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Influence of macro-economic growth, CAP reforms and biofuel policy on the Polish agri-food sector in 2007–2020[2]

Abstract. This paper presents the possible development scenario of the Polish agricultural sector till 2020. It also assesses the impact of macroeconomic growth, CAP reforms and worldwide policies towards the agriculture on this development. The scenario is build using an extended version of the Global Trade Analysis Project model GTAP which is a computable general equilibrium model of the world economy. The analysis shows that the growth of Polish agri-food sector observed after accession to the European Union will be prolonged in the future and will lead to an increase of agri-food sector incomes. However, it is expected that the positive trade balance in agri-food products will decrease significantly in consequence of the world trade liberalization and the EU policy stimulating biofuels production.

Key words: agri-food products, CAP, Biofuel Directive, agricultural trade liberalization, CGE modeling

Introduction

In this paper is shown the possible development scenario of the Polish agri-food sector till 2020. Future trends of main economic characteristics describing the sectoral development as production, trade and sectoral incomes are analyzed as well as the agricultural policies impact on these characteristics identified. The projections are established under a set of assumptions which apply to the macro-economic development, the EU agricultural policies and the world trade liberalization policies.

The development scenario is build using an extended version of the Global Trade Analysis Project model GTAP which is a computable general equilibrium model of the world economy. The extended version of GTAP includes an improved land, labour and capital market modelling, a dynamic consumer demand function and substitution possibilities between capital and energy as well as between different energy sources including biofuels.

This paper is organized as follows. In the first section, the GTAP database and model are introduced. The next section describes the scenario set-up. The following section presents simulation results concerning the Polish agri-food sector development and discusses effects of different policies on the obtained results. A summary is the final section.

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[2] This paper is based on preliminary results of the ongoing EURURALIS project. For the EURURALIS project see: http://www.eururalis.eu/

Model and data

In order to run simulations we have used 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 the version 6 of the GTAP database [Global Trade, Assistance... 2006]. This database contains consistent data on a worldwide basis for 2001. The GTAP database contains detailed bilateral trade, transportation and protection data characterizing economic linkages among regions, and consistent individual country input-output databases which account for intersectoral linkages. The social accounting data were aggregated to 36 regions and 25 sectors. The sectoral aggregation distinguishes all agricultural sectors (e.g. rice, grains, wheat, oilseed, sugar, horticulture, other crops, cattle, pork and poultry, milk) and the fuels sector that demands fossil and bioenergy inputs.

The regional desaggregation includes all 15 old EU member states (EU15), all 12 new EU countries (EU12) and the most important countries and regions outside the EU from the agricultural production and demand point of view.

For modeling the biofuel policy and for including the first generation of biofuels the GTAP database has been adjusted for the intermediate inputs of grain, sugar and oilseeds in the petroleum industry reflecting the 2004 biofuels shares in the fuels sector.

GTAP model. The GTAP model is a multi-regional, multi-sectoral, static, general equilibrium model based on a neo-classical microeconomic theory [Global Trade Analysis... 1997]. In the extended GTAP version [van Meijl et al. 2006; Nowicki et al. 2007], which has been used, the production is modeled using a multilevel nested CES production function. In the primary value added nest, the multilevel CES production function explains the substitution of different primary production factors (land, labour, capital and natural resources) and some intermediate production factors (energy and animal feed components). The CES nest is also introduced to take into account a substitution possibility between different energy sources including biofuels [Banse at al. 2008]. The model uses fixed input-output coefficients for the remaining intermediate inputs.

On the consumption side, one household per region is distinguished. It distributes its income across savings and (government and private) consumption expenditures according to fixed budget shares. Consumption expenditures are allocated across commodities according to a non-homothetic dynamic CDE expenditure function which allows for changes in income elasticities when PPP-corrected real GDP per capita changes. Government expenditures are allocated across commodities according to fixed shares. The commodities consumed by firms, government and households are CES composites of domestic and imported commodities. In addition, the imported commodities are differentiated by region of origin using Armington elasticities.

Regional endowments of labour, capital and natural resources are fixed and fully employed and the land supply is modeled by land supply curves [Eickhout et al. 2008], which specify the relationship between land supply and land rental rate. Labour is divided into two categories: skilled and unskilled. These categories are considered imperfect substitutes in the production process.

