Agricultural incomes development in EU till 2030: Scenario analysis of main driving factors

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Paper prepared for presentation at the 108th EAAE Seminar 'Income stabilisation in a changing agricultural world: policy and tools', Warsaw, February 8-9, 2008

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Abstract

Europe's rural areas are expected to witness rapid changes due to developments in demography, (agricultural) policies, global trade, climate change, technology and enlargement of the European Union. These changes will affect farmers' production and income level and make the final outcome of this process uncertain. This paper tries to assess this uncertainty by analyzing the results of 34 scenarios of the EURURALIS project. The scenario outcomes were used to investigate agricultural income development and to analyze the impact of different combinations of macro-economic and policy factors on agricultural income. The results of these scenarios were achieved in a modeling framework consisting of a modified version of the Global Trade Analysis Project model (GTAP) and the more ecological-environmental oriented Integrated Model to Assess the Global Environment (IMAGE).

Key words: Agricultural incomes and production, agricultural policy, long-term scenarios

1. Introduction

Europe's rural areas are expected to witness rapid changes due to changes in demography, (agricultural) policies, global trade, climate change, technology and enlargement of the European Union. These changes will affect farmers' production and income level and make the final outcome of this process uncertain. This uncertainty can be assessed by analyzing the consequences of different scenarios concerning the development of factors influencing agricultural income.

In the EURURALIS project, the future development of the agricultural sector till 2030 was investigated in four key scenarios determined by two key uncertainties: first, the level of economic cooperation and second, the degree of government intervention in economy. The uncertainties about economic cooperation and the degree of government intervention are closely connected with economic policies concerning trade and domestic support and strongly affect the speed of the economic development. Within the four key scenarios, the specific policy options were analyzed concerning different degrees of domestic income support and trade (border support) liberalization, and biofuel policies. To perform the analysis, a consistent modeling framework was used consisting of the modified version of the macro-economic Global Trade Analysis Project (GTAP) model and a more ecological-environmental oriented model, the so-called Integrated Model to Assess the Global Environment (IMAGE). In this modeling framework the long-term economic and environmental consequences of different scenarios were quantified and analyzed in time steps of ten years, starting from 2001 up to 2030. This modeling framework allows to analyze the development of agricultural income level and the influence of different combinations of macro-economic and policy options on agricultural income.

This paper is organized as follows. In Section 2, scenarios and their assumptions are discussed. The database and model used to run simulation scenarios are introduced in Section 3. Section 4 describes the simulation results concerning the real agricultural income development and discusses the effect of selected macroeconomic factors and agricultural policy options on the level of agricultural income and production. The paper closes with a summary of the quantitative results in the final section 5.

2. Scenarios and scenarios assumptions

The four key EURURALIS scenarios were build around two uncertainties concerning the future world development (Westhoek et al., 2006): globalization and state regulation level of the world economy (Figure 1). These four scenarios are depicted in a two dimensional diagrams describing:

- the globalization level ranging from regional to global cooperation;
- the degree of government intervention varying from low to high regulation.

The scenarios are described by the following storylines

*Global Economy (A1)***.** In the Global Economy scenario trade bares are removed and trade is fully liberalized Global integration puts poor countries on a path of catching up and high growth. Technological change is high, driven by economic profit and not hampered by environmental, ecological and social concerns. The role of the government is very limited. Nature and environmental problems are not seen as a priority of the government.

Global Co-operation (B1). Similarly to Global Economy scenario, the Global Co-operation scenario is characterized by free trade and global international cooperation. However, the technological development is not only profit driven but also takes into account environmental and social goals (e.g. poverty reduction). Many of this non-profit related aspect of the economic growth are regulated by the government.

Continental Markets (A2). In the Continental Markets scenario the focus is on markets and economic incentives combined with preserving of national interests. The world is divided on regional blocks. The EU and NAFTA (USA, Canada and Mexico) form one block. Important goals are ensuring food security and food safety and therefore agricultural trade barriers and support mechanisms continue to exist. This yields welfare gains in EU and NAFTA in contrast with continuing poverty of developing countries where markets become more segmented.

Regional communities (B2). In the Regional Communities scenario the focus is on both economic and non-economic values, but national interests prevail. Trade and agricultural policies remain almost unchanged, except for export subsidies that are abolished. The strong government regulation aims on achieve environmental and social targets. The resulting economic growth is lower than in other scenarios but social values lead to catching up of developing countries because they can adopt existing technologies from developed countries.

These scenario storylines lead to specific assumptions concerning macro-economic growth, demographic developments, trade liberalization and agricultural policies, which are implemented in the simulation experiments (see Table 1).

Figure 1. The four EURURALIS scenarios (Westhoek et al., 2006)

Because options on future trade and agricultural policies are uncertain and because different policies might be relevant for each key scenario, we analyze various policy options within each of the four key scenarios. These policies differ by degree of trade and domestic support liberalization and biofuel policy options (Table 2). Possible combinations of the agricultural policy options associated with each key scenario are presented in Table 3. For each key scenario a low (E1) and a medium (E2) bioenergy policy variant is possible. For Regional Communities (B2) and Global Economy (A1) scenario, a high bioenergy policy variant (E3) is also possible. It should be mentioned that only a pre-defined set of certain combinations of agricultural policy options are allowed here which are indicated by shaded cells in Table 3. This selection leads to 34 different scenarios. Moreover, for each key scenario the default setting of policies was chosen. The key scenario associated with this policy setting is assumed to be the base key scenario. In this way, four base key scenarios are defined. They are marked in bold in Table 3 and the associated superscript refers to the biofuel policy option that is relevant for these base scenarios. Superscript 1 stands for E1 and 2 for E2 biofuel policy. So in terms of scenario and policy options codes the base key scenarios are A1G1C1E1, B1G1C2E2, A2G3C3E1 and B2G3C3E2.

