INSTITUTE OF AGRICULTURAL AND FOOD ECONOMICS
NATIONAL RESEARCH INSTITUTE

Development and application of advanced analytical methods for ex-ante and ex-post evaluation of the effects of changes in the Common Agricultural Policy and in macroeconomic determinants

(Synthesis)

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THE ECONOMIC AND SOCIAL CONDITIONS OF THE DEVELOPMENT OF THE POLISH FOOD ECONOMY FOLLOWING POLAND`S ACCESSION TO THE EUROPEAN UNION

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THE ECONOMIC AND SOCIAL CONDITIONS OF THE DEVELOPMENT OF THE POLISH FOOD ECONOMY FOLLOWING POLAND`S ACCESSION TO THE EUROPEAN UNION

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The study was carried out within the framework of the research topic

Development and Application of Advanced Analytical Methods for ex-ante and ex--post Evaluation of Impacts of Changes in the Common Agricultural Policy and Macroeconomic Determinants

in the tasks:

Production Growth and Equilibrium in Agri-Food Sector – Development of Analytical Methods and their ex-post and ex-ante Verification

Analysis, Forecasting and Price Risk Management on the Major Agricultural Markets – Prospects for Farmers Income Stabilization

Dynamic Stochastic General Equilibrium Model for Agricultural Sector as a Tool to Support Formulation of Future National Agricultural Policy

The aim of the study is to present possibilities and results of applying selected analytic methods and economic models for evaluating effects of potential changes in the Common Agricultural Policy (CAP) and macroeconomic determinants as well as implications of these changes for the Polish agri-food sector.

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Introduction

This elaboration presents a synthesis of studies carried out in the topic „Development and Application of Advanced Analytic Methods for Ex-ante and Ex-post Evaluation of Effects of Changes in the Common Agricultural Policy and in Macroeconomic Determinants", realized in 2008-2009 under the multi-annual programme „Economic and Social Determinants of Development of Polish Food Economy after Poland's Access to the European Union". The problem range of the topic covered the following three substantively connected research tasks:

1. Production growth equilibrium in the agri-food sector – development of analytic methods and their *ex-post* and *ex-ante* verification.
2. Model of dynamic stochastic state of general equilibrium in the agricultural sector as a tool supporting formulation of assumptions for future national agricultural policy.
3. Price risk analysis, forecasting and management in basic agricultural markets – possibilities of stabilizing the income of food producers.

The basic assumption underlying the undertaken studies was recognizing further changes in the European Union's Common Agricultural Policy (CAP) as practically inevitable, and treating the macro-economic environment as a very important source of determinants for functioning of the Polish agriculture and the entire food economy. Under that assumption, the main objective of the conducted research works was using advanced analytic methods to give an answer to key questions concerning realistic premises for production growth in the agri-food sector, effects of potential changes in the CAP and their implications for the national agricultural policy, or finally the possibility of stabilizing the income of agricultural producers under increased price risk resulting from limitation of the protectionism and increasing liberalization of international trade.

The research works connected with realization of the topic were carried out by IERiGŻ-PIB employees and numerous external research workers, who represented such academic centres and institutions, as: Agricultural Market Agency, Institute of Structural Research in Warsaw, Institute of System Research of the Polish Academy of Sciences in Warsaw, National Bank of Poland, Warsaw University of Life Sciences (Szkoła Główna Gospodarstwa Wiejskiego), Warsaw School of Economics (Szkoła Główna Handlowa), Poznań University of Life Sciences (Uniwersytet Przyrodniczy) and University of Warmia and Mazury in Olsztyn.

The main tools used in the conducted studies were various types of mathematical and econometric models, namely: mathematical model of production growth in the agri-food sector, partial equilibrium model, dynamic stochastic general equilibrium model, temporal series analysis and linear programming models, or finally the multi-person game model based on the game theory. The most important findings and practical conclusions following from the conducted studies are a result of theoretical and empirical analyses focused on the following issues:

1. Premises for production growth and income allocation in the agri-food sector;
2. Possibilities of applying dynamic and stochastic general equilibrium models in analysis and evaluation of the agricultural policy;
3. Prospects and effects of possible changes in CAP;
4. Price and income risk in basic agricultural markets;
5. Possibilities of stabilizing the income of food producers.