Land and natural resources are heterogeneous production factors, and this heterogeneity is introduced by using CET transformation functions which allocate these factors among the sectors. Capital and labour markets are segmented between agriculture

and non-agriculture. Labour and capital are assumed to be fully mobile within each of these two sectors, but imperfectly mobile across them. This leads to differences in prices of capital and labour between agriculture and non-agriculture. This is implemented by using a dynamic CET function where changes in capital and labour supply in agricultural and non-agricultural sectors depend on an agricultural relative to non-agricultural remuneration of these factors and a total factor supply. With the same relation of agricultural to non-agricultural remuneration, labour and capital grow with the same rate in both sectors that is equal to the total factor supply growth rate.

To introduce the demand of petroleum sector for biofuels, the nested CES function is implemented to make possible a substitution in the petroleum sector intermediate use between different categories of oil (oil from oilseeds and crude-oil), of ethanol (produced from grains and sugar) and of petroleum products. The substitution elasticities were calibrated basing on elasticities applied in Burniaux and Truong [2002].

Most of the policy instruments are represented in the GTAP model as ad valorem tax equivalents. These create wedges between the undistorted market prices and the policy impact inclusive prices. In order to model the CAP in dairy and sugar sectors the model includes a quota module [van Meijl and van Tongeren 2002]. Both the EU milk quota and the sugar quota are introduced at a 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.

The EU biofuel directive (BFD) fixes the share of biofuels in fuel used in transportation. In order to achieve this policy target a subsidy on bioenergy inputs is necessary to make it competitive with the crude oil. Since this policy instrument is assumed to be 'budget-neutral', these input subsidies are financed by a user tax on petrol.

Scenario set-up

In order to investigate the possible development of the Polish agri-food sector till 2020 a reference scenario has been run. In order to identify the possible effects of EU and WTO policies towards the agricultural sector, additional policy scenarios have been created.

The reference scenario includes a set of assumptions concerning the most important driving forces influencing the agri-food sector. They include the macroeconomic assumptions concerning the world and Polish economy development, the technological progress as well as agricultural and trade policy changes.

The macro-economic environment determines to a great extent the demand for agri-food products and the primary production factors supply. The expected population and welfare growth are important factors driving the demand for agricultural products. On the other hand, the labour and capital availability together with the technological progress influence significantly the production possibilities. The growing importance of agri-food trade for the Polish agri-food sector development implies that not only Polish but also the world economy growth importantly influences development possibilities of this sector.

For a simulation experiment the GDP and population growth projections provided by the Economic Research Service (ERS) Agency of the U.S. Department of Agriculture have been taken [Economic... 2008]. It has been assumed that the capital stock would grow with the same rate as GDP and the employment with the same rate as population. For the

projection of productivity growth in agriculture, an additional information on yields is derived from Bruinsma [2003].

The ERS assumes an average GDP growth in Poland equal to 4.8% per year and a population decrease of 0.1% per year. The expected Polish economy growth is faster than the average EU economy expansion.

Table 1. Main macro-economic scenario assumptions: average yearly growth rates in 2001-2030

Parameter	Country or group of countries			
	world	EU15	EU12	Poland
GDP	3.52	2.10	4.51	4.80
Population	1.10	0.07	-0.34	-0.11
Yields	2.09	1.05	0.55	0.61

EU15 means old 15 EU member states, EU12 new EU member states

The policy assumptions include the already decided or expected changes in the EU and WTO policy towards the agricultural sector:

- milk quota abolition (MQA): a milk quota increase by 12% in the period 2007-2013 and the milk quota abolition in years 2013-2020;
- Biofuel Directive (BFD): a mandatory blending obligation for bio-energy: 5.75%, 7% and 10% target values for the share of bio-energy components in the fuel for transportation in 2010, 2013 and 2020 respectively;
- WTO trade liberalization [World... 2008]: import tariffs reduction according to the Falconer's tiered formula and export subsidies elimination by 2013.

In order to identify the possible impact of policy decisions additional scenarios have been tried which differ from the base scenario only by the policy assumptions included.

The scenarios are built as a recursive updating of the database in five consecutive time steps, 2001-2004, 2004-2007, 2007-2010, 2010-2013 and 2013–2020. The two first periods are included to update the data and policy variables to the 2007 situation by taking into account the European Union enlargement, the AGENDA 2000 and the Fischler's reform implementation as well as the macro-economic development of the world economy. The following three periods are distinguished to take into account the future CAP and WTO agendas and timing of their implementation.

