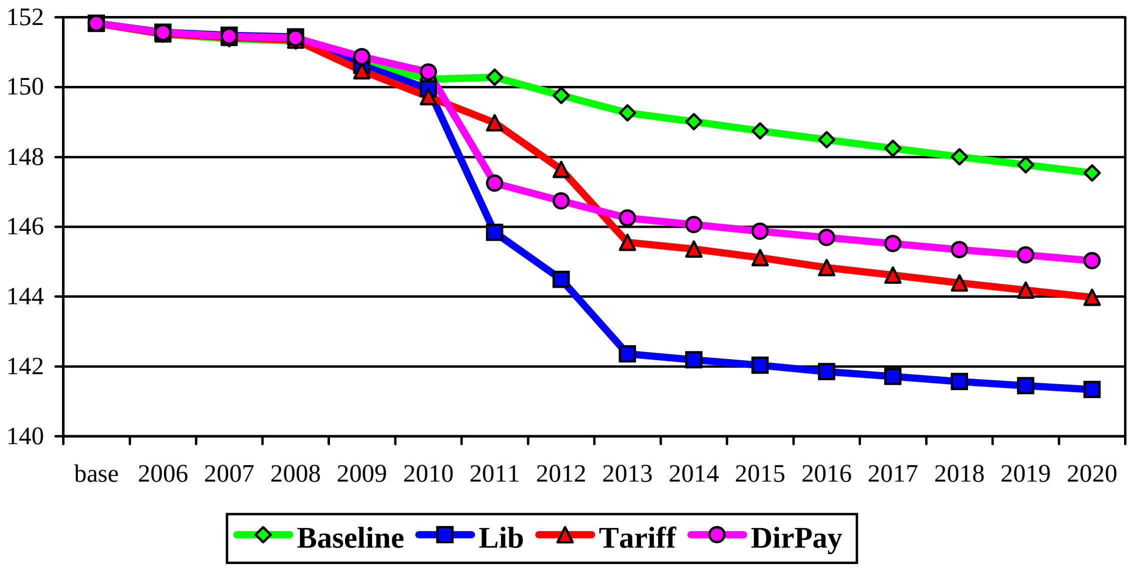
Figure 12: Total Agricultural Land Use in the EU under Selected Scenarios (2015, in mio ha)



Source: Own calculations.

Figure 13 shows the development of agricultural land use in the total EU over the projection horizon. The major decline in area happens between 2009 and 2013 when the bulk of policy reforms is scheduled. But a smooth declining trend continues until 2020 under all scenarios because of falling world market prices in real terms.

Figure 13: Development of Agricultural Land Use in the EU-27 under Selected Scenarios (in mio ha)



Source: Own calculations.

5 Experiences from the Model Combination

5.1 Supply Response of ESIM and LEITAP under Liberalization Compared to Baseline

Table 3 gives a comparison of the supply response in LEITAP and ESIM under the liberalization scenario compared to the baseline.

Table 3: Supply response in LEITAP and ESIM, Changes under the Liberalization Scenario relative to the Baseline, 2020, in %

	EU-15		EU-12		EU-27	
	LEITAP	**ESIM**	**LEITAP**	**ESIM**	**LEITAP**	**ESIM**
Wheat	2.2	0.8	-0.3	-0.1	1.2	0.5
Coarse grains	-8.9	-0.5	-7.1	-0.7	-8.2	-0.7
Oilseeds	-21.2	-2	-7	0.7	-18.9	-1.1
Sugar	-29.5	-65.9	-3.5	-89.3	-19.6	-70.5
Cattle	-20.8	-28.2	-13.8	-24.8	-19.3	-27.6
Pork & poultry	-1.1	-5.5	-5.8	-3.1	-1.9	-5
Milk	3.4	-0.7	0.2	-6.9	2.6	-1.6

Source: Own calculations.

For all products except milk, the direction of the supply response is the same in both models. However, the relative changes differ, for some products significantly. Generally, supply responses differ more for crops than for animal products. For sugar, the difference is most pronounced. In ESIM, sugar production almost completely ceases whereas the decline is moderate in LEITAP. This mainly stems from the trade specification: LEITAP is based on the Armington assumption assuming domestic and imported sugar being imperfect substitutes. This does not allow EU sugar production to decline as much as in a net trade specification such as ESIM.

