SCENAR2020: Future of European Agriculture under Different Policy Options, the economic modelling framework.

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Abstract

This paper identifies major future trends and driving factors and perspectives and challenges resulting from them for European agriculture and food sectors until the year 2020. The focus of the paper is an analysis of key driving forces and the provision of a well developed reference scenario under the assumption of continued CAP reform and taking into account the framework discussions in the Doha Development Round. To assess the impact of policies the paper also examines a liberalisation (no support) and regionalisation (max support) scenario. In terms of policy options the paper shows that structural change process in agriculture is a long-term process that continues with or without policy changes. EU is facing an increasing diversity of structure and structural adjustment. The livestock sector faces important challenges and restructuring. Alternative policy settings may not produce very different effect on the overall production. However, the regional impact may prove to be more significant.

Key words: Economic Modelling, Future, CAP Policy Options, Structural Change

1. Introduction

The objective of this paper is to identify major future trends and driving factors and perspectives and challenges resulting from them for European agriculture and food sectors until the year 2020. The focus of the paper is an analysis of key driving forces and the provision of a well developed reference scenario under the assumption of continued CAP reform and taking into account the framework discussions in the Doha Development Round. The paper also examines alternative relevant and consistent scenarios. The Scenar 2020 study has been a precursor of the Commission proposal for the 'Health Check'of 2008, in which issues explored in Scenar 2020 (further decoupling; removal of market intervention measures, set aside and quotas; and increased encouragement of bio-energy production) are officially tabled for discussion. The financial implications of these issues along with others – such as modulation – are also examined in the Scenar 2020 study.

We begin this paper with a systematic review of those drivers which are endogenous or exogenous to policy decisions. Next the effects of the drivers are analysed at global and national levels taking into account general equilibrium effects of the drivers and the different policy options. This analysis at global and national levels is achieved by the LEITAP model which is an extended GTAP model extended for land market and a segmented factor market for agriculture. To derive a more detailed analysis of different policy options on agri-food sectors at national level and regional level the partial equilibrium models ESIM and CAPRI are used here as well.

With this modelling tool the paper identifies the future trends and driving forces that is the framework for the European agricultural and rural economy on the horizon of 2020. A reference scenario ('baseline') is based on an analysis of trends from 1990 to 2005, and these trends are projected forward to 2020. This trend analysis provides a substantiated basis for determining the long-term driving forces ('exogenous drivers') that is reflected in the reference scenario. Under the assumption that agricultural, rural and environmental policies are able to inflect these trends, these policies are

studied as a second-level set of driving forces ('endogenous drivers'). Two counter-factual scenarios to the baseline scenario are defined ('regionalisation' and 'liberalisation'), and these are intended to demonstrate two reasonable variations in policy during the coming fifteen years. With this combined analysis this paper contributes to the ongoing debate on policy options under the health check of the CAP.

The driving forces and scenarios are described in section 2. Section 3 describes the economic modelling framework and section 4 provides the modelling results. Section 5 concludes.

2. Driving forces and scenarios

An assumption that has guided the preparation of the SCENAR2020 scenario study is that there are two levels of drivers that will influence scenario building (Nowicki et al. 2006). The first level is a set of *exogenous* drivers; these are drivers that are not directly influenced by policies, or at least not in the time horizon of the Scenar 2020 study (that is, up to 2020). As presented in Table 1, exogenous drivers are population growth, macro-economic growth, consumer preferences, agri-technology, environmental conditions and world markets[1]. The second level is a set of *policy-related* drivers, and these will certainly have a discernable effect within the Scenar 2020 time horizon. They are EU agricultural policies, enlargement decisions and implementation, WTO and other international agreements and environmental policy.

Several choices have been made for the development and analysis of scenarios. The first is to have a baseline scenario that is based on the exogenous drivers. The second is that the policy-related drivers are then coupled to the baseline scenario in three iterations. The first iteration is the *baseline (reference) scenario*, in which current policies are considered to continue into the future, with modifications over time that are reasonably certain to happen according to the current political situation. The second iteration is a *regionalisation scenario*, in which there is a sustained policy preference to promote regional economic strength and social welfare; to some extent this is also an emphasis on the maximum degree of support for agricultural supply that is possible under the current, and likely, WTO framework. The third iteration is a *liberalisation scenario*, in which policy intervention in the economy – and in social welfare, including environmental protection – is reduced to the minimum that would be socially acceptable.

[1] World markets are partly endogenous in this study as we use a global economy-wide model in which world markets are dependent on macro-economic and population developments, preferences shifts, technological change and policy changes.

Table 1: Scenario assumptions.

(a) Based on the exogenous drivers

Assumptions	**Demographics**	**Macro-economic growth**	**Consumer preferences**	**Agri-technology**	**World Markets**
Baseline	Major population trends as observed in the past	Moderate growth as seen in the trends; Increasing trend for labour market liberalisation	More demand for value added and increasing absolute spending per capita; Consumption of organic and regional food as observed in the past	Continuous trends in cost saving technical progress; Biotechnology; GMO	Outcome depends on other exogenous drivers. Trends in agri-markets, generally, as observed in OECD/FAPRI studies. Change from these trends due to different assumptions on exogenous and policy-related drivers.

(b) Based on the policy-related drivers

Assumptions	**CAP**			**Biofuels**	**Enlargement**	**WTO and other international agreements**	**Environmental policies impact on agriculture**
	Market policies	**Direct payments**	**Rural development policy**				
Baseline	Balanced markets, i.e. keeping public intervention stocks at 1 to 2% of domestic consumption; if stocks are too high support prices will be decreased	Financial discipline and 25% modulation	Taking into account the new financial perspective	Continuation of EU Biofuels Strategy	EU-25 plus the accession of Bulgaria, Romania, Turkey and the Western Balkans	EU offer	Continuation of existing environmental legislation
Regionalisation	Existing CAP	Financial discipline and 5% modulation	Significant increase in funding of rural development through all EAFRD axes	Higher policy support to produce biofuels	Baseline	No WTO agreement / bilateral approach	Reinforcement of environmental legislation
Liberalisation	No internal support policies	Removing direct agricultural payments	Rural development is funded according to EAFRD provisions: decrease in funding of all EAFRD axes	No per hectare subsidies for biofuels	Baseline	Removing import tariffs	Partial withdrawal of environmental legislation

3. Economic modelling

In the Scenar 2020 project the commodity focus and regional / territorial focus have to be connected[2]. The global economy-wide dimension is covered by the economic LEITAP model and the biophysical IMAGE model (Figure 1). ESIM is providing more agricultural detail for the EU-27 countries and CAPRI is distributing this impact to the regional (NUTS2) level. The gap in our (and the EU research community) modelling framework is what happens with the other sectors (i.e. rest of the economy) at the regional level. This is important for rural development because an agricultural decline in a region is only causing problems when there is no absorption capacity in the other sectors of the economy of the redundant agricultural labour. In this project we attempt to fill this gap by combining empirical information on the regional (NUTS2/3 & HARM2) level from the past and projections at the national level produced by the modelling framework. We use time series analyses to identify relations in the past and to identify relations between the national and the regional level.