Simulation results

Polish agricultural sector in the EU perspective. Figure 1 shows that the growth of arable crops and livestock production in Poland is higher than in the EU15 countries and also higher than (in case of arable crops) or the same as (in case of livestock) in all new EU member states (EU12). However, the processed food production is expected to grow slower in Poland than in the EU12 countries. This is caused by a highly negative impact of the WTO agreements and the Biofuel Directive on beef, veal, milk and dairy production.

The higher agri-food production growth in the EU12 when compared with the EU15 countries results from a higher economic growth and a lower initial consumption level in the EU12 when compared with the EU15. Despite of a high production growth the agri-food sector incomes (value added) are growing slower than the industry, services and total

economy value added. It means that the share of agriculture and food sectors in the total GDP is decreasing. This is a continuation of the historical trend caused by low (and decreasing with income growth) income elasticities of food demand and a relatively high productivity growth in agriculture which leads to a decrease of agricultural and food prices relatively to average price level.

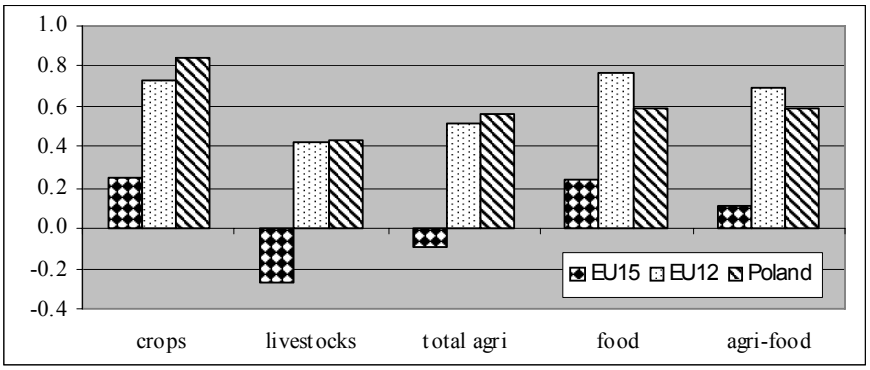

Fig. 1. Growth of agri-food production in 2007 – 2020, annual growth rates, %

Source: model calculations.

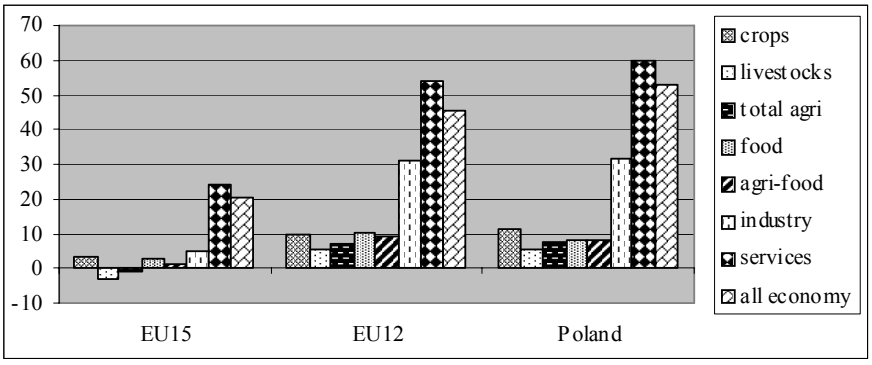

Fig. 2. Sectoral value added growth in 2020 compared with the 2007 level, %

Source: model calculations.

Since the initial income level is higher and the food share in the total consumption is lower in the EU15 than in the EU12 countries, the macro-economic significance of the agricultural and food sector is decreasing faster in the EU12 than in the EU15 countries. In the analyzed period the GDP in the EU15 is growing almost 24% faster than the agri-food sector value added while in the EU12 is growing 36% and in Poland 46% faster.

Main development characteristics of Polish agricultural sector. The Polish agri-food sector is expected to grow in the 2007-2020 period, which is a continuation of a trend observed after accession. The volume of agricultural production is expected to grow about 0.55% per year. The increasing agricultural output leads to a harvested area increase by 0.3% per year.