Table 1. Most important characteristics of the four EURURALIS scenarios

	Global Economy (A1)	Global Co-operation (B1)	Continental Market (A2)	Regional Communities (B2)
Macro-economic growth	High	Moderate	Moderate	Low
Demographic development	Increasing	Increasing	Decreasing	Decreasing
Agro-technology	High	High	Low	Low
Border support	Phased out	Phased out	Stable	Stable
Market support	Phased out	Decreasing	Stable	Stable
Bio-energy policy	No target	Blending target: 5,75%	No target	Blending target: 5,75%

Beside of projected policy development, current agricultural policies were implemented in the simulation experiments such as the 2003 reforms of the European Common Agricultural Policy. This means that decoupling of direct payments and reforms of dairy policy are introduced in all scenario calculations.

The most important scenario assumptions driving the model results are those concerning the macroeconomic development. The GDP and population growth are important factors affecting the consumption development which in turn determines the production level. The assumed GDP and population growth differ per scenario and per country. GDP growth and associated employment and capital growth are based on projections published by CPB (2003) while the population growth is determined on the basis of IPCC's Special Report on Emission Scenarios (SRES: Nakicenovic, 2000).

Table 2. Specific policy assumptions

Border support	
G1	full liberalization: in 2010 still market price support after 2020 all market price support abolished; price difference with world market = 0%
G2	decreasing market price support: in 2010 still market price support after 2020 all price support reduced by 50%
G3	constant price support: until 2030 unchanged market price support
Income support	
C1	abolishment of all income support; abolished after 2010
C2	decreasing income support; budget for income support will be reduced by 50% in 2030
C3	stable income support; no change in the budget for income support till 2030
C4	increasing income support; budget for income support will be increased with 50% in 2030
Biofuel	
E1	low or no ambition on bio-energy - 0% blending obligations, no taxes, no subsidies, no encourages at all
E2	medium ambition on bio-energy - 2010 and the following periods: 5.75% blending obligation
E3	high ambition on bio-energy - 2010 and the following periods: 11.50% blending obligation

The main macro-economic scenario assumptions are summarized in Table 4. The world economic growth varies between 1.7% per year in the Regional Communities (B2) scenario and 3% per year in the Global Economy (A1) scenario. The highest world population growth - 1.2% per year - is assumed under the Continental Markets (A2) and the lowest - 0.85% per year – under the Global Co-operation (B1) scenarios. The highest economic and population developments differs significantly between different scenarios and regions. In general, the higher the globalization level and the lower the government intervention level the higher economic growth. Therefore, the Global Economy (A1) scenario shows the highest GDP growth for all regions, see Table 4. In the Continental Markets (A2) scenario, the United States and EU create a Trans-Atlantic internal market, which is supposed to boost economic growth in both regions in contrast with developing countries where markets are assumed to become more segmented and separated. In the Regional Communities (B2) scenario, developing counties gain form close cooperation within the trade blocks facilitating trade in industrial products.

Table 3. Scenarios setup: the policy options

	market support	constant price support	decreasing price support	liberalization
income support		G3	G2	G1
increasing support	C4	B2	A2 B2	impossible variant
stable support	C3	**A2**[1] **B2**[2]	A2 B1 B2	B1
decreasing support	C2	A2 B2	B1	A1 **B1**[2]
no support	C1	A2	impossible variant	**A1**[1]

Comments:

- All key scenarios have E1 and E2 bioenergy policy, scenarios is shadow cells have also E3 biofuel policy option.
- The key scenarios in bold are base key scenarios. The associated superscript informs about the biofuel policy in these scenarios: 1 means E1 option and 2 means E2 option.

The assumptions on rates of technical progress in agricultural technology have been derived from Bruinsma (2003). However, to take into account the scenario differences, a deviation from these assumptions are made per scenario. Under the Global Economy and the Global Cooperation scenarios with a focus on technological development, rates of technical progress are assumed to be 5% above rates published by FAO. In the Regional Communities and the Continental Markets scenarios, however, this level is assumed to 5% lower (Eickhout et al., 2004).

Table 4. Main macro-economic scenarios assumptions: growth rates in 2001 – 2030.

	GDP					Population				
	EU15	EU12	High Inc	Low Inc	World	EU15	EU12	High Inc	Low Inc	World
A1	102.3	187.8	98.6	286.3	139.6	8.5	0.3	22.3	40.2	35.8
B1	51.2	171.0	63.6	239.3	98.2	3.8	-0.9	17.7	31.6	28.0
A2	70.7	95.1	83.0	110.0	85.6	-0.7	-15.0	23.1	48.4	41.8
B2	23.8	48.4	47.1	162.4	65.0	-4.0	-15.8	16.1	35.9	30.6

Comments:
EU15: old 15 EU member states, EU12 new EU member state, High Inc: the high income countries – NAFTA, Japan Korea, New Zeeland and Australia, Low Inc: the low income developing countries – the remaining world counties

3. Model and data

The simulation scenarios were run by using the GTAP data and an extended version of the GTAP model: the so-called LEITAP model (for more complete description of LEITAP see Nowicki et al, 2007). This version of the model incorporates some specific features concerning the agricultural sector.