	Agricultural	Rest of economy
Global	LEITAP-IMAGE	
EU/national	ESIM	LEITAP
NUTS2	CAPRI	TSA[1] or downscaling
Grid	CLUE-s	

[1] TSA: Time series analysis

Figure 1: Schematic overview of the models: geographical and sectoral coverage.

Description of the chain of models: LEITAP/IMAGE – ESIM – CAPRI — CLUE-s

To perform the analysis, a modelling framework is constructed, existing of three economic models (LEITAP, ESIM, and CAPRI), a more ecological-environmental based model framework (IMAGE) and a land use allocation model (CLUE-s) to disaggregate the outcomes to the landscape level. In this modelling framework the long-term economic and environmental consequences of different scenarios are quantified and analysed, starting from 2005 up to 2020, for several regions in the world and all 25 EU countries. The LEITAP main contribution is in the WTO policies (affects all sectors not only agriculture) and the interaction with the rest of the economy (other industries and factor markets).

[2] Complete sets of detailed regional data were not available for the two new Member States, Bulgaria and Romania, during the period of preparing data for use in the modelling exercise, and the results presented reflect this fact; thus these two countries are presented separately when the data for them have been available for analysis.

ESIM's main contribution is the projection of developments in EU agricultural markets into the future. ESIM is also the only model in which we model the production of biofuels. CAPRI's main contribution is changes in CAP policies and the regional impact (NUTS2 level).

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 Tongeren, 2002). More specifically, LEITAP is a modified version of the global general equilibrium Global Trade Analysis Project (GTAP) model. 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) and 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.*, 2006b; Eickhout *et al.*, 2006). The ESIM and CAPRI models are EU-27 partial equilibrium models for the agricultural sector at respectively country and NUTS2 level with a strong focus on EU common agricultural policies. A detailed description of CAPRI can be found in (Britz et al., 2007). In the final modelling stage the spatially explicit land use model CLUE-s (Conversion of Land Use and its Effects - Verburg *et al.*, 2002) is used. The CLUE-s model disaggregates the outcomes of LEITAP/IMAGE – ESIM – CAPRI to a temporal resolution of two years and a spatial resolution of 1 km.

4. Results

4.1 National level

The results indicate that the structural changes, i.e. decline of agricultural contribution to total income and employment, will continue at national level. In the baseline scenario the process of structural change continues in the near future in the EU-27. The share of agriculture and food processing industries in total income continues to fall until 2020. Compared to the EU-15, the macro-economic significance of primary agriculture is higher in the EU-10 in the initial situation. Therefore, the structural change process is more severe in the EU-10 than in the EU-15 countries. The strong decline in contribution of agro-food industries in the EU-10 implies that more labour will be released from the agri-food sectors in these countries (given the assumption that in the longer run labour will earn equal wages in both the agricultural and non-agricultural sectors). Regions with high shares of agriculture and industries may be vulnerable to this process with regard to employment and income growth, as the structural change process is often characterised by adjustment processes and related costs.

The employment figures are in line with the structural change process. Employment in the agri-food and manufacturing industries decreases whereas it increases in the services sectors. Figure 2 shows that employment effects in protected sectors are more pronounced in the EU-10 countries because the higher rate of structural changes due to the enlargement and a process of catching up which leads to higher GDP growth rates and related structural change. The impact of liberalisation is especially negative on employment in the protected sectors.

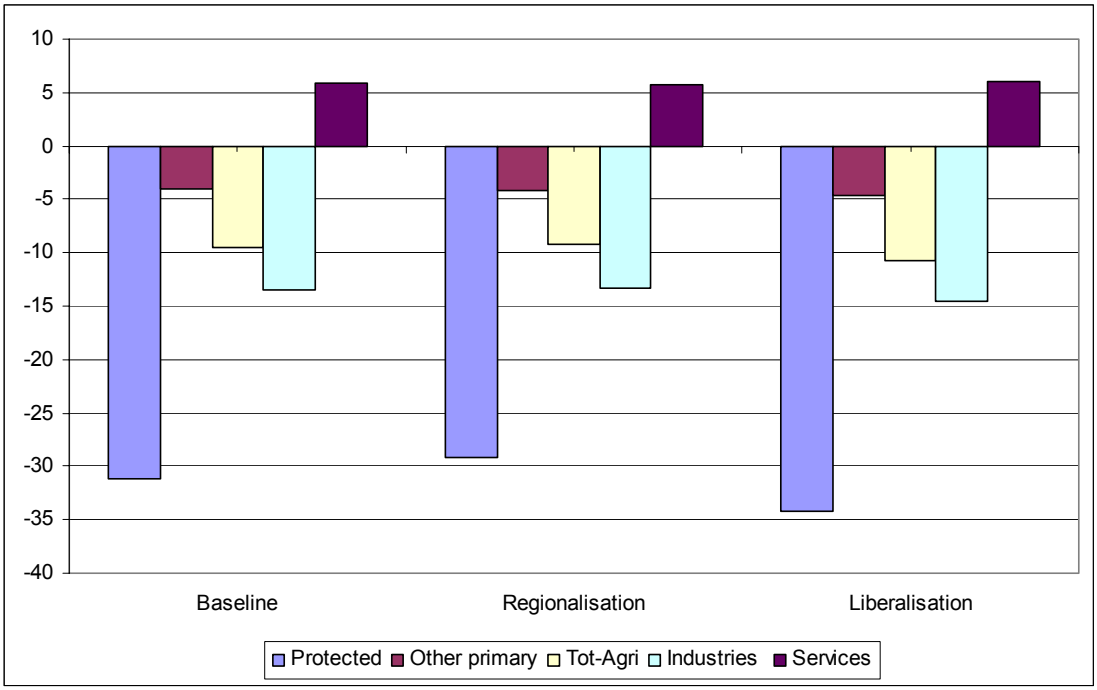

Figure 2: Sectoral employment growth in the EU-10, 2005-2020.

The development of factor prices in Figure 3 shows that, in line with historical trends, the wages of skilled labour increase more than the wage of unskilled labour and the wages in general increase relative to the rental rate of land and especially capital. The rental rate of capital rises not as quickly as the capital stock will be augmented with investments (it will not become as scarce as labour). Increase in wages is a bit higher in liberalisation scenario and lower in the regionalisation scenario relative to the baseline scenario. Increase in wages is higher in EU-10 than EU-15 due to the process of catching up.