1. Demand-related premises of production growth and income allocation in the agri-food sector

1.1. Growth in demand for food as determinant of production growth

The possibilities of production growth in the agri-food sector conditional on the market equilibrium are strictly determined by prospects of growth in demand for agri-food products over a specific time. The given rate of that growth can be treated as a factor increasing the dynamics or limiting the production growth in that sector, and in consequence also growth in agricultural produce designated for consumption. This applies to the market on the scale of national economy, economy of a world region, and the global economy. In most countries or economically integrated regions with relatively high GNP level per capita, e.g. the European Union, demand is a determinant which limits the production growth in the analyzed sector. In such a situation, it is the efficiency improvement rather than the production growth by increasing expenditure on production means that gains importance as the main development factor. The demand barrier affects also less developed countries, though their food needs are not satisfied. Under the analytic approach adopted in the conducted studies, relations of the balance type were captured. The consumer's behaviour was not analyzed in the aspect of his/her endeavours to achieve balance, i.e. maximization of his/her usefulness function, which is a strictly microeconomic approach, and refers to behaviour mechanisms. Nevertheless, such a microeconomic behaviour of the consumer is captured in an implicit assumption.

In turn, the equation for rate of change in demand for food was modelled on the approach proposed by Hallet and Yotopoulos, both classic and obvious in its simplicity. According to that approach, the level of demand for food on the scale of a country or integrated market is determined in the initial period by the following identity:

$$\dot{Z}^D = L_K \cdot \frac{\dot{Z}^D}{L_K}; \tag{1.1}$$

$$\dot{Z}_L^D = \frac{\dot{Z}^D}{L_K}; \tag{1.2}$$

$$\dot{Z}^D = L_K \cdot \dot{Z}_L^D; \tag{1.3}$$

where:

$\dot{Z}^D$ – demand for food on macroeconomic scale (domestic consumption),

L_K – population of the country,

$\dot{Z}_L^D$ – average food consumption (demand per inhabitant).

Hence in the macroeconomic approach the demand for food is determined by the number of population and by the size of demand *per capita*, while the growth rate of the demand for food is determined solely by changes in these two easily identifiable factors. In order to obtain a dynamic demand formula, we can transform the above identity to an index form. A transient form is the following sum of difference quotients:

$$\frac{\Delta\dot{Z}^D}{\dot{Z}^D} = \frac{\Delta L_K}{L_K} + \frac{\Delta\dot{Z}_L^D}{\dot{Z}_L^D} + \frac{\Delta L_K \cdot \Delta\dot{Z}_L^D}{L_K \cdot \dot{Z}_L^D}. \tag{1.4}$$

The components of this sum are of very essential, defining importance for the conducted analysis, namely:

$\frac{\Delta\dot{Z}^D}{\dot{Z}^D} = \dot{z}^D$ – growth rate (e.g. average annual rate, average monthly rate) of the demand for food on the country scale (jointly, as an aggregated quantity),

$\frac{\Delta L_K}{L_K} = l_K$ – growth rate of the population number or the consumer number (average annual rate, average monthly rate),

$\frac{\Delta\dot{Z}_L^D}{\dot{Z}_L^D} = \dot{z}_L$ – growth rate of the demand per inhabitant or per consumer (growth rate of the individual demand for food over a specific time).

Assuming that the quotient: $\frac{\Delta L_K \cdot \Delta\dot{Z}_L^D}{L_K \cdot \dot{Z}_L^D}$ tends to zero, we can assume that the growth rate of demand for food is shaped by two indexes: l_K (growth rate of the population number or the consumer number) and $\dot{z}_L$ (growth rate of the individual demand). Both of them can be easily analyzed theoretically and identified empirically. However, though the first of them has a self-explanatory character, the second one requires an additional definition and more exact specification of its economic essence.

According to the well-known Engel's equation, the individual demand (demand per person $\dot{Z}_L^D$) is a function of income:

$$\dot{Z}_L^D = f(m) \tag{1.5}$$

where:

m –income per consumer in real terms (individual income).

Reducing equation 1.5 to an identity and differentiating it with respect to time, we obtain:

$$\frac{\partial \dot{Z}_L^D}{\partial t} \cdot \frac{1}{\dot{Z}_L^D} = \frac{\partial \dot{Z}_L^D}{\partial m} \cdot \frac{m}{\dot{Z}_L^D} \cdot \frac{\partial m}{\partial t} \cdot \frac{1}{m} \tag{1.6}$$

The individual elements of equation 1.6 can be interpreted as follows:

$\frac{\partial \dot{Z}_L^D}{\partial t} \cdot \frac{1}{\dot{Z}_L^D} = \dot{z}_L$ – growth rate of the individual demand for food in a given period;

$\frac{\partial m}{\partial t} \cdot \frac{1}{m} = m^{\bullet}$ – growth rate of the average income (individual income of the consumer in a given period);

$\frac{\partial \dot{Z}_L^D}{\partial m} \cdot \frac{m}{\dot{Z}_L^D} = E_{\dot{Z}}$ – income-related flexibility of demand for food;

$\frac{\partial \dot{Z}_L^D}{\partial m}$ – extreme growth of demand for food with respect to income growth (expressed per capita).