Data

The analysis is based on version 6 of the GTAP data (Dimaranan ed., 2006). The GTAP database contains detailed bilateral trade, transport and protection data characterizing economic linkages among regions, linked together with individual country input-output databases which account for intersectoral linkages. All monetary values of the data are in $US millions and the base year for version 6 is 2001. This version of the database divides the world into 88 regions. The database distinguishes 57 sectors in each of the regions. That is, for each of the 65 regions there are input-output tables with 57 sectors that depict the backward and forward linkages amongst activities. The database provides quite a great detail on agriculture, with 14 primary agricultural sectors and seven agricultural processing sectors (such as dairy, meat products and further processing sectors).

The social accounting data were aggregated to 37 regions and 13 sectors. The sectoral aggregation distinguishes agricultural sectors that use land (e.g. rice, grains, wheat, oilseed, sugar, horticulture, other crops, cattle, pork and poultry, and milk) and the petrol sectors that demands fossil and bioenergy inputs. The regional aggregation includes all EU-15 countries (with Belgium and Luxembourg as one region) and all EU-12 countries (with Baltic regions aggregated to one region, with Malta and Cyprus included in one region and Bulgaria and Romania aggregated to one region) and the most important countries and regions outside EU from an agricultural production and demand point of view.

Standard GTAP model

The GTAP model is a multi-regional, a multi-sectoral, static, applied general equilibrium model based on neo-classical microeconomic theory (see Hertel (1997). The standard model is characterized by an input–output structure (based on regional and national input–output tables) that explicitly links industries in a value added chain from primary goods, over continuously higher stages of intermediate processing, to the final assembling of goods and services for consumption. In the model, a representative producer for each sector of a country or region makes production decisions to maximize a profit function by choosing inputs of labor, capital and intermediates to produce a single sectoral output. All sectors are producing under constant returns to scale, and perfect competition on factor markets and output markets is assumed. Firms combine intermediate inputs and primary factors (land, labor and capital). Intermediate inputs are used in fixed proportions, but are themselves CES composites of domestic and foreign components. In addition, the foreign component is differentiated by region of origin (Armington assumption), which permits the modeling of bilateral (intra-industry) trade flows, depending on the ease of substitution between products from different regions. Primary factors are combined according to a CES function. Regional endowments of land, labor and capital are fixed. Labor and capital are perfectly mobile across domestic sectors. Land, on the other hand, is imperfectly mobile across alternative agricultural uses, hence sustaining rent differentials. Each region is equipped with one regional household which distributes income across savings and consumption expenditures according to fixed budget shares. Consumption expenditures are allocated across commodities according to a non-homothetic CDE expenditure function.

LEITAP: improvements of agricultural sector modeling

To analyze the development of the agricultural sector, the presentation of the agricultural sector has been extended in the LEITAP model; see van Meijl et al. 2006. Particularly the functioning of the land market is crucial. Therefore, following OECD's Policy Evaluation Model (OECD, 2003), we included a new land demand structure to reflect that the degree of substitutability of types of land differs between land types (Huang, et al. 2004). Moreover, we incorporated a land supply curve (Eickhout et al. 2008), which specifies the relation between land supply and a rental rate. Through this land supply curve an increase in demand for agricultural purposes will lead to land conversion to agricultural land and a modest increase in rental rates when enough land is available, whereas if almost all agricultural land is in use increases in demand will lead to excessive increases in rental rates.

To take into account imperfect mobility of labor and capital between agriculture and non-agriculture (De Janvry et al., 1991), market segmentation for labor and capital between agricultural and non-agricultural markets was introduced. Following Hertel and Keening (2003), we introduced constant elasticity of transformation (CET) structure that transforms agricultural labor (and capital) into non-agricultural labor (and capital). The CET function was calibrated using elasticities from Policy Evaluation Model (OECD, 2003).

To model CAP towards dairy and sugar sector, we extend the standard model with a quota module (see, Van Meijl and van Tongeren 2002). In our model both the EU milk quota and the sugar quota are implemented at national level. This is achieved by formulating the quota as a complementarity problem. This formulation allows for endogenous regime switches from a state when the output quota is binding to a state when the quota becomes non-binding. In addition, changes in the value of the quota rent are endogenously determined.

For modeling the biofuel policy and implementing first generation of biofuels, the GTAP data base has been adjusted for the intermediate input of grain, sugar and oilseeds in the petroleum industry to reproduce 2004 biofuels shares in the petroleum sector. To introduce the demand of petroleum sector for biofuels, the nested CES function was used to make possible the substitution between different categories of oil (oil from oilseeds and crude-oil), ethanol (produced from grains and sugar) and petroleum products in the petroleum sector intermediate use. The substitution elasticities were calibrated base on elasticities applied in Burniaux and Truong (2002).