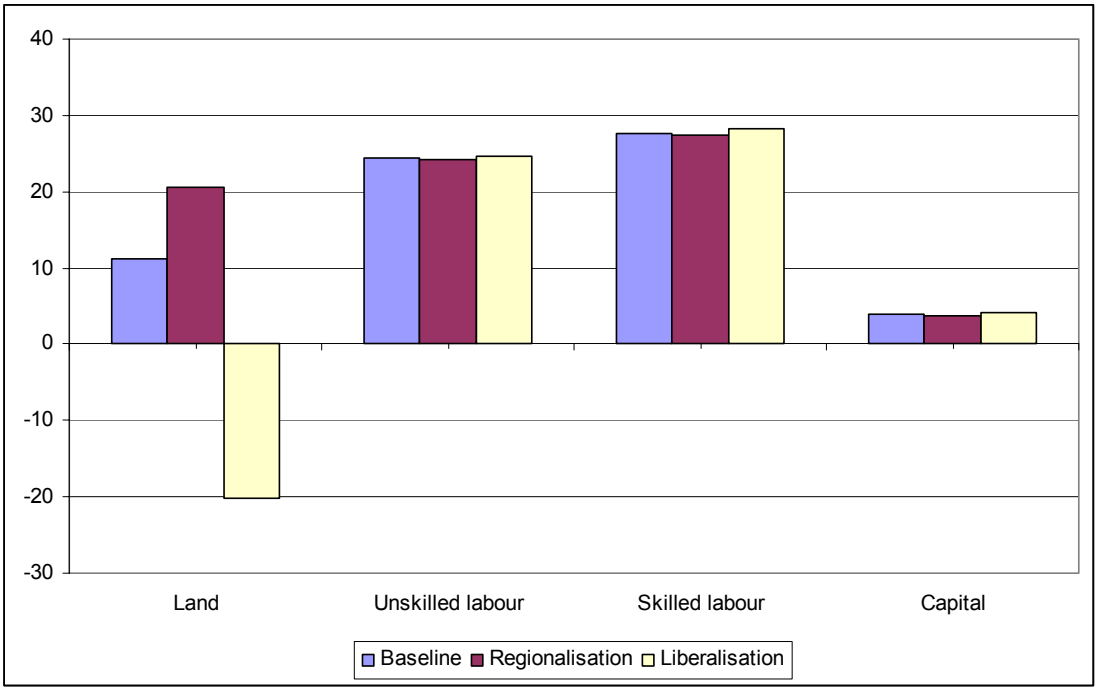

Figure 3: Development real factor prices in the EU-15, 2005-2020.

The land price is very dependent on the policy scenario. The direct payments and profitability of agriculture accrue partly in the price of the fixed factor land. In the regionalisation scenario direct payments stay highest and agriculture is more profitable relative to the other scenarios: land prices are highest. In the liberalisation scenario land prices decline fast as all direct payments are abolished and profitability in agriculture is low. The land market will have an important buffer function easing the adjustment of production.

4.2 Sectoral level

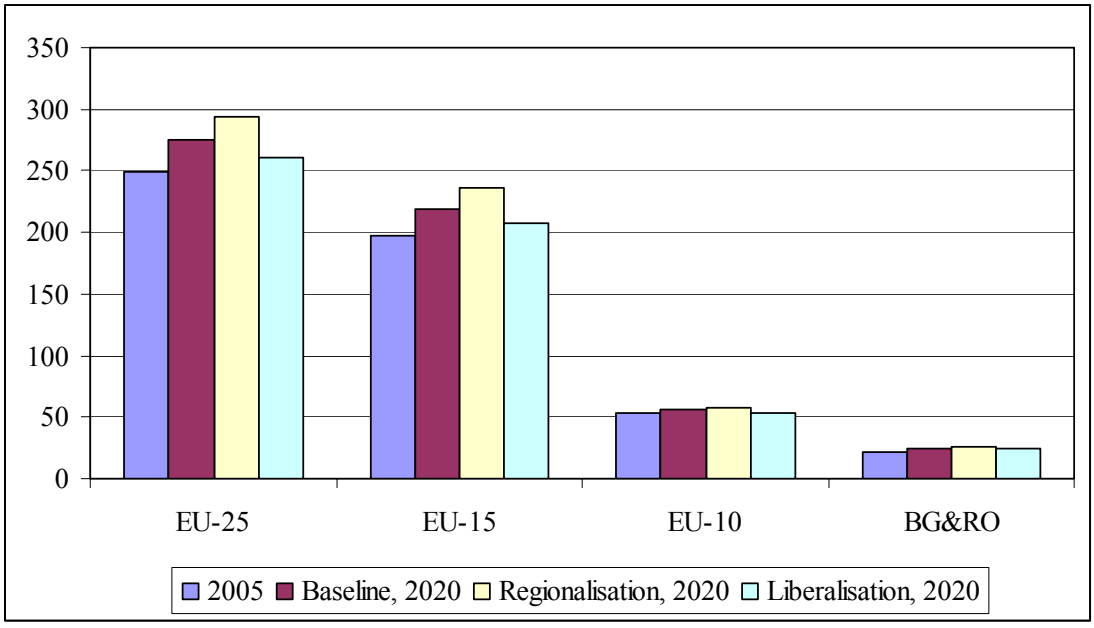

Figure 4: Production of cereals under the different scenarios in the EU, 2005 and 2020, in mio t.

Between 2005 and 2020, cereal production in the EU-25 increases by over 10 percent, which is equivalent to 25 mio t. Within cereals, wheat production grows by over 13 percent (equivalent to 14 mio t). For the cereal market the implementation of the EU October 2005 offer leads to a further reduction in price, which predominantly affects coarse grain production, e.g., barley and rye. In order to balance domestic markets, the level of intervention prices for barley is reduced under the baseline scenario. However, the consequence of trade liberalisation is not a decline in coarse grain production but a constant production level. The falling land prices help to limit the production decline.

The general trends in livestock market in the EU-15 are similar to those at EU-25 level (See, Figure 5-7). Beef production declines slightly between 2005 and 2020. In total, beef production declines by 0.4 mio t, i.e. 7 percent. The projection indicates a slight increase in cheese production by 0.2 mio t. EU-15 poultry production increases by almost 10 percent and pork production expands by only 4 percent compared to the year 2005. On the consumption side, total meat consumption per capita increases by almost 3 percent in the EU-15; but the share of beef decreases relative to pork and poultry, which is consistent with an observed shift in consumer perference.