As a result, we obtain the following equation for the growth rate of the demand for food per inhabitant:

$$\dot{z}_L = m^{\bullet} \cdot E_{\dot{Z}} \tag{1.7}$$

By equation 1.7, the growth rate of the demand for food per capita is determined by the growth rate of the average income $m^{\bullet}$ and by the value of the coefficient of income-related flexibility in the demand for food $E_{\dot{Z}}$. The income change rate $m^{\bullet}$ is an index concentrating the effects of economic growth. When interpreting coefficient $E_{\dot{Z}}$, we assume occurrence of competitive equilibrium conditions in the food market. This means that the coefficient correctly reflects the influence of income on the demand for food in presence of given preferences, tastes, current price relations and given social and income structure of consumers, as well as given nutrition models, advertising, regulations and other limitations. With such assumptions, the demand growth is the result of consumer's sovereign decision compliant with the consumer's objective, which is maximization of the usefulness function in the context of specified limitations.

Taking in consideration equations 1.4 and 1.7, we can finally derive an equation which enables calculation of the growth rate of the joint demand for food products, having the following form:

$$\dot{z}^D = l_K + m^{\bullet} \cdot E_{\dot{Z}} \tag{1.8}$$

According to this equation, the growth rate of the demand for food is the sum of the population growth rate l_K and the product of the growth rate of the per capita income $m^{\bullet}$ and the value of the coefficient of income-related flexibility of the demand for food products $E_{\dot{Z}}$. This equation also reflects the potential rate of changes in the food market value and income of the agri-food sector. As a final effect, it determines the actual demand for agricultural produce growth, which in turn determines other relations in agriculture, including first of all possibilities and actual increase in agricultural producers' income. Unfortunately, the demand growth rate determined by the variables contained in equation 1.8 need not be sufficient for shaping the appropriate growth rate of agricultural producers' income, and consequently of the development processes based, as generally known, on accumulation and investments.

When considering the factors influencing the growth rate of the demand for food, in case of an open economy, we have to additionally take into account the foreign trade exchange balance (export and import balance). This is particularly important when foreign trade in food products can have an increasingly large share in shaping the possibilities of agricultural produce growth due to demand barriers in the domestic market. It is worth noting here that such an approach is not fully compliant with the terms of common EU market, which should provide conditions for utilization of the production potential of the whole EU agriculture. However, the EU market is not a single currency area, and hence we have to do with potential impact of the exchange rate on the volume of trade exchange between some EU countries. Since such a situation applies, among others, to Poland, it is justified to include the foreign trade category in the analysis of factors influencing the growth of demand for food, due to the impact of the exchange rate on shaping of that demand, while preserving *ceteris paribus* in case of other factors. As a result, an index $hz_{\dot{Z}}$ was defined to illustrate the influence of foreign trade on shaping the growth of the demand for food on the country scale. The said index has the form:

$$hz_{\dot{Z}} = \frac{\Delta X_{\dot{Z}}}{X_{\dot{Z}}} - \frac{\Delta I_{\dot{Z}}}{I_{\dot{Z}}} \tag{1.9}$$

where:

$X_{\dot{Z}}$ – food export,

$I_{\dot{Z}}$ – food import.

This index is of a corrective character and, depending on whether export or import dynamics prevails, the value of the index either increases or decreases the calculated growth rate of the domestic demand for food. One can also assume that the size of export or import of agri-food products is a function of the relation between the prices of those products in the domestic and international markets. Given the assumption on absence of limitations in international trade, increase in prices in the world market beyond domestic prices leads not only – which is obvious – to increased export, but also to increase in domestic prices. In the opposite situation, we have to do with increase in the domestic demand and increasing import of food products. We also assume occurrence of the equilibrium conditions, in which price increase leads to supply increase and demand decrease, while price decrease has the opposite effects. Taking these assumptions into account, we add index $hz_{\dot{Z}}$ to the right hand side of equation 1.8, obtaining as a result:

$$\dot{z}^D = l_K + m^{\bullet} \cdot E_{\dot{Z}} \pm hz \tag{1.10}$$

Equation 1.20 determines the growth rate in the agri-food sector conditional on the market equilibrium. The index on the left hand side of this equation is in fact in a sense the index of vector ($\dot{\mathbf{z}}^D$), which results from multiplying the quantities of food products $\{x_1, x_2, ..., x_n\}$ by their prices $\{c_{\dot{Z}}^1, c_{\dot{Z}}^2, ..., c_{\dot{Z}}^n\}$. Hence this index determines the change in the total income of agri-food sector in the potential, forecasted or actual dimension. The discussed equation can also be used for simulating growth processes and for examining various growth scenarios from the viewpoint of both the market equilibrium and changes in the economic and technical relations triggered by changes in the production effectiveness and production techniques. Specific assumptions, forecasts or analyses of the actual state of things regarding the parameters included on the right hand side of the equation can be used as a basis for estimating the chances of income growth in the agri-food sector.