In our approach, yields in LEITAP depend on an exogenous part (the trend component) and an endogenous part depending on relative factor prices (the management component). We use LEITAP – IMAGE[1] iteration procedure to alter the

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[1] IMAGE (Integrated Model to Assess the Global Environment) model (Alcamo et al., 1998; IMAGE Team, 2001) explores the long-term dynamics of global environmental change. Ecosystem, crop and land-use models are used to compute land use on the basis of regional production of food, animal products and timber and local climatic and terrain properties.

exogenous yields in GTAP using environmental feedbacks from IMAGE (Van Meijl et al. 2006, Eickhout et al., 2006). In general, IMAGE uses calculated by LEITAP production and management component to calculate land changes and their consequences for climate and land productivity. The updated land productivities are returned to LEITAP.

Finally, we introduced a new household's demand function allowing for decreasing response of demand on income changes when income level is increasing. We implement this feature to model a decrease of share of food in total consumption when incomes are enough high and increase.

Calculation of agricultural income

The agricultural income is calculated as revenue of agricultural sectors less intermediate input cost (i.e. value added) plus agricultural subsidies net of taxes deflated by the national GDP deflator. Output (production) value is revenue from production and it depends on agricultural production volume and prices. The value of intermediate inputs is presented as a cost of using goods and services in the production process. This value depends on production volume, technical coefficients and prices of goods and services. Agricultural subsidies include factor (land and capital) and intermediate input subsidies. Taxes are labor taxes.

4. Scenario results

This section shows the development of real agricultural income in different scenarios. Based on the scenario results, we will quantify the impact of various policy options and macro-economic factors on agricultural income level.

4.1. Scenario set-up

The scenarios are build as a recursive updating of the database in three consecutive time steps, 2001–2010, 2010–2020 and 2020–2030. In the experiments, the projected (exogenous) GDP targets are achieved through different rates of growth of factor endowments and population. This procedure implies that technological change is endogenously determined within the model for each country or region (Hertel et al., 2004). The growth of sectoral total factor productivity (TFP) is implemented as i.e., Hicks neutral technical change (CPB, 2003). For the projection of productivity growth in agriculture additional information on yields is derived from Bruinsma (2003).

4.2. Real agricultural income development: Word wide picture

In all scenarios, real agricultural income strongly increases in the EU12 and, especially in Low Income African, Asian and Latin American countries and decreases in EU15 and other High Income countries (Figure 2). The income growth in the EU12 and in low income countries is mainly driven by GDP and population growth. Low income countries have relatively high food consumption shares in the total consumption and a relatively low food consumption level in 200l. Therefore, the increase in household income (GDP) leads to a high increase of food consumption, which in turn boosts the agricultural production and agricultural income level. With the introduction of CAP payments in the EU12 counties after EU-accession, agricultural income further increases in these countries.

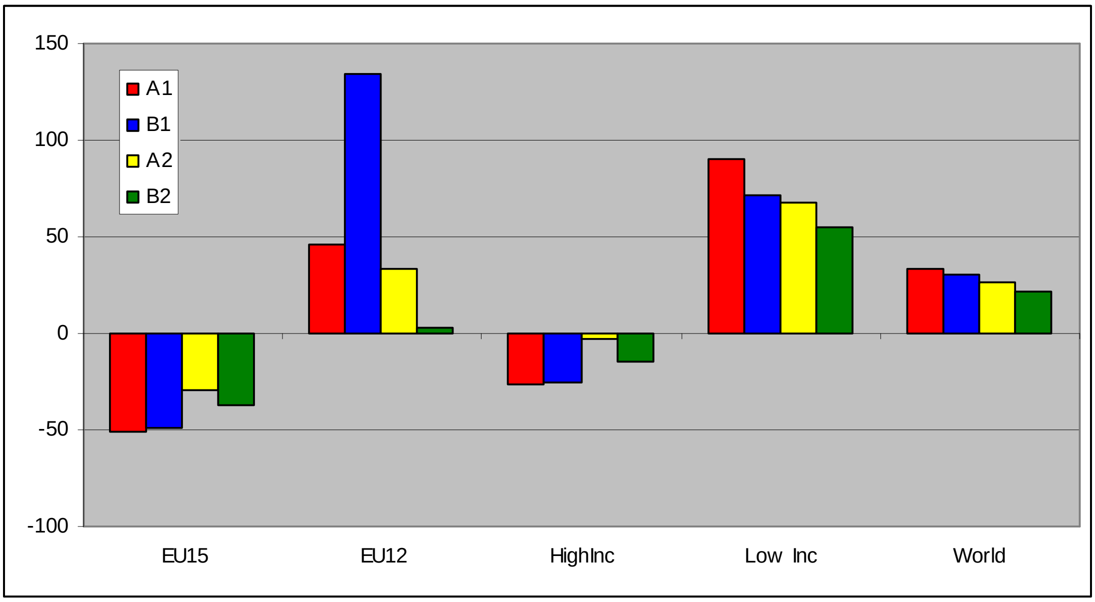

Figure 2. Real agricultural income growth (in %) in 2001 - 2030

In high income counters, the share of food in total consumption is relatively low and decreases further when private income grows. Therefore, food consumption in these countries barely increases. The resulting low expansion of agricultural production cannot compensate the strong decline of agricultural prices in high income countries. In these countries the deterioration of agricultural terms of trade is due to a high rate of technical progress which coincides with low increase in agricultural demand. Since agricultural prices decline stronger than industrial goods and services prices, the production costs increase relative more than revenue, which again lowers agricultural income. It happens especially in the Global Economy (A1) and the Global Co-operation (B1) scenarios witch development is fueled by liberalization with a lower government support to the agricultural sector.