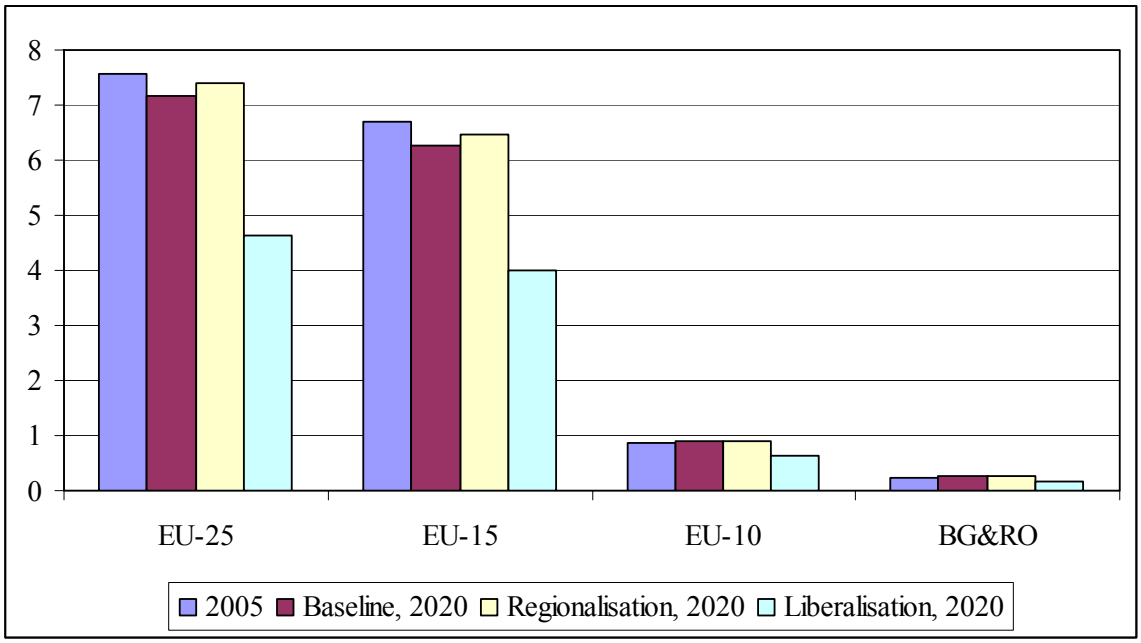

Figure 5: Production of beef under the different scenarios in the EU, 2005 and 2020, in mio t.

The production results indicate similar results in the EU-10 for cheese production as in the EU-15. However, beef production is relatively constant at 0.9 mio t and poultry production declines by 0.2 mio t, i.e. 12 percent. This different development in the EU-10 compared to the EU-15 is due to different assumptions on the rate of technical progress and on different reactions to cross price effects.

These differences between the EU-15 and the EU-10 are also reflected in the development on the consumption side. While total per capita meat consumption increases slightly in the EU-15, per capita meat consumption increases in the EU-10 by over 14 percent between 2005 and 2020.

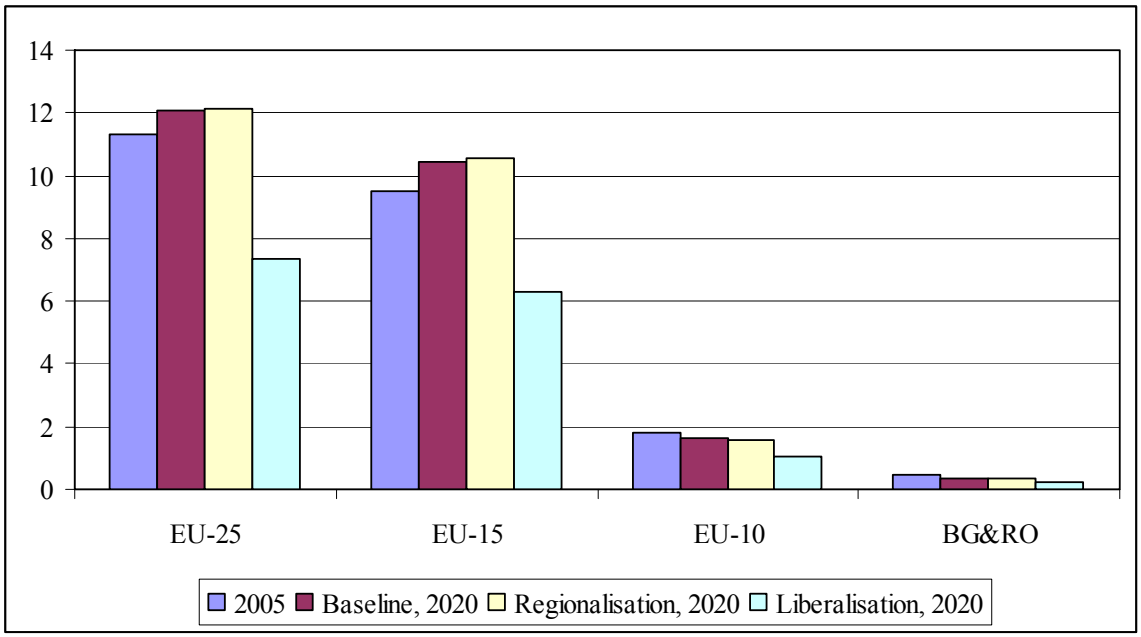

Figure 6: Production of poultry meat under the different scenarios in the EU, 2005 and 2020, in mio t.

Full liberalisation with no distorting trade policy measures and a phasing out of quota restrictions leads to a significant reduction in beef and poultry meat productions. Beef production is almost 35 percent less than under the baseline scenario. The reduction in poultry meat production of over 37 percent is even more severe than under the baseline. The phasing out of quota regulation in combination with a cut in import tariffs and TRQs results in an increase in cheese production of over 15 percent. Milk production in the EU-25 is around 12 percent higher than in the baseline, where milk quota is binding. With the increase in milk production, the production of dairy products also increases. However, cheese production expands further than butter and SMP. Therefore, some (high value added) sectors would benefit from a process of liberalisation