The liberalization of the agricultural trade as well as the Biofuel Directive implementation result in a deterioration of a positive trade balance in the agri-food products. The strong macroeconomic growth and the resulting high demand for labour outside the agricultural sector lead to an agricultural employment decrease by about 2% per year and to an increase of agricultural wages. However, the wage difference between agriculture and non-agriculture is preserved. This is a consequence of the assumed limited mobility of farmers which is depicted by the segmentation of labour and capital markets implemented in the model. Despite of a relatively slow wage growth we observe a relatively fast increase of agricultural incomes (value added) per person employed in the farm sector which is a result of increasing capital and land rents.

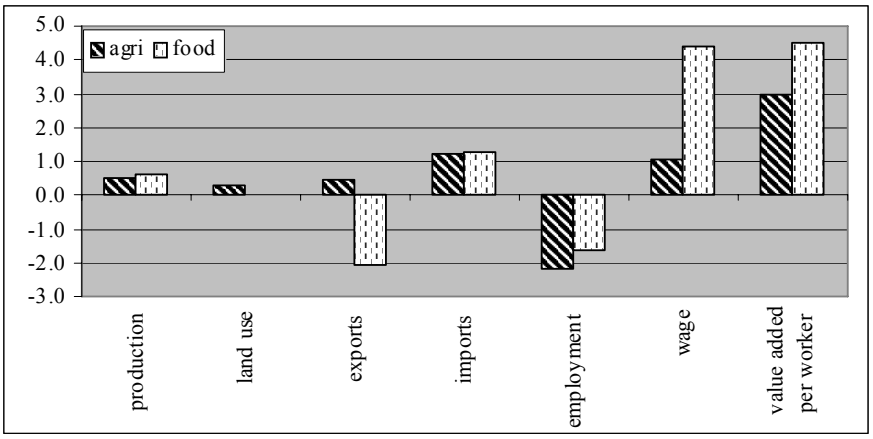

Fig. 3. Main development characteristics of Polish agriculture in 2007-2020, annual growth rates, %

Source: model calculations.

Agricultural markets and policy effects. The following Figures 4, 5, 6, 7 and 8 show the policy as well as macroeconomic factors impact on the development of different product markets in the Polish agri-food sector.

The world trade liberalization has the most pronounced impact on milk and dairy, beef and veal sectors. Since these sectors are the most protected sectors, the import tariffs reduction and the export subsidies elimination causes a significant increase of milk, dairy, beef and veal imports and consequently a decrease of the domestic production. Two sectors are gaining as a result of the trade liberalization: the (almost) not protected oilseeds sector and the pig and poultry sector which as a sensitive sector benefits from a low imports tariff reduction.

The Biofuel Directive has a huge impact on the agricultural production structure and the land use. It creates an extra demand for biofuel crops (grains and oilseeds) and causes an expansion of cereal and oilseeds land at a cost of the pasture land which decreases by about 10%. The consequence of the Biofuel Directive implementation is an increase of cereals and oilseeds production by 13% and 17% respectively and a decrease of production in other sectors. Especially, the animal production is decreasing: the milk, dairy, pig and poultry production by more than 8% and the beef and veal production by more than 4%. This causes a decrease of exports of animal products. In particular, a high decrease of pig and poultry exports is expected as the result of trade liberalization.

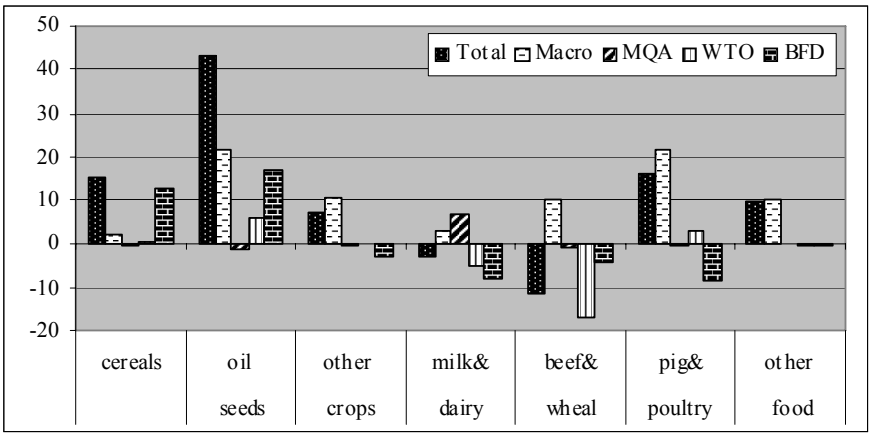

Fig. 4. Policy impact on the agri-food output in 2020, compared with 2007, %

Source: model calculations.