4.3. Real agricultural income development in EU

Figure 3 shows that real agricultural income in the EU15 decreases between 14 percent in case when the EU and NAFTA countries form a trade block, further trade and domestic liberalization is limited, and when biofuel policies are in place. Agricultural income in the EU15, however, decline by more than 50 percent if world-wide trade liberalization is implemented without biofuel policies. In general, high liberalization of domestic and trade support without biofuel policies lead to a strong decline in EU15 agricultural income. When the income per employee is analyzed, the income development in EU15 is less negative due to employment decrease by about 20%. This layoff of agricultural workers even leads to a small improvement of income under scenario without liberalization and with biofuels policies implemented.

For the EU12, agricultural income grows in almost all scenarios except for those with low macroeconomic growth, limited inter-regional cooperation and no biofuel policies installed. For scenarios assuming strong economic growth and close regional integration, agricultural income in the EU12 increases more than twice. Due to decline in agricultural employment the income per employee increases in all scenarios in the EU12 countries.

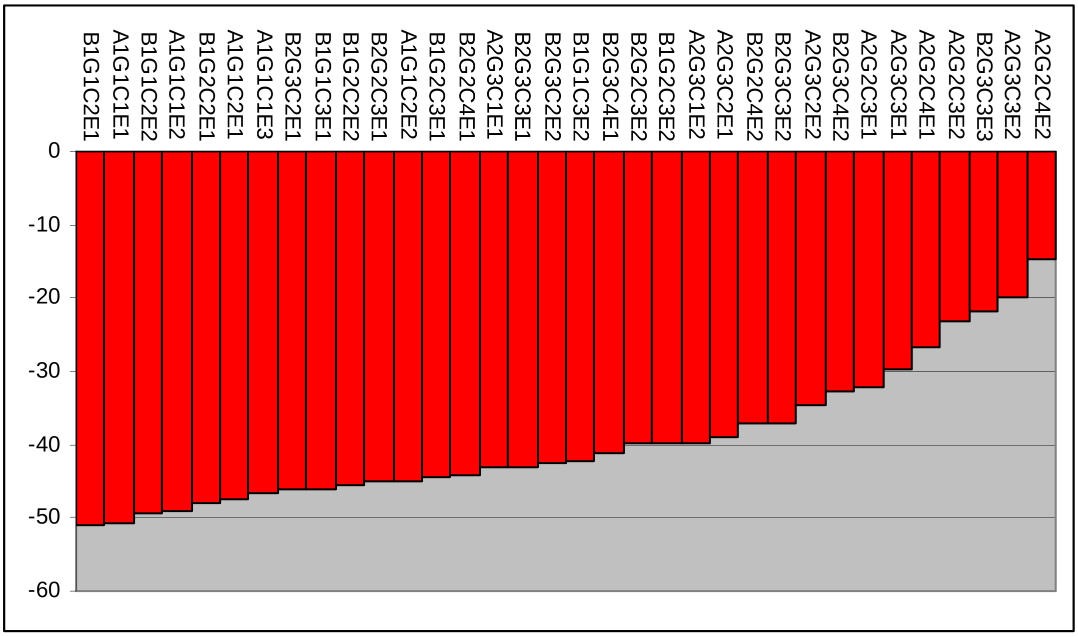

Figure 3. Real agricultural income growth (in %) in different scenarios in EU15 in 2001 - 2030

Comparing the development of income from production of high-protected agricultural commodities (CAP commodities) and from production of those agricultural products which gain only limited or even no support (N-CAP commodities), one can identify significant differences. In the EU15, due to the policy liberalization, income growth of farms producing protected commodities such as wheat, grains, rice, oilseeds, sugar beets, cattle and milk is highly negative under the Global Economy (A1) and Global Co-operation (B1) scenarios (Figure 4). Real income from production of commodities with limited or no support declines less than for protected commodities.