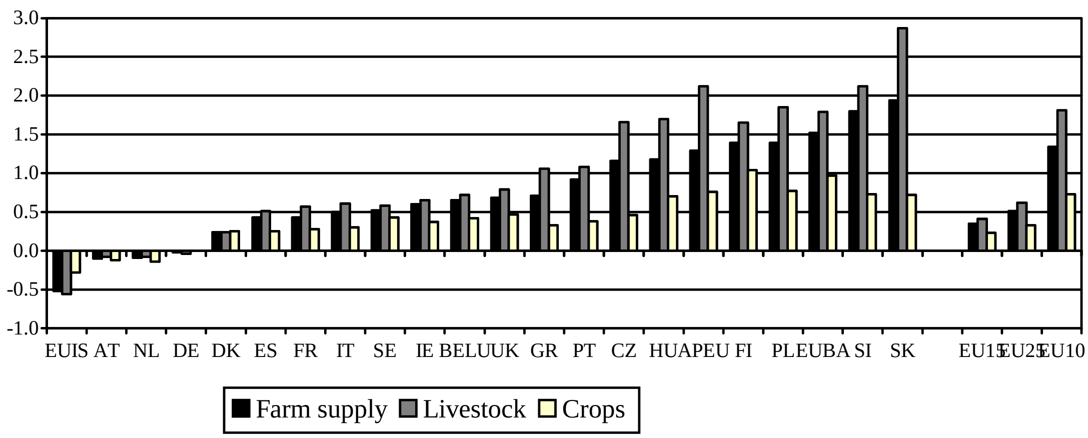
Also for coarse grains and oilseeds the negative supply response under liberalization is much more pronounced in LEITAP. This mainly stems from the fact that full liberalization includes the abolition of direct payments, which are modelled as subsidies to land and capital in agriculture in LEITAP and have a strong impact on production. This is in contrast to ESIM, where direct payments are modelled as having only a small impact on production (see above).

For animal products the supply response is much more similar. Only for milk it differs in sign, but the supply response under liberalization is small: both models support that a full liberalization of dairy markets would not affect milk supply considerably. This is because the supply depressing effect of lower dairy product prices would be compensated by the supply enhancing effect of an abolishment of dairy quotas.

5.2 Relevance of Including Factor Price Changes from GE Models in Policy Scenarios of PE Models

In order to get an impression of how relevant the inclusion of factor price changes (only labor and capital) simulated with a GE model is for the supply response in a PE model, the impact of changes in factor prices due to liberalization in the member states is illustrated in Figure 14. The differences are presented relative to an ESIM run without considering factor price changes.

Figure 14: Difference in Agricultural Supply with GE-Effects on Capital and Labor Prices in the Liberalization Scenario in 2020 (% Difference Compared to a Run without GE Effects)



Source: Own calculations.

On average, capital and labor price changes – endogenously generated in LEITAP and transferred to ESIM – have a relatively small effect on the outcome of ESIM. Farm supply for the EU-25 is 0.5% higher when taking into account lower factor prices after liberalization. For some countries with high shares of agriculture in GDP such as Bulgaria and Romania, however, these effects are much more pronounced: livestock supply is more than 2% higher under liberalization in ESIM if factor price changes are considered. On average, effects are much more relevant for the EU-10 than for the EU-15 countries. Furthermore, the inclusion of capital and labor price changes in a PE model is more relevant for animal products than for crops, as labor and capital have a higher cost share in animal products.

6 Summarizing Conclusions

Conclusions can be grouped into two categories: conclusions with regards to model results and conclusions with regard to the model combination applied.

6.1 Conclusions with Regard to Model Results

It is striking that compared to the pronounced developments of the agri-food sectors under the baseline, the impact of policy scenarios is rather small. As a conclusion, the agricultural sector is much more determined by the macroeconomic and the world market environment and the development of agricultural supply and demand shifters such as technology, population and income growth over time, than by agricultural policies. For example, real agricultural prices in the EU fall by about 20% under the baseline, whereas the additional price decrease in case of full liberalization is only 14%.