According to equation 1.8, the rate of changes in the domestic demand for food is the resultant of the population number change rate and the individual consumption change rate. The results of the conducted studies indicate that in Polish conditions the first causative factor not only has failed to be the driving force of the demand for food over the recent years but, to the contrary, has had a weakening influence on it (slight, but perceivable decrease in the number of

population). Demographic forecasts for our country indicate that in the coming decade the situation in this area might be even less advantageous.

As to the changes in the individual food consumption level, the latter consumption is determined by the growth rate of the average income of the population and the income-related flexibility of the demand for food. Potential growth of the population income resulting from economic growth should stimulate the demand for food. However, we should also take into account the fact that possible growth of the population income will translate to growth of the demand for food in a degree much lower than proportional, due to the relatively low income-related flexibility of the demand for food, decreasing together with growing affluence. This is shown by the data on the domestic consumption level of basic food products compared to changes in the GDP in 2000-08. Though the 38.3% GDP growth (calculated in fixed prices) was accompanied by similar, and even slightly higher, dynamics of expenditure on food, yet the individual consumption of basic food products was characterized by stagnation in that period, and in case of some of them (e.g. potatoes, baker's goods and milk) even by a decreasing tendency. This means that the clear, reaching 40% growth in the expenditure on food noted in that period was caused by increased demand for the quality and processing form of the food product rather than for its quantity in the initial form produced by the farmer.

By equation 1.10, in addition to the domestic demand, also export can be a source of income for the agri-food sector. However, we should remember that the above income can also be weakened by the demand for imported products. Since its access to the EU, Poland has been noting a clearly positive balance in foreign trade in agri-food products, exceeding EUR 2 billions in 2006 and 2007. However, up to now the scale of this very advantageous phenomenon has not been large enough to allow for recognizing export as a decisive factor in shaping the demand for food produced in our country (the balance amount in the mentioned years constituted 7-8% of the total amount of the national expenditure on food). Maintenance, not to speak of possible improvement in this situation, will be relatively difficult, and will be conditional on favourable foreign exchange relations and on the competitiveness of Polish food products following from their quality.

Summing up, we should state that the presented analytic approach can be successfully applied for determining realistic possibilities of increase in the agri-food sector income. In the Polish conditions, that income will depend in the nearest future on two factors: population income and food export dynamics. Possible growth of the population income and the export surplus will contribute to growth of the sector's income, determining at the same time the growth pos-

sibilities of agricultural producers' income. The latter depend also on the allocation of income in the individual links of the marketing chain of food. While growth of the sector's income due to the food export growing faster than import should translate to improvement in the income situation of agricultural producers, the above is not so obvious in case of the population income growth. Having in mind the tendency observed in the country which consists in an increase in expenditures on food with simultaneous stagnation in the quantitative consumption level, we could think that the potential growth of the agri-food sector income as a result of population income growth, conditional on the income-related flexibility of the demand for food, would first of all benefit the processing industry and trade link rather than the agricultural producer. A symptom of this specific asymmetry in income allocation in the individual links of the marketing chain of food is formation of the so-called price spreads.

1.2. Price spreads in the marketing chain of food

Price spreads can be measured using the absolute value or percentage approach. In the first approach, the price spread is a difference between the retail price of a food product and the purchase price of the agricultural raw material used for manufacturing that product. In the second approach, the price spread is the relation of those prices, showing the percentage share of the agricultural producer and the added value, generated in extra-agricultural links of the marketing chain, in the final price of the food product paid by the consumer.

In general, increase in the price spreads with simultaneous increase in consumers' expenditure on food gives rise to negative income-related consequences for agricultural producers, following from decrease of their share in the allocation of income generated in the whole agri-food sector. Evaluation of the phenomenon of price spread formation in Polish conditions was conducted based on the analysis focused on the changeability in the relations between prices occurring in the individual links of the marketing chains of the main agri-food products in 1996-2008, and especially the changeability of the share of the agricultural raw material price in retail prices. The analysis covered the following agri-food markets and the monthly prices of basic agricultural raw materials and food products noted down in those markets by GUS (Central Statistical Office), GIJHAR-S (Main Inspectorate of Commercial Quality of Agricultural and Food Products) and MARD (Ministry of Agriculture and Rural Development), namely:

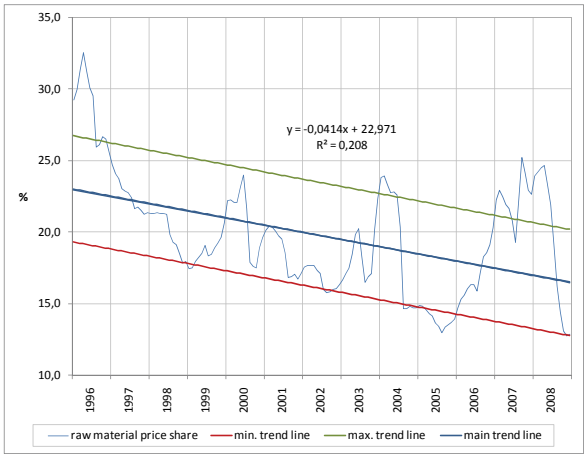
- Grain and grains products (purchase prices of wheat, rye and barley, as well as sales prices and retail prices of the „Poznańska" wheat flour, baker's

wheat flour – 850 type, baker's rye flour – 720 type, mixed bread, rye bread, wheat rolls and the „Mazurska" barley grits);

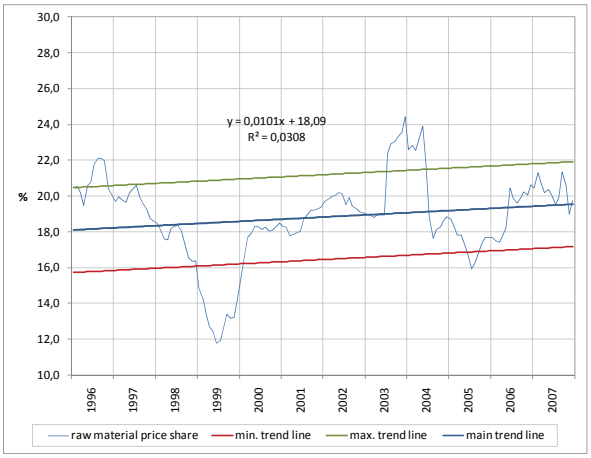
- Rape and consumer oil products (purchase prices of rape, as well as sales prices and retail prices of edible rape oil and the „Palma" margarine);
- Pork and pork products (purchase prices of pork livestock, as well as sales prices and retail prices of pork loin, boiled pork ham, „Zwyczajna" sausage, and pork frankfurters);
- Beef and beef products (purchase prices of beef livestock, as well as sales prices and retail prices of raw meat with bone – flank, raw meat with bone – rump, and boneless raw meat – boned haunch);
- Poultry and poultry products (purchase prices of poultry livestock, as well as sales prices and retail prices of gutted chicken, chicken breast, poultry ham and poultry frankfurters, purchase prices of turkey broiler, turkey haunch and turkey breast);
- Cow milk and milk products (purchase prices of milk, as well as sales prices and retail prices of milk with 3.0-3.5% fat content, 18% cream, „Gouda" ripening cheese, semi-fat cottage cheese and fresh butter up to 85% fat content).

The food products with prices subjected to analysis are characterized by homogeneity of quality attributes (relatively constancy of standards). That is why, the prices of those products in a given marketing chain can be deemed comparable over time. In order to determine the price spreads for the individual markets and the related products, the shares of raw material purchase prices and of the sales prices in the retail price of each considered food product were calculated, and then aggregation was carried out to enable establishment of the average values of those shares for a given product category. The results of the calculations, which show shaping of the share of the purchase prices of basic agricultural raw materials in the retail prices of food products and the share of the main links of the marketing chain in those prices, are presented synthetically in Figures 1.1 and 1.2.

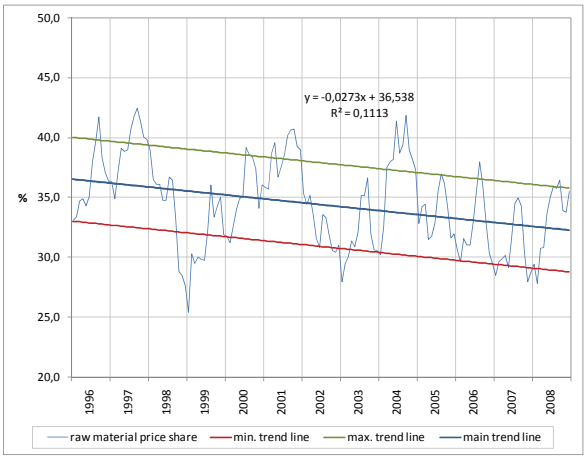
Figure 1.1. Share of purchase prices of basic agricultural raw materials in retail prices of analyzed food products in 1996-2008