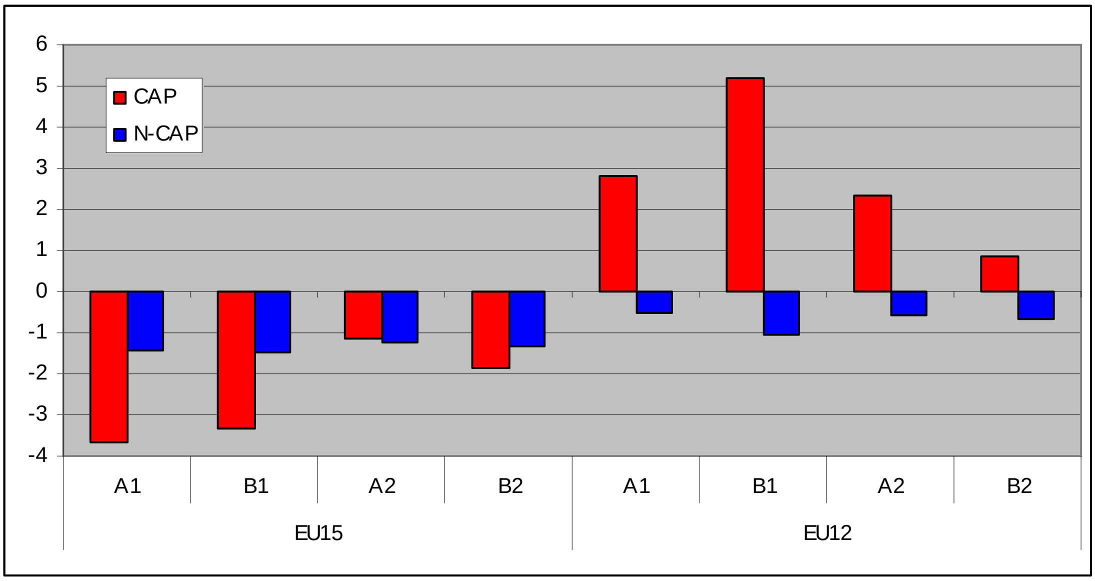

Figure 4. Real agricultural income per employee for protected (CAP) and not-protected (N_CAP) commodities in EU15 and EU12: yearly growth rates in 2001 - 2030.

In more regional oriented scenarios, i.e. Continental Market (A2) and Regional Communities (B2) scenarios, the difference between protected and unprotected commodities is less significant. In Continental Market (A2) scenario assuming only moderate liberalization of market support, the real incomes from production of protected commodities decrease only slightly and less than incomes from production of not-protected commodities. This shows an importance of CAP for agricultural income.

In the EU12, real farm income from production of protected commodities increases in all scenarios while real farm income from production of not-protected commodities decreases. This is caused by the implementation of CAP policy measures in EU12 countries after their accession to the EU.

4.4. Impact of policy measures on incomes and output changes in EU

By comparing key scenario results assuming different policy options, we can calculate the impact of these policy options on the level of real agricultural income and production. Figures 5 and 6 presents production and related real agricultural income changes associated with implementation of different policy options in different key scenarios. The numbers presented in figures 5 and 6 are calculated for key scenarios varying by only one policy option. The impact of each policy options is calculated as follows. The impact of C1 policy option is calculated as agricultural income or production obtained under this policy minus agricultural income or production obtained under C2 policy option. Similarly, we calculated the impact of C2, G1, G2, C4, E2 and E3 policy options by comparing their results with the results of C3, G2, G3, C3, E1 and E2 policy options respectively.

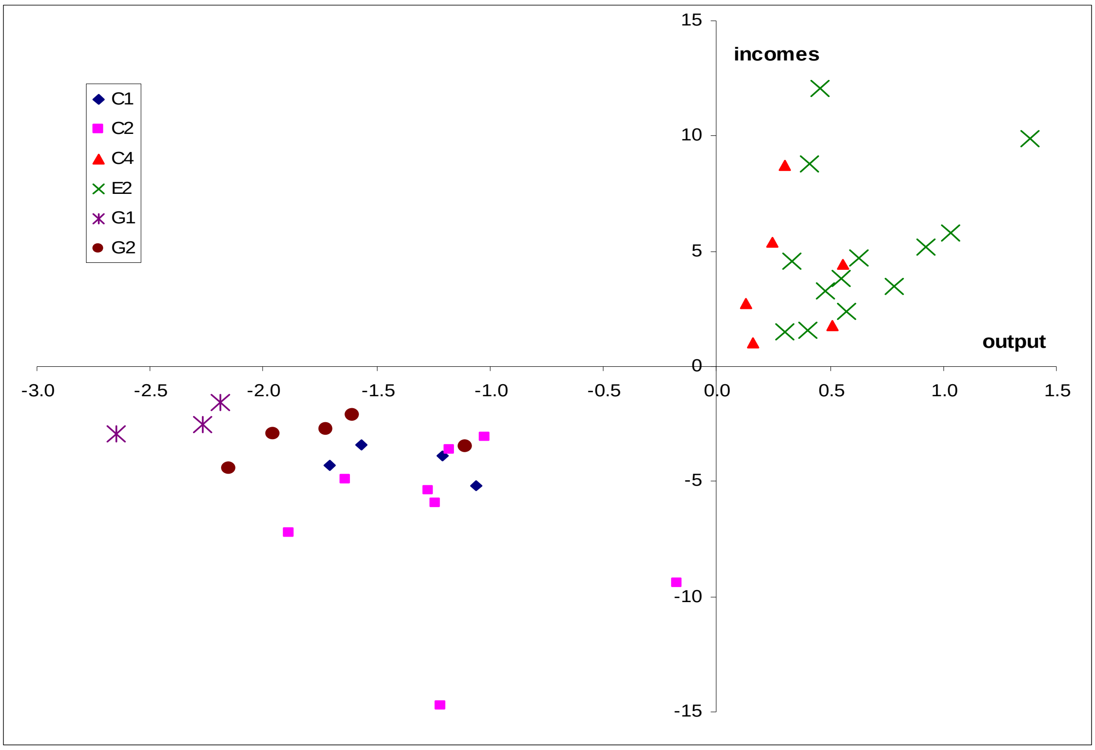

Figure 5. Effect of agricultural policy options on real agricultural incomes and production in EU15: growth rate differences in 2001 - 2030.