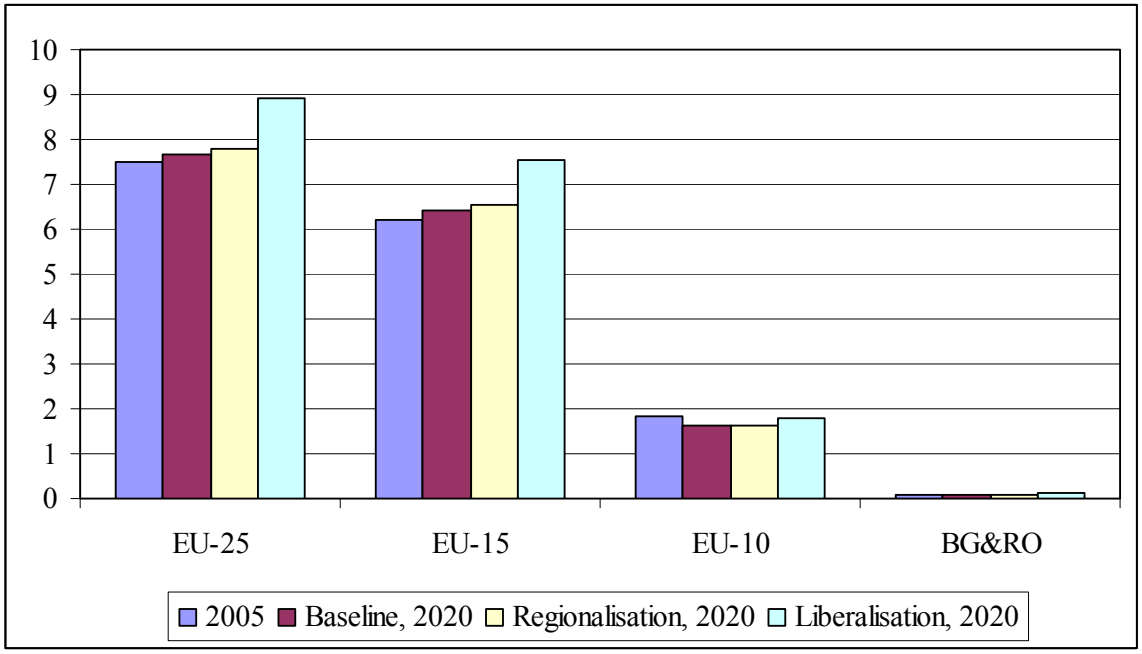

Figure 7: Production of cheese under the different scenarios in the EU, 2005 and 2020, in mio t.

4.3 Regional level

The following Figure 8 presents the effect on regional income measured in € per ha. Regional income effects can be very diverse, depending on the income effect per activity and the share of agricultural activities in total number of agricultural activities. Figure 8 presents the results of the liberalisation scenario relative to the baseline scenario. Regions with high shares of beef cattle and arable crops will lose most from liberalisation. These are especially regions in France, eastern Germany and in the new member states. Regions with a relative high share of income coming from other animals, dairy cows and vegetables and permanent crops lose relatively less. These sectors are characterised by relatively high gross margins. As a result price changes have relative little effect on gross margins.

In the northern part of Portugal the income effect is much less negative than in the rest of the country. This is due to high income shares from intensive livestock activities and vegetables and permanent crops in this region.

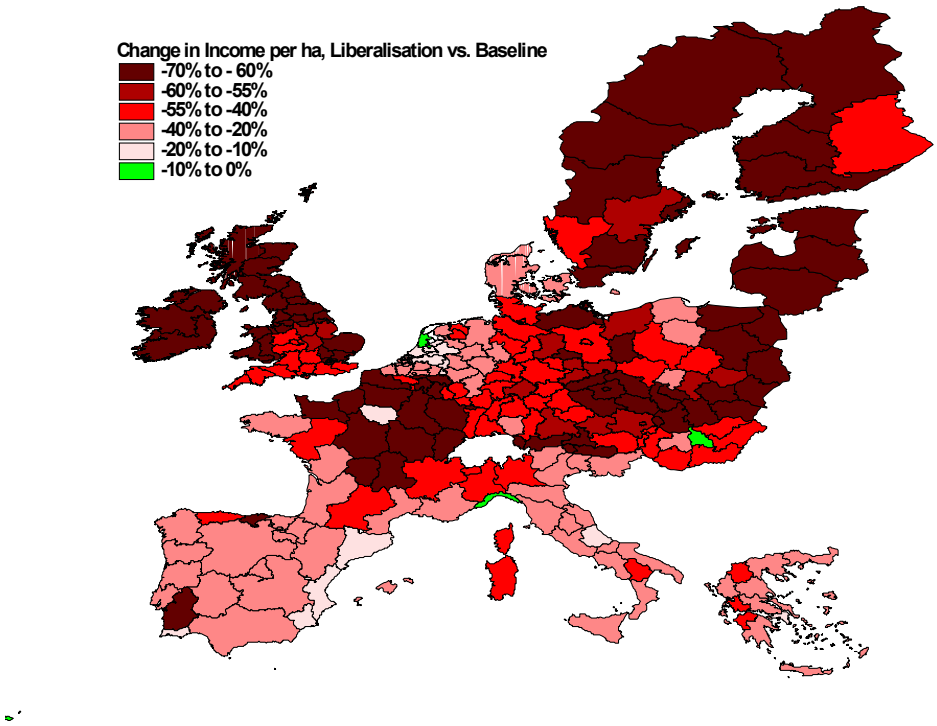

Figure 8: Changes in farm income per ha: liberalisation versus baseline scenario.

The following Table 2 shows the results with respect to the number of farms per sub-sector for the EU-25. In the baseline the number of farms is based on extrapolation of adjusted yearly trends per country and aggregation over all countries. The number of farms in the EU-25 per sub-sector in the liberalisation scenario is assumed to be linearly dependent on the differences between gross value added per sub-sector per country in the liberalisation scenario compared to the baseline in 2020. To derive the situation at the EU-25 level, results are aggregated over all countries. Table 2 shows that in 2003 there are about 10 mio farms in the EU-25.

Table 2: Number of farms per sub-sector in 2003 and in 2020 in different scenarios (in mio farms).

Sub-sector	2003	2020		Difference (%)		
		Baseline	Liberalisation	Baseline vs. 2003	Liberalisation vs. baseline	Liberalisation vs. 2003
Arable crops	2.3	1.4	0.9	-37.4	-35.4	-59.6
Vegetables and permanent crops	2.8	2.6	2.1	-7.9	-19.1	-25.4
Cattle activities	1.8	1.5	0.7	-19.6	-53.0	-62.2
Other animals	0.4	0.6	0.7	74.3	15.5	101.3
Mixed livestock farms	0.7	0.2	0.2	-64.4	-30.4	-75.2
Mixed crop farms	0.8	0.1	0.1	-88.1	-18.8	-90.3
Other livestock and crop farms	1.2	1.0	0.6	-15.3	-39.9	-49.1
Total	10.0	7.5	5.3	-25.4	-29.1	-47.1

More than 50% of these farms are classified as arable or vegetables and crop farms, in other words belonging to the arable or vegetables and crop sub-sector. Table 2 also shows that in the baseline the number of farms will decrease in all sub-sectors. The only exception is the other animals sub-sector. The later is especially explained by the increase in the EU-10. In the baseline the decrease in the number of farms is especially strong in the mixed livestock and the mixed crop sub-sectors. This could be explained by the tendency to specialise in a limited number of production lines as showed by the increase in the number of other animal farms. In the baseline the total number of farms in the EU-25 decreases by about 25%.