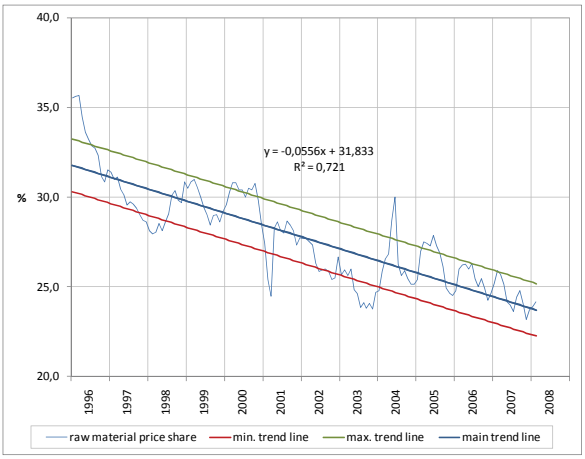
a) grain products



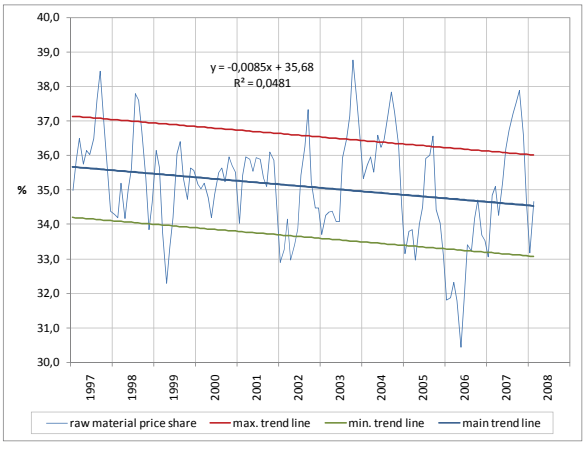
b) rape oil and margarine



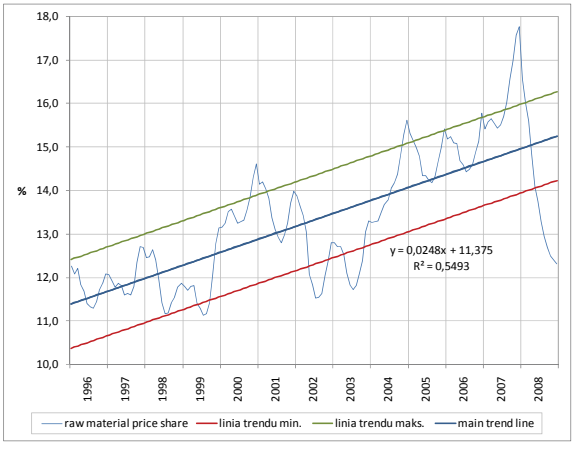
c) pork products



d) beef products



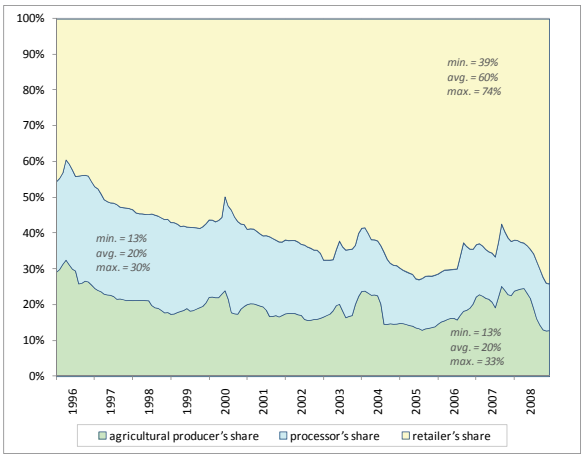
e) poultry products



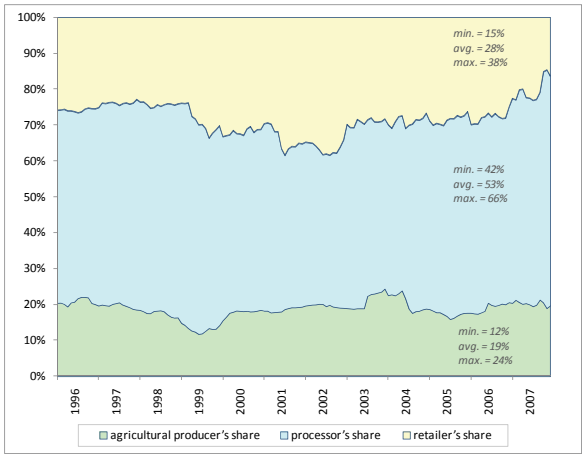
f) milk products

Source: own elaboration based on GUS, GIJHAR-S and MARD data.