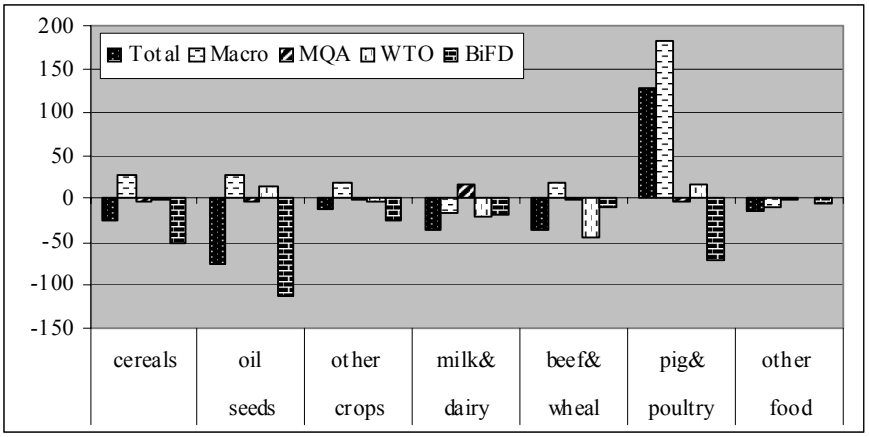

Fig. 5. Policy impact on agri-food exports in 2020, compared with 2007, %

Source: model calculations.

Since the domestic production is not large enough to meet the biofuel crops demand, the cereals and oilseeds imports are increasing more than 4 and 2.5 times respectively. This leads to a negative trade balance in these sectors.

The high demand for biofuel crops causes a significant price increase of these products which leads to more than doubling of incomes (measured by value added) per person emplyed in these sectors.

The abolition of milk quota influences significantly only the milk and dairy sector. Its production and exports are increasing by 7% and 17% respectively. The milk production is increasing by almost 5.5%.

The macro-economic factors like a GDP and population growth determine in a great extent the demand for agricultural products and the agricultural productivity growth influences the agricultural products supply. The model results show that the

macroeconomic factors affect positively the oilseeds, other crops, meat and other food products production. This is a result driven by the incomes increase and a shift of consumption demand towards horticultural products (included in 'other crops'), meat and processed food products (included in 'other food'), which is a commonly observed trend in the consumption pattern. The macroeconomic growth drives also demand for biofules which results in a higher oilseeds production and has a positive impact on farmer's incomes.

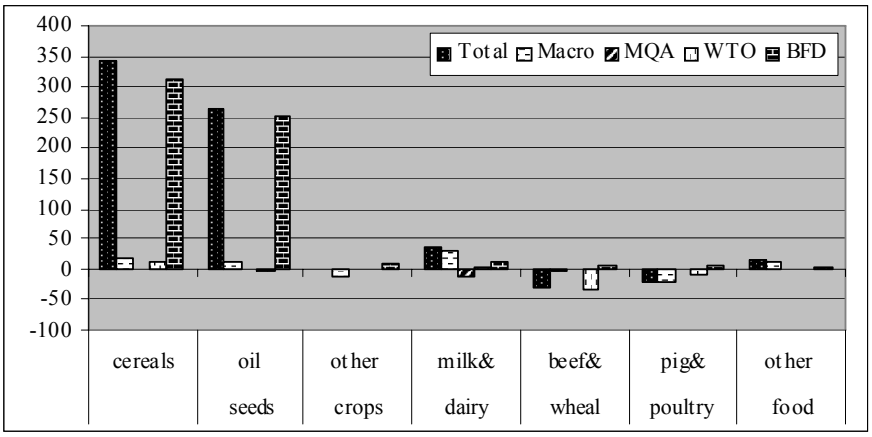

Fig. 6. Policy impact on agri-food imports in 2020, compared with 2007, %

Source: model calculations.