Furthermore, the contribution of the agricultural and food sector to the overall economy of the EU is rather limited. For example the full liberalization of the EU agricultural sector results in a decline of the shares of the agri-food sectors in total GDP by 0.11 percentage points and in total employment by 0.08 percentage points. However, there are important differences between groups of member states, which are not necessarily similar with the aggregated groups of ‘old’ member states from the EU-15 and the EU-12. For example, in Bulgaria in Romania full liberalization results in the agricultural share in GDP declining by more than 0.5 percentage points.

Agricultural supply in the EU is rather stable. Even under full liberalization, agricultural supply will not decline dramatically: it falls by about 10% if compared to the baseline. This is also because agricultural factor prices decline in case of agricultural liberalization and dampen the effect of lower product prices.

Due to segmented factor markets income disparities between agricultural and non-agricultural sectors increase under the baseline and under all scenarios.

6.2 Conclusions with Regard to Model Combination

Both models have been applied independently from each other. No close formal link between both models has been implemented. This allows making full use of the strengths of both model types. The adjustment of some Armington elasticities and CET elasticities of factor allocation allows bringing LEITAP results closer to ESIM results. While the general direction of supply response is similar except for milk, some differences remain in the results of both models. This holds especially for cereals and oilseeds, for which the allocative effects of removing direct payments are stronger in LEITAP than in ESIM. In addition, ESIM simulates a much stronger decline in sugar production in case of full liberalization because of it’s net trade specification compared to the Armington specification of LEITAP.

The consideration of a decline of agricultural factor prices for capital and labor matters for the supply response, but not too much. Farm supply for the EU-25 is 0.5% higher when taking into account lower factor prices after liberalization. For many of the NMS, however, with high shares of agriculture in GDP such as Bulgaria and Romania, these effects are much more pronounced up to 2%. The inclusion of capital and labor price changes in a PE model is more relevant for animal products than for crops, as labor and capital have a higher cost share in animal products.

7 References

Balkhausen, O. and M. Banse (2005), Modelling of Land Use and Land Markets in Partial and General Equilibrium Models: The Current State. Working paper prepared for the joint research project “The Impact of Decoupling and Modulation in the Enlarged Union: A sectoral and farm level assessment”, Revised Version, Göttingen.

Balkhausen, O., Banse, M., Grethe, H. and S. Nolte (2005), Modelling the Effects of Partial Decoupling on Crop and Fodder Area as well as Beef Supply in the EU: Current State and Outlook. In Arfini, F. (ed.), "Modelling Agricultural Policies: State of the Art and New Challenges", Proceedings of the 89th Seminar of the European Association of Agricultural Economists, University of Parma: 565-587.

Banse, M. and H. Grethe (2005), How Will Decreasing Subsistence Production Affect Future Dairy Markets in the Central European Countries? In Arfini, F. (ed.), "Modelling Agricultural Policies: State of the Art and New Challenges", Proceedings of the 89th Seminar of the European Association of Agricultural Economists, University of Parma: 863-881.

Banse, M. and H. Grethe (2006), Using the Logistic Functional Form for Modelling International Price Transmission in Net Trade Simulation Models. Poster Paper at the 26th Conference of the International Association of Agricultural Economists "Contributions of Agricultural Economics to Critical Policy Issues", 12-18 August 2006, Brisbane, Australia.

Banse, M. and H. Grethe (2008), Effects of the New Biofuel Directive on EU Land Use and Agricultural Markets. Paper presented at the 107th EAAE Seminar "Modeling of Agricultural and Rural Development Policies". Seville, Spain, January 29 - February 1, 2008.

Banse, M., Grethe, H. and S. Nolte (2005). European Simulation Model (ESIM) in GAMS: User Handbook. Göttingen and Berlin.

Banse, M., Münch, W. and S. Tangermann (2000), Eastern Enlargement of the European Union: A General and Partial Equilibrium Analysis. In: Peters, G.H. and P. Pingali (2001). Tomorrow's Agriculture: Incentives, Institutions, Infrastructure and Innovations. Proceedings of the Twenty-Fourth International Conference of Agricultural Economists. pp. 488-498.

Böhringer, C. and T.F. Rutherford (2006), Combining Top-Down and Bottom-Up in Energy Policy Analysis: A Decomposition Approach. ZEW Discussion Paper 06-007.

Britz, W. (2004), CAPRI Modelling System Documentation. Common Agricultural Policy Regional Impact Analysis. Bonn.