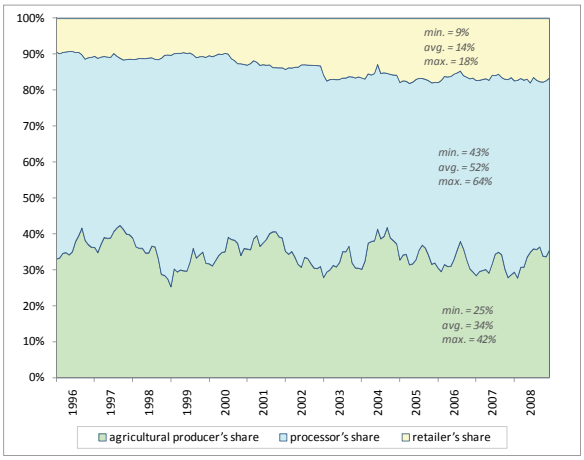
Figure 1.2. Share of main links of the marketing chain in retail prices of basic food products in 1996-2008



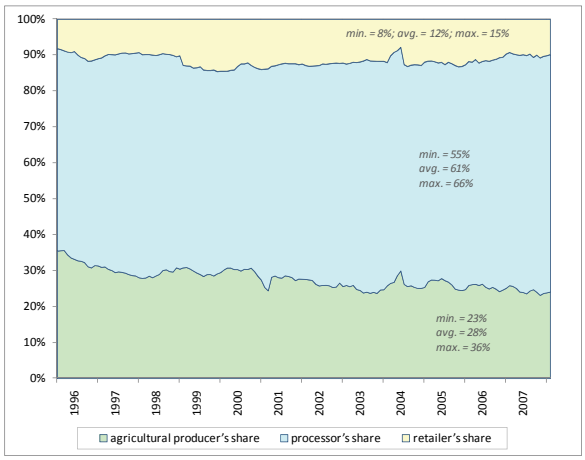
a) grain products



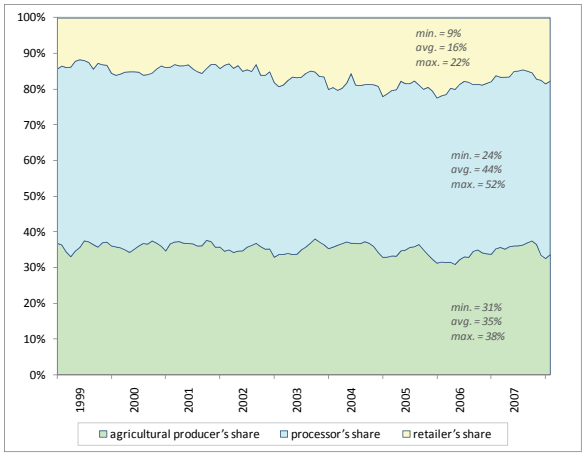
b) rape oil and margarine



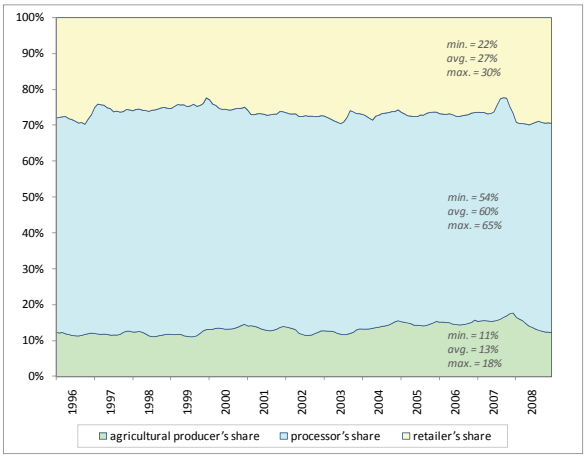
c) pork products



d) beef products



e) poultry products



f) milk products

Source: own elaboration based on GUS, GIJHAR-S and MARD data.

Based on the results on the conducted analysis, covering the years 1996-2008, one cannot speak of an unequivocal – over that period – model of price spread shaping in the markets of basic agricultural raw materials and food products. First of all, the sizes of those spreads, measured by the share of purchase prices in retail prices of food, differ considerably depending on the type of agri-food products and the related degree of their processing. In case of grain and main grain products, such as flours and baker's goods, the average share of the purchase prices of grain in the retail prices of those products amounted to about 20% in the analyzed period, while the average share of the purchase prices of pork, beef and poultry livestock in the retail prices of main meat products exceeded 30%. The average share of the purchase price of milk in the retail prices of main milk products was the lowest (about 13%). However, we should stress here that with respect to all analyzed markets, a very clear connection was revealed between the processing degree of the product and the size of price spread (i.e., the higher the processing degree, the bigger the spread).