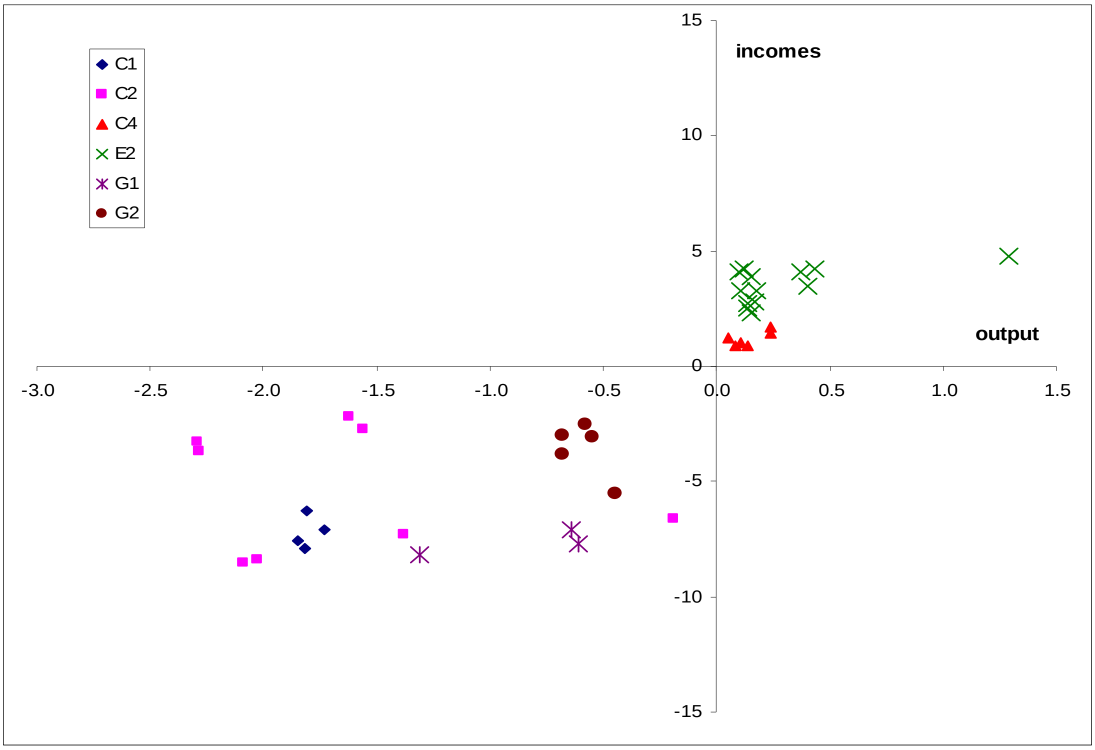

Figure 6. Effect of agricultural policy options on real agricultural incomes and production in EU12: growth rate differences in 2001 - 2030.

The results are presented for the EU15 and the EU12 countries separately. Table 5 presents the average policy impact across all scenarios, associated standard deviation and percentage variation coefficients.

The three main features concerning the impact of different policy options on income and production can be seen from Figures 5 and 6. First, the agricultural policy liberalization causes a decrease of the level of real agricultural income and production. Additional agricultural support, however, either in form of supplementary income support or of biofuel policies, results in an increase of both real agricultural income and production. Second, the level agricultural income is much more affected by agricultural policy reforms than the agricultural output. Third, the calculated policy effects differ per scenario. The variation of the policy effects is quite high in a case of 50% decrease of income support (C2), increase of market support (C4) and implementation of biofuel directive (E2) policy options.

According to the obtained results (Table 5), EU15 farm income and supply are more affected by changes in income support than by market price liberalization. On the other hand farmers in the EU12 are similarly affected by market price liberalization or by the withdrawal of income support. The market support liberalization cause a significantly higher agricultural production decrease than income support liberalization in the EU15 countries. The opposite can be observed in EU12 countries. All EU farmers gain substantially from the implementation of the EU biofuel directive. However, this directive does not significantly influence the overall agricultural production level but has a strong effect on the production structure.

Table 5. Average over all scenarios policy impact and associated standard deviation, and percentage variation coefficients.

	C1	C2	C4	G1	G2	E2
	EU15 real agricultural incomes					
Average	-4.2	-6.8	4.0	-2.3	-3.1	5.1
standard deviation	0.8	3.8	2.8	0.7	0.9	3.1
% variation	-18.1	-55.7	70.5	-28.5	-28.0	61.7
	EU15 output					
Average	-1.4	-1.2	0.3	-2.4	-1.7	0.5
standard deviation	0.3	0.5	0.2	0.2	0.4	0.5
% variation	-21.9	-41.8	56.3	-10.4	-23.1	106.8
	EU12 real agricultural incomes					
Average	-7.2	-5.3	1.2	-7.7	-3.6	3.3
standard deviation	0.7	2.6	0.3	0.6	1.2	1.1
% variation	-9.7	-49.3	26.9	-7.2	-32.7	32.6
	EU12 output					
Average	-1.8	-1.7	0.14	-0.9	-0.6	0.2
standard deviation	0.1	0.7	0.08	0.4	0.1	0.3
% variation	-2.8	-41.2	56.3	-46.4	-16.5	141.8

The results presented above show the impact of one factor - the specific agricultural policy option - on the real agricultural, income and production. Below, the multifactor analysis of income and production development is presented. We use a linear regression model to explain income and production as a function of GDP, agricultural policy options and key scenario types. As observations for income and production, we use income and production changes obtained from 34 EURURALIS scenarios and as GDP is concerned the underlying scenario assumptions concerning the GDP growth per country. The agricultural policy options and key scenario types are included by using dummy variables. Only the significant scenario dummies are included into the final regression. The estimation results are presented in Table 6.