As could be expected liberalisation of agricultural markets has a large effect on the number of farms. Compared to the baseline the number of farms decreases by almost 30%. Here again, it is expected that liberalisation results into a further increase in the number of farms specialising in the other animals sub-sector. The largest decreases in the number of farms are found in the cattle activities and the mixed livestock and crop sub-sectors. In the liberalisation scenario the number of farms in 2020 will be about 50% lower compared to the number of farms in 2003.

Regional results are presented in the following figures. Figure 9 shows that the withdrawal of direct payments and price support in the liberalisation has the strongest impact in the Northern EU Member States compared to the South of the EU where the relative contribution of direct payments to total farm income is smaller. Even in the Southern EU Member States, however, the liberalisation has a negative impact on the numbers of farms. Relative to the development under the baseline the decrease in the number of farms, measured relative to the results of the baseline for 2020, is largest in regions in the south of Finland, north of Sweden and the Baltic countries. In most of those regions – under the liberalisation – the number of farms decreases by more than 50% relative to the baseline.

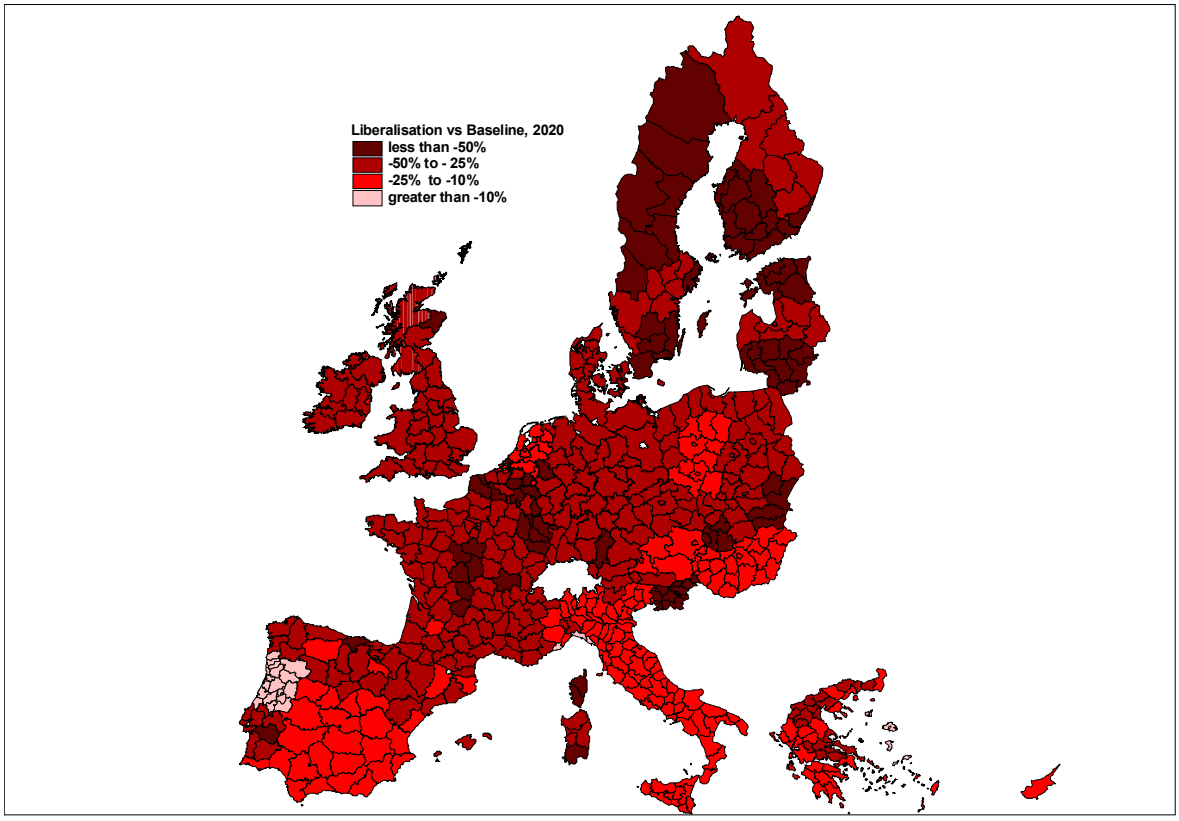

Figure 9: Changes in the number of farms per region in 2020, liberalisation vs. baseline (%).

The effect of the scenarios on the nitrate balance as compared to the baseline is limited for the EU25. The average effects of the liberalisation scenario exceed the average environmental effects of the regionalisation scenario. Regional effects can be very different from the average effects. This is illustrated in Figure 10. Figure 10 shows the effects of the liberalisation scenario. Here the picture is more complicated. An increase is expected in northwest Europe, including the Netherlands, Belgium, parts of Sweden and parts of France and United Kingdom. Also in parts of Italy, a limited increase in nitrate surplus per ha is expected. In general the explanation is the increased application of nutrients from animal manure and mineral fertiliser. Increased application of nutrients from animal manure follows the increased livestock densities regionally (other animals, and dairy cows due to quota abolition). In the Netherlands, East Anglia (United Kingdom) and Norra Mellansverige (Sweden) the application of nutrients is further stimulated by a technology switch from extensive grassland to intensive grassland.

In the rest of Europe a decrease in nitrate surplus per ha is expected. Here the application on nutrients from animal manure decreases as the decrease in the number of beef cattle outweighs the increase in the number of other animals and possibly dairy cows. Moreover, regions with decreasing nitrate surpluses per ha experience a relatively large increase in low input crops, including fallow land.