Cypris, C., Kleinhanß, W., Kreins, P., Manegold, D., Meudt, M. and R. Sander (1997), Modellrechnungen zur Weiterentwicklung des Systems der Preisausgleichszahlungen. Forschungsgesellschaft für Agrarpolitik und Agrarsoziologie e.V., Bonn, Arbeitsmaterial Nr. 1.

Eickhout, B., van Meijl, H., van Rheenen, T. and A. Tabeau (2007), Economic and ecological consequences of four European land-use scenarios, Land Use Policy 24 (2007) 562–575.

European Commission (2007a), Agriculture in the European Union - Statistical and economic information 2006. Brussels.

European Commission (2007b), The impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on agricultural markets. Impact assessment of the Renewable Energy Roadmap - March 2007. DG Agri, AGRI G-2/WM D(2007), 30.04.2007, Brussels.

FAPRI (2006), U.S. and World Agricultural Outlook. Food and Agricultural Policy Research Institute. Iowa State University. University of Missouri-Columbia. Ames, Iowa.

Francois, J., van Meijl, H. and F. van Tongeren (2005), Trade liberalization in the Doha Development Round. Economic Policy: 351-391.

Grant, J.H., Hertel, T.W. and T.F. Rutherford (2006), Extending General Equilibrium to the Tariff Line: U.S. Diary in the Doha Development Agenda. Paper presented on the 9th Conference on Global Economic Analysis, June, 15-17 2006, Addis Abeba.

Helming, J., Tabeau, A., Kuhlmann, T. and F. van Tongeren (2006), Linkage of GTAP and DRAM for Scenario Assessment: Methodology, Application and some Selected Results. 9. Paper presented on the 9th Conference on Global Economic Analysis, June, 15-17 2006, Addis Abeba.

Hertel, T and R. Keening (2003), Assessing the Impact of WTO Reforms on World Agricultural Markets: A New Approach.

Huang, H., van Tongeren, F., Dewbre, J. and H. van Meijl (2004), A New Representation of Agricultural Production Technology in GTAP. Paper presented at the Seventh Annual Conference on Global Economic Analysis, June, Washington, USA.

Jansson, T., M. Kuiper, M. Banse, T. Heckelei and M. Adenäuer (2008), Getting the best of both worlds? Linking CAPRI and GTAP for an economy-wide assessment of agriculture. Paper presented on the 11th Annual GTAP Conference, June 11-14, 2008, Helsinki, Finland.

Kuhlmann, T., Tongeren, F. van, Helming, A., Tabeau, A., Gaaff, A., Groeneveld, R., Koole, B. and D. Verhoog (2006), Future Land-Use Change in the Netherlands: An Analysis based on a Chain of Models. Agrarwirtschaft, Vol. 55, No. 5/6: 238-247.

Manegold, D., Kleinhanß, W., Kreins, B., Osterburg, B. and K. Seifert (1998), Interaktive Anwendung von Markt-, Regional- und Betriebsmodellen zur Beurteilung von Politikalternativen. In: Berg, E., Henrichsmeyer, W. and G. Schiefer (Eds.), Agrarwirtschaft in der Informationsgesellschaft. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e. V., Bd. 35, Münster-Hiltrup: 147-157.

Meijl, H. van and F.W. van Tongeren (2002), The Agenda 2000 CAP reform, world prices and GATT-WTO export constraints. European Review of Agricultural Economics, Vol 29 (4): 445-470.

Meijl, H. van, van Rheenen, T., Tabeau, A. and B. Eickhout (2006), The impact of different policy environments on land use in Europe, Agriculture, Ecosystems and Environment, Vol. 114: 21-38.

Nowicki, P., H. van Meijl, A. Knierim, M. Banse, J. Helming, O. Margraf, B. Matzdorf. R. Mnatsakanian, M. Reutter, I. Terluin, K. Overmars, D. Verhoog, C. Weeger, H. Westhoek (2007), Scenar 2020 - Scenario study on agriculture and the rural world. Contract No. 30 - CE - 0040087/00-08. European Commission, Directorate-General Agriculture and Rural Development, Brussels.

OECD-FAO (2007), Agricultural Outlook 2007-2016, OECD and FAO, Paris, France.