Table 6. Estimation results of incomes and production linear regression model

	EU15				EU12			
	income		production		income		production	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	Coefficient
constant	-44.4	-25.1	-14.5	-73.9	-36.5	-29.0	-11.2	-40.7
GDP	0.1	1.9	0.3	64.6	0.7	46.0	0.2	51.2
C1	-15.0	-6.6	-2.7	-10.7	-13.2	-12.2	-3.3	-14.1
C2	-7.5	-4.9	-1.3	-7.4	-5.6	-7.5	-1.7	-10.5
C4	3.9	2.4	0.4	2.1	1.3	1.5	0.2	1.0
G1	-5.7	-2.2	-4.1	-14.1	-11.5	-8.4	-1.5	-5.0
G2	-2.6	-1.7	-1.6	-9.2	-3.6	-4.4	-0.5	-3.0
E2	5.3	4.6	0.7	5.2	3.5	6.4	0.3	2.4
E3	15.0	5.6	1.6	5.3	10.4	8.2	0.5	1.8
A1					-30.2	-13.2	4.2	8.5
B1					59.4	32.8	-1.9	-4.8
A2	10.1	4.6	1.3	5.2				
R^2	0.954282		0.998488		0.999423		0.999091	

According to the estimation results, the GDP growth and policy options explains very well agricultural income and production changes. Almost all policy variables have a statistically significant impact on income and production.

The estimation results shows that real agricultural income elasticity in the EU12 in respect to real GDP growth is very high compared to the production elasticity. This means that income-driven increases of demand for agricultural products cause a higher growth of agricultural prices than production in EU12.

The real agricultural income elasticity in the EU12 in respect to real GDP growth is also very high compared with the same elasticity for the EU15. The EU15 have higher per capita income level and therefore lover demand elasticities for agricultural products compared to the EU12 countries. Therefore, the demand and production of agricultural commodities grows slower in the EU15 compared with the EU12. This explains the differences between estimated EU15 and EU12 elasticities. Consistently with these results, the GDP impact on farms income and production is much higher in EU12 than in EU15 (Table 7).

Table 7. Percentage change of the real agricultural incomes and production resulting from GDP change in key scenarios

EU15				EU12			
Income		production		Income		Production	
A1	B1	A2	B2	A1	B1	A2	B2
8.8	4.4	6.1	2.1	136.9	124.6	69.3	35.3

The estimated parameters for policy dummies describe the impact of the implementation of analyzed policy options compared with the policies being currently in force (G3, C3 and E1 policy options). The estimated parameters are broadly consistent with Figures 5 and 6. They show that full liberalization of the income policies will cause a decrease of agricultural incomes by 15% and 13.2% in the EU15 and the EU12 respectively. At the same time, it will cause a decrease of agricultural production by 2.7% and 3.3% in the EU15 and the EU12 respectively. Full liberalization of market support results in a decline of agricultural income and production by 5.7% and 4.1% respectively in the EU15 and 11.5% and 1.5% respectively in the EU12. Finally, implementing an obligatory blending target of biofuel crops in the petrol sector of 11.5% increases incomes of farmers by 15% and 10.4% in EU15 and EU12 respectively. Total agricultural production response to the biofuel directive, however, is rather low with 1.6% in the EU15 and 0.5% in the EU12.

6. Conclusions

This paper analyzes the development of real agricultural income and production in the EU until 2030 using a scenario approach. By comparing different scenario results we quantify the impact of selected macro-economic factors and agricultural policy options on agricultural income and production.

In general, real agricultural income in EU15 significantly depends on agricultural policy. For the EU12 countries macro-economic growth is more important. It over-compensates possible negative effect of agricultural policy liberalization

In general, most scenarios indicate a significant decrease of the real agricultural income in the countries of the EU15. The higher the cut in income and border support the stronger the decline of income of EU15 agricultural sector. When income per employee is analyzed, the income development in EU15 is less negative due to a decline in agricultural employment of about 20%. Under policy options with less liberalization and a strong support of renewable energies agricultural income in the EU15 even increases.

Compared to the development in the EU15, the results show a significant improvement of agricultural income for the EU12 in almost all scenarios. The high macro-economic growth combined with close economic integration and liberalization, leads to an increase of real agricultural income in the EU12. Due to the decrease in agricultural employment, the per employee income increases in all scenarios in EU12 countries.

According to obtained results, EU15 farmers will lose much more from income support liberalization than from market support liberalization. For EU12 farmers the impact of liberalization of market price and income support leads to similar effects. The market support liberalization causes significantly higher agricultural production decrease than income support liberalization in the EU15 countries. The opposite is observed in the EU12 countries. In all EU countries, farmers gain substantially from biofuel directive implementation. However, while this directive has only limited effect on the overall agricultural production level it may show a strong impact on the agricultural production structure.

Depending on different assumptions the calculated policy effects significantly differ across scenarios. The variation of the policy effects is quite high in a case of 50% decrease of income support policy (C2), increase of market support (C4) and implementation of biofuel directive (E2).

To sum up, a shift from border to income support is less production distorting and is better in terms of preserving an income level for EU15 farmers. However, an increase of agricultural income support increases possibility of income variation. For the EU12 farmers, market support liberalization is more favorable in terms of agricultural income and production development. Under this policy option the variation of income and production might even increase, however at a higher absolute level compared to the income support liberalization.

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