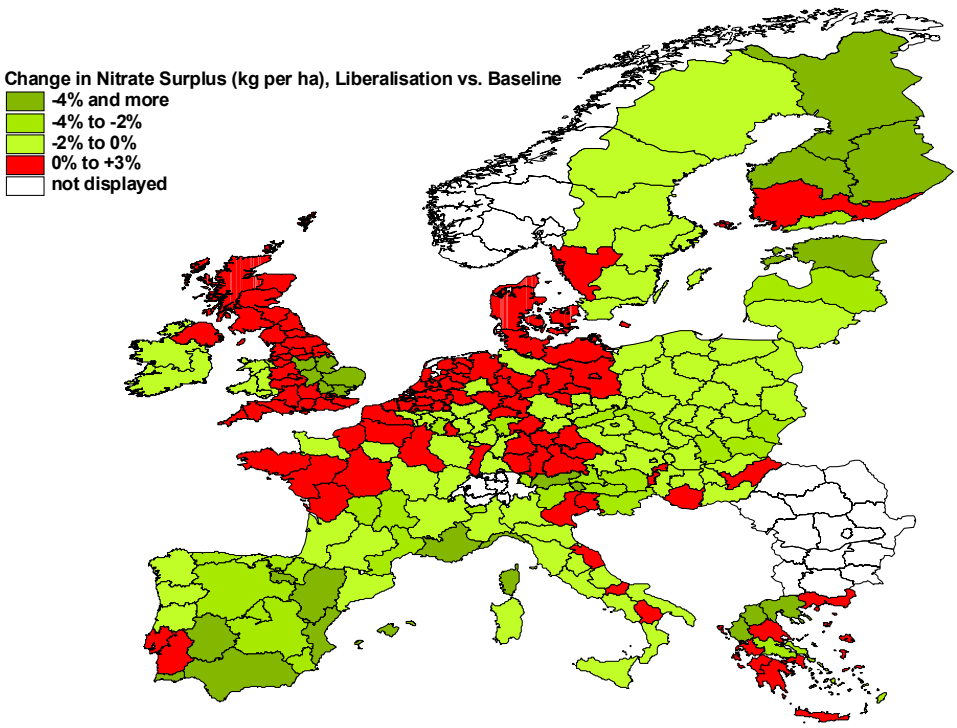

Figure 10: Changes in nitrate surplus (kg per ha): liberalisation vs. baseline.

4.4 Impact of border and domestic support on production and income

The following figure presents the results of the decomposition of the production growth for two relatively protected agricultural products. The decomposition method enables to identify the impact of changes in specific assumptions. For this analysis the focus is on the impact of changes in domestic and border support on production while all the other assumptions are aggregated in a third category. In Figure 11 production growth of protected products (grains, oilseeds, sugar, beef and dairy) is 4.9% in the base scenario. The contribution of domestic policies is -0.5% and of border policies is -2.4%. The contribution of the changes in all other assumptions (e.g. macro shocks such as growth in technological change and endowments) is 7.7%.

In general, EU-15 production growth of products with protection is low in all three scenarios. This is mainly due to the low income elasticity of demand. The production growth of protected products is highest in the regionalisation scenario and rather small in the liberalisation scenario. The contribution of changes in domestic support is negative in all scenarios. In the base and regionalisation scenario this is due to decoupling that partly redistributes payments from protected commodities to less protected commodities and enlargement impacts that provide income payments to the EU-10 and applicant countries and give them a competitive advantage. In the liberalisation scenario the negative impact is even higher due the complete withdrawal of all domestic support. The contribution of changes in border support (export subsidies and import tariffs) is negative in all three scenarios. The

impact is limited in the regionalisation scenario for the EU-15 countries because the only change in border support is due to the Mid-Term Review of 2003 and the sugar reform. In the base and liberalisation scenario the impact is more pronounced due to global liberalisation agreements. In the base scenario border support is reduced according to the EU WTO offer and in the liberalisation scenario all border support is abolished. The latter has a severe negative impact for the production of protected commodities. The decomposition of these effects clearly identifies that the abolition of border support has a higher impact on production than the abolition of domestic or income support.

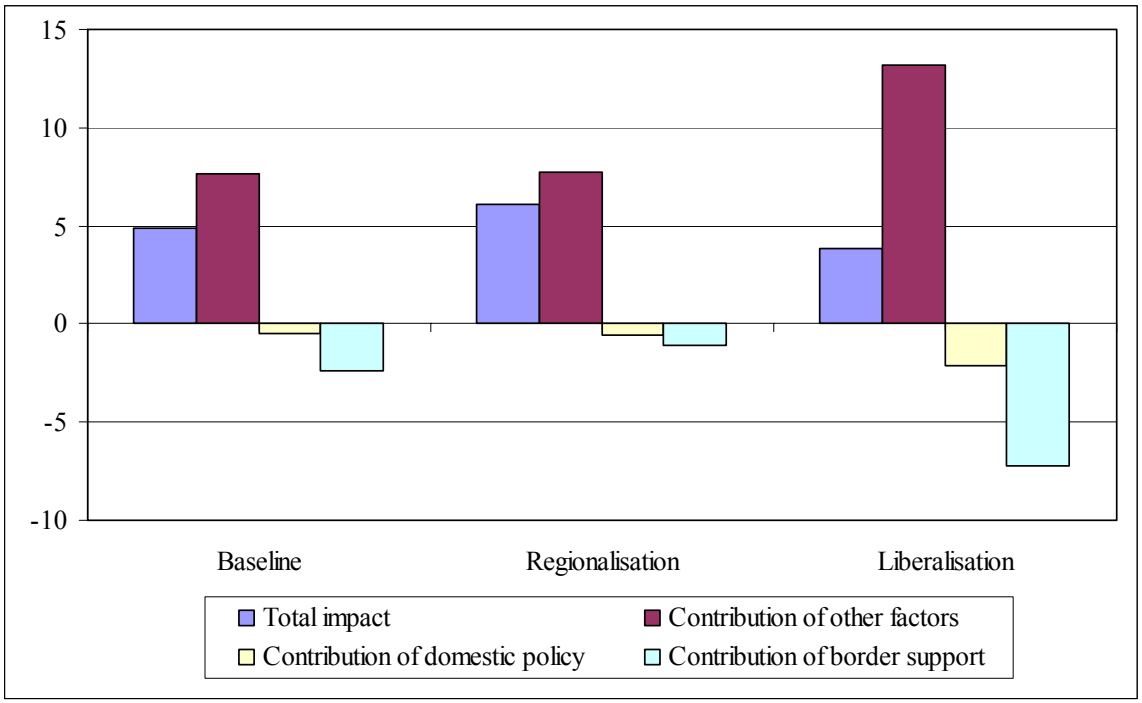

Figure 11: Decomposition of Production Growth of Protected Agricultural Products, EU-15, 2005-2020, in percent.

In the EU-15 income growth in the crops sectors is negative within the period 2005 to 2020. This development is mainly determined by policy changes and other factors such as technical progress. The decline in real prices is caused by a relatively high rate of technical progress and by an inelastic demand for these commodities. The strong decline in farm income under the liberalisation scenario is mainly caused by the withdrawal of income support.