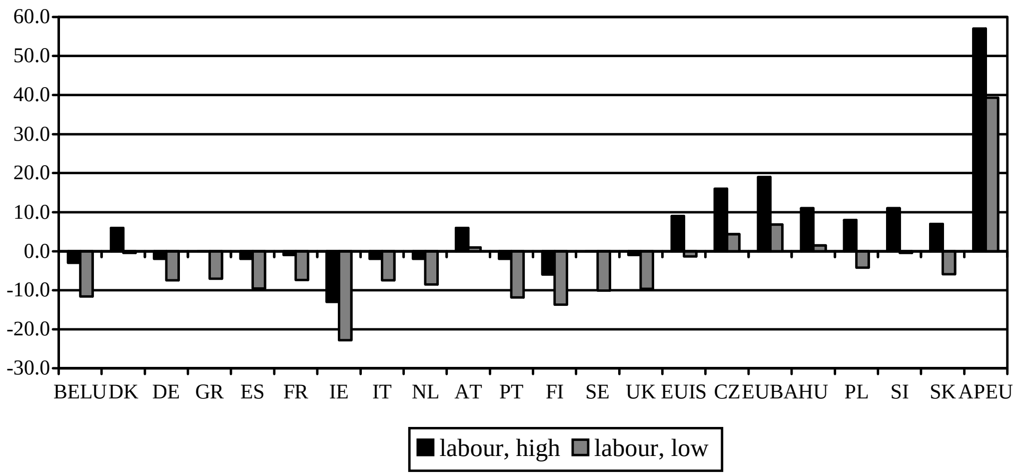
van Tongeren, F. (2000), Perspectives on Modelling EU Agricultural Policies. Agrarwirtschaft 49, No. ¾: 157-163.

van Tongeren, F.W., H. van Meijl and Y. Surry (2001), Global models of trade in agriculture and related environmental modelling: a review and assessment. Agricultural Economics, Vol 1493: 1-24.

Annex: Sensitivity Analysis of LEITAP Results with Respect to CET Elasticities of Labor Allocation

In LEITAP agricultural factor markets are modelled as separated markets from the factor markets in the overall economy by using a Constant-Elasticity of Transformation (CET) function between non-agricultural factor markets and agricultural factor markets. The lower the CET elasticity the more segmented both factor markets. To illustrate the effects of different CET elasticities, the following figures show the effect under the Liberalization scenario.

Figure A-1: Change in Agricultural Wage Rates in Liberalization Scenario in 2020 with Different CET Elasticities, relative to 2005, in %



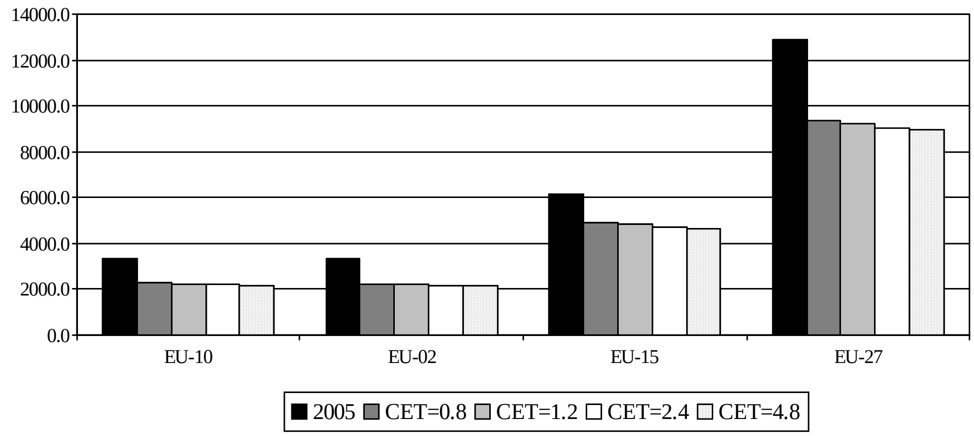
Remark: EUIS = Malta and Cyprus, EUBA = Baltic countries, APEU = Bulgaria and Romania

Source: Own calculations.

If agricultural factor markets are modelled as less separated from factor markets ("high": CET elasticity = 4.8; "low": CET elasticity = 0.8) outside agriculture, wage rates in agriculture react less strongly, because factors can leave the agricultural sector more easily, see figure A-1.