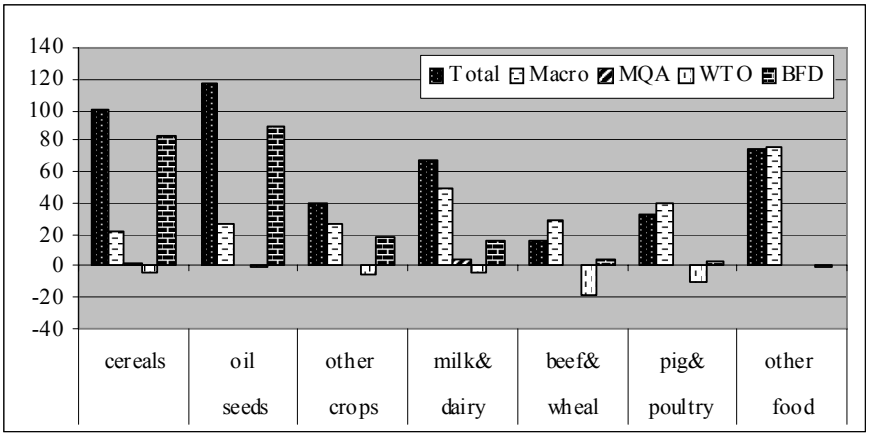

Figure 7. Policy impact on incomes per person employed in the agri-food sector in 2020, compared with 2007, %

Source: model calculations.

All in all, the highest production growth is expected for cereals, oilseeds, other food and pig and poultry sectors (Figure 5). As it was shown above, cereals and oilseeds production is mostly driven by an industrial demand for biofuels while the other food and pig and poultry production increase in response to the growing households demand for

processed food. This development of household consumption is a consequence of a significant macroeconomic growth which leads to a welfare increase.

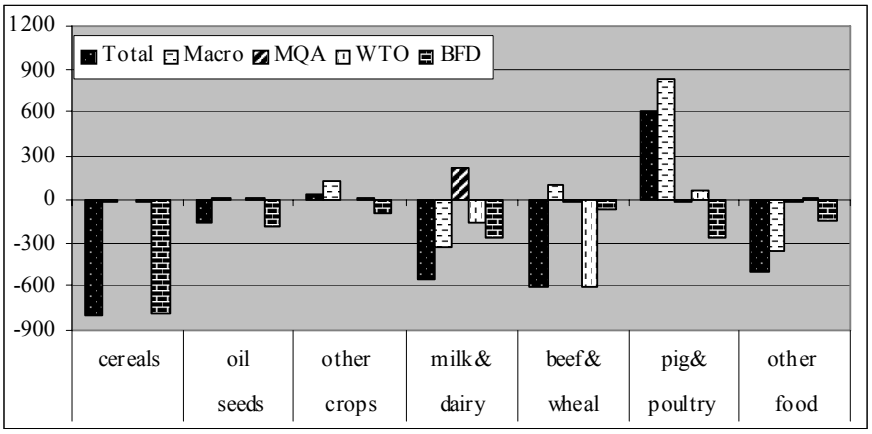

Figure 8. Policy and macro-economic impact on the net exports change of different agri-food products in 2007-2020. USD million

Source: model calculations.

The simulation results show that the positive Polish agri-food trade balance can deteriorate by USD 2000 million in 2020 mostly as a result of the Biofuel Directive implementation but also due to the trade liberalization. The two most important sectors which notice the negative trade balance are cereals as well as milk and dairy sectors. The only sector that notices a balance of trade improvement is the pig and poultry sector.

Finally, the Biofuel Directive has a very pronounced impact on incomes increase in cereals and oilseeds sectors. In other sectors, the most important factor driving farmer's incomes is the macro-economic growth.

Summary

The analysed scenario shows that a growth of Polish agri-food sector observed after accession to the European Union will be prolonged in the future and will lead to an increase of the agri-food sector incomes. However, it is expected that the positive trade balance in the agri-food products will decrease significantly as a consequence of the world trade liberalization and the EU policy stimulating biofuels production.

Cereals, oilseeds, other food and pig and poultry sectors are expect to grow at most. The beef and veal sector is predicted to shrink significantly as a result of the world trade liberalization.

The macro-economic factors like GDP, population and agricultural productivity are the most important factors stimulating the output and income development in the agri-food sector. The Biofuel Directive influences significantly the agricultural output and incomes increases but, together with the world trade liberalization, has a negative impact on the agri-food trade balance.

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