In the base and regionalisation scenarios the impact of domestic support is limited because of continued income support in these two scenarios (this is the case although modulation occurs in the baseline scenario as it is assumed that second pillar payments continue to be distributed within the agricultural sector). The positive impact is caused by the introduction of dairy and sugar payments and decoupling. Similar to the development in the crops sectors, income from livestock production declines in all scenarios in the EU-15. Under the baseline scenario the decline in income for livestock products in the EU-15 is due to the cut in border support. Other factor and domestic policy measures have only a limited impact on the development of income for the livestock sector in the EU-15. The higher border protection assumed under the regionalisation scenario contributes to a smaller decline in

income from livestock. The abolishment of direct payment under the liberalisation scenario contributes significantly to the decline in income for this commodity group.

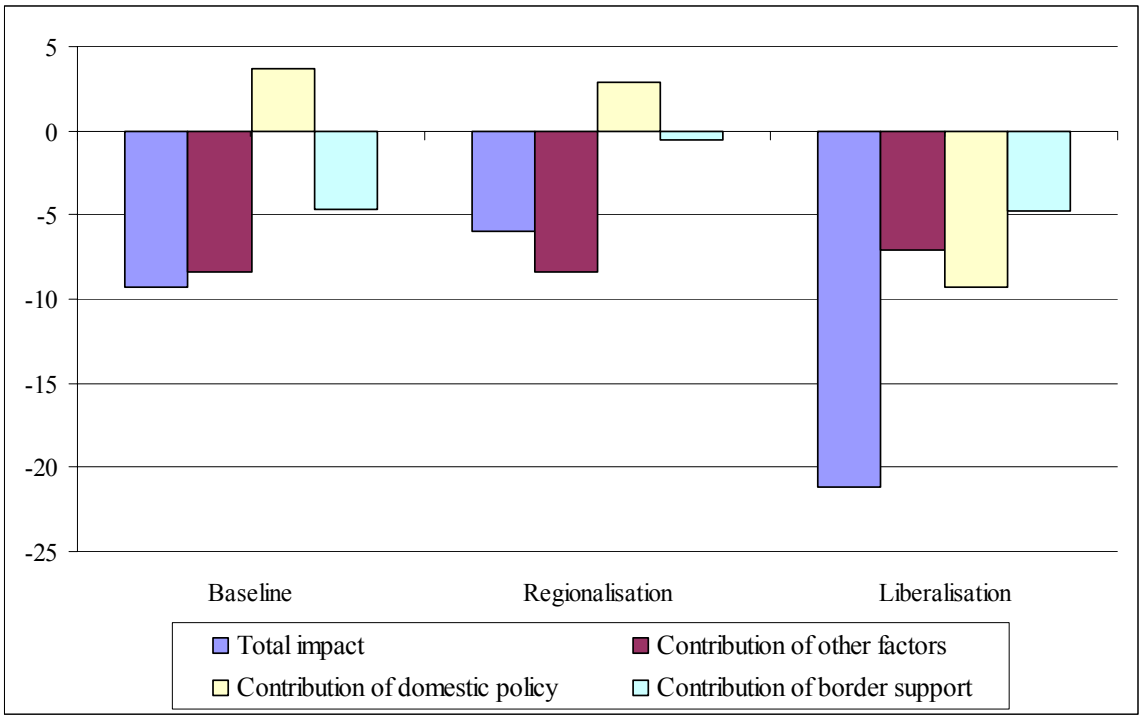

Figure 12: Sector income growth for crop sectors in EU-15, 2005-2020.

5. Conclusion

In terms of policy option the paper shows that structural change process in agriculture is a long-term process that continues with or without policy changes. EU is facing an increasing diversity of structure and structural adjustment. The livestock sector faces important challenges and restructuring. Alternative policy settings may not produce very different effect on the overall production. However, the regional impact may prove to be more significant.

The results show that the reduction of border support has a higher impact on agricultural production than the reduction of domestic income support. On the other hand, reducing domestic income support has a larger impact on farm income than the reduction of border support. The process of liberalisation has a greater impact on agricultural income than on agricultural production and land use; this fact consolidates the structural pressure throughout Europe to decrease labour in farming and to increase the average farm size

However, it should be mentioned that none of the model results is based on the assumption of the current prices for inputs, such as fossil energy and agricultural output. The results of the partial equilibrium models applied here (ESIM and CAPRI) are based on long-term price projection which does not assume a persistence of high agricultural prices until 2020. For the increase in non-agricultural input price, such as fossil energies, fertilizers etc. only moderate growth rates have been assumed.

All scenarios are calculated for both the general and the partial equilibrium models and basic assumptions on economic growth and annual increase in population are the same in both type of models. Therefore, both models are based on similar assumptions with regard to policy changes and changes in main macro-economic variables. However, both models have been applied independently from each other without an implementation of close formal link between both types of models. As a consequence, there remains a certain degree of inconsistency between the outcome of both types models. Therefore, the results presented here contribute to an integrated quantitative analysis of CAP policy option, while future projects will focus on a formal linking of partial and general equilibrium models.

Another important aspect is related to the economic development of non-agricultural sectors at regional level. More qualified quantitative models are required to address the questions whether region with a high labour surplus from structural change in agriculture will be able to absorb this capacity at regional level or not. This analysis could be bases on regional input/output models or on regional GE models which explicitly cover non-agricultural sectors . This type of modelling framework will also be explored in the future.

References

Britz, W., Heckelei, T. and Kempen, M. (2007). Final Report. Description of the CAPRI modeling system. Final Report of the CAPRI-DynaSpat project. Sixth Framework Programme. Project/Contract no. 501981. Bonn.

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

Francois, J., Meijl, van, H., Tongeren, van, F. (2005). Trade Liberalization and Developing Countries under the Doha Round. *Economic Policy* 20-42: 349-391.

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

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

Meijl, H. van, Rheenen, van, T., Tabeau A., Eickhout, B. (2006). The impact of different policy environments on land use in Europe. *Agriculture, Ecosystems and Environment* 114-1: 21-38.

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

Nowicki, P., Weeger, C., Meijl, van, H., Banse, M., Helming, J.F.M., Terluin, I., Verhoog, D., Overmars, K., Westhoek, H., Knierim, A., Reutter, M., Matzdorf, B., Margraf, O., and Mnatsakanian, D. (2007). SCENAR 2020. Scenario study on agriculture and the rural World. Published by the European Commission.

Verburg, P.H., Soepboer, W., Veldkamp, A., Limpiada, R., Espaldon V. and Sharifah Mastura, S.A. (2002). Modeling the Spatial Dynamics of Regional Land Use: the CLUE-S Model. *Environmental Management* 30 (3): 391-405.