The empirical foundation of the CET elasticities is rather weak. Therefore, a systematic sensitivity analysis for different level of the CET is carried out. If the CET elasticities are increased and agricultural workers react more elastic to wage differentials between agricultural and non-agricultural wages, the changes in agricultural employment become more pronounced, see figure A-2. Under high CET elasticities around 0.4 mio additional workers will leave agriculture.

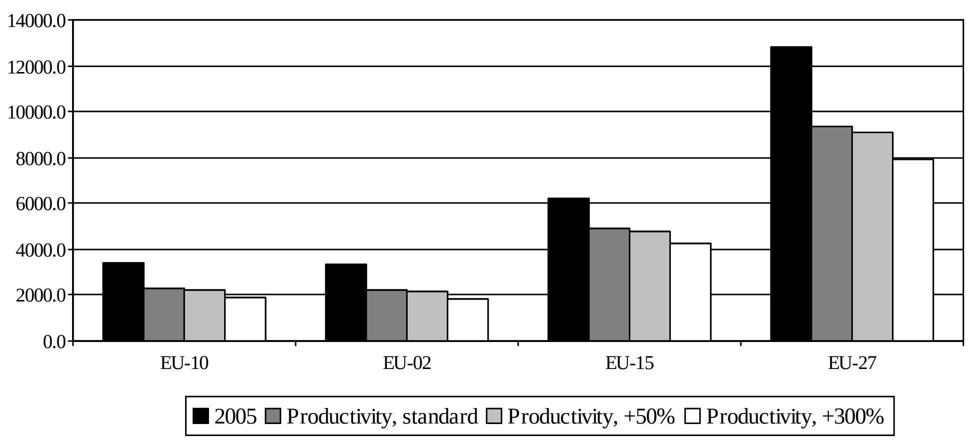
Figure A-2: Agricultural Employment in Baseline 2005 and 2020 with Different CET Elasticities (1000 persons)



Source: Own calculations.

Figure A-3 presents results if assumptions on labor saving technical progress are altered. If the rate of labor augmenting technical progress is increased by 50%, results remain almost unchanged compared to the standard assumptions. Only if productivity growth rates increase by 300% - which seems to be a rather unrealistic high number – the modelling results show a strong decline in agricultural employment.

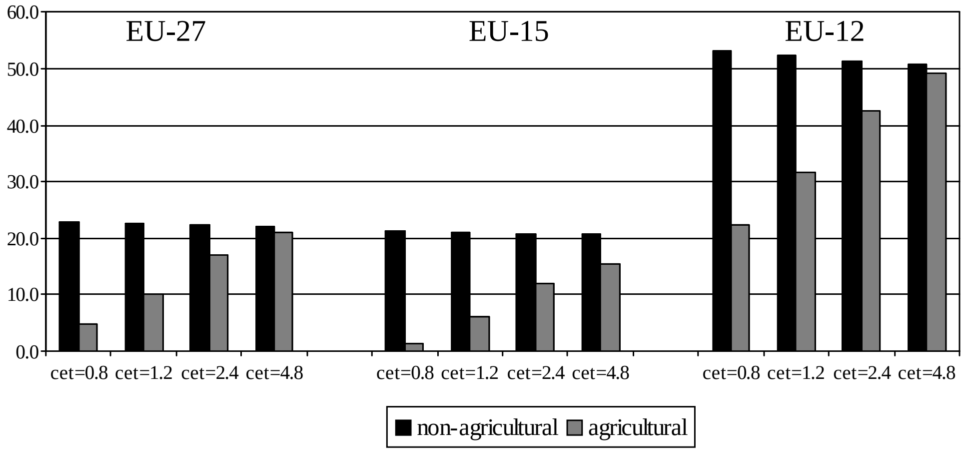
Figure A-3: Agricultural Employment in Baseline 2005 and 2020 with Different Growth Rates in Labor Productivity



Source: Own calculations.

The less separated the factor markets the more similar is the development of factor prices inside and outside agriculture. Figure A-4 illustrates the effect of increasing the CET elasticities, reflecting a decline in the degree of separation of agricultural and non-agricultural factor markets.

Figure A-4: Change in Agricultural and Non-Agricultural Wage Rates, 2020 in Baseline with Different CET Elasticities



Source: Own calculations.

If CET elasticities are set to the value of 4.8, the development of wage rates inside and outside agriculture in the NMS is almost similar. The difference in the change in agricultural wages and non-agricultural wages is only 0.5 percentage points.