Secondly, the tendencies which characterized the shaping of the examined price spreads in the analyzed period were different. Price spreads in the markets of grain and grain products, as well as in the markets of pork, beef and poultry livestock and main meat products, showed a tendency for growth (especially strong in the beef livestock and beef market). However, in case of rape, rape oil and margarine markets, as well as milk and main dairy products markets, we can speak of a tendency for decrease.

Thirdly, in the analyzed period, the examined spreads differ both in their structure (in division by the processor and the retailer) and in the changes taking place in this respect. In the marketing chain of grain and grain products, the share of the retail link in the price paid by the consumer amounted on average to about 60%. In turn, in the marketing chains of all meat types and main meat products this share was much lower, and amounted on average to 14% in case of pork, 12% in case of beef, and 16% in case of poultry. In these marketing chains, the link with the highest share in the retail price of a product was the processor. The processing industry link in the price paid by the consumer was the highest in the marketing chain of beef as well as of milk and milk products (in both cases, it reached about 60%).

The common feature of all the examined spreads is their very high variation over the analyzed period, which is a symptom of the absence of immediate and full transmission of price impulses in the marketing chain of food. The course of that process, and in consequence the shaping of the price spreads over time, depends on the competitiveness of the discussed market structures, and on the distribution of the market force in the marketing chain.

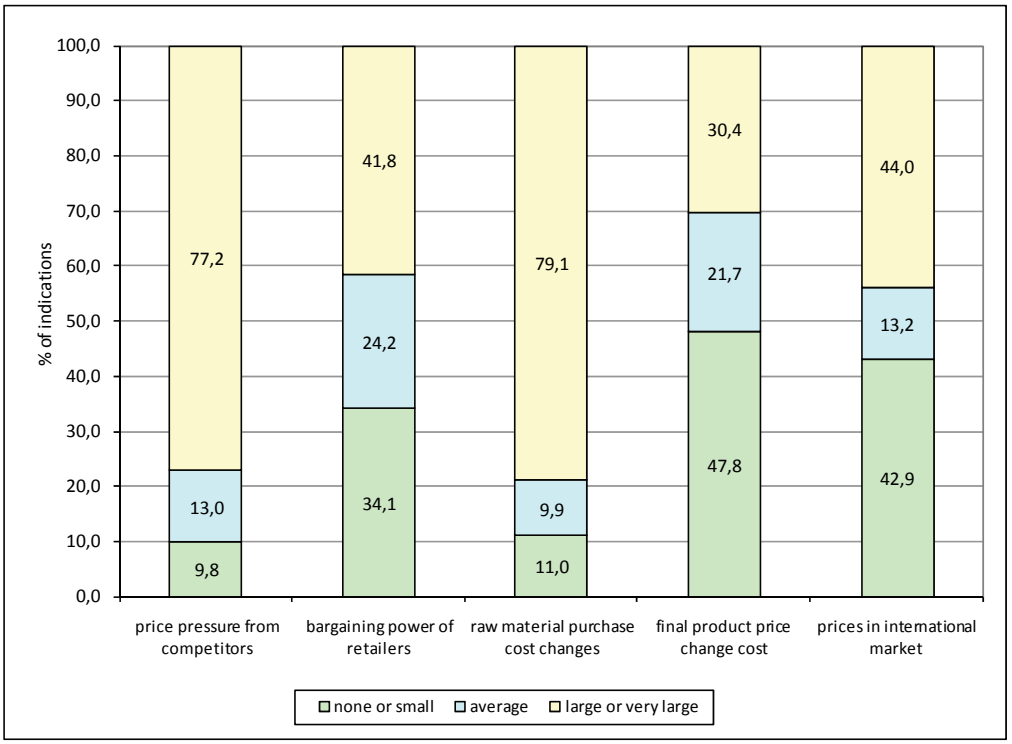
1.3. Implications of price behaviour of agri-food processing enterprises

As the demand for agricultural raw materials has a derived character with respect to the consumer demand for food, the income of agricultural producers depends not only on the size of that demand but also on the competitiveness of the price behaviour of processing and trade enterprises, and on the pricing policy conditional upon the market power they possess. The prices behaviour of the participants of a given food marketing chain that diverge from the competitive model of price transmission usually have a negative influence on the income of agricultural producers. In particular, this applies to the asymmetry of price responses of the processing enterprises to increases and decreases in the prices of agricultural raw materials. The occurrence of this phenomenon is also proven by the results of studies concerning the decisions of agri-food processing industry enterprises regarding changes in the prices of the manufactured products in response to changes in the prices of raw materials.

The main objective of those studies was identification and establishment of the importance of the factors influencing the price decisions of the enterprises, as well as determination of the speed and the strength of the price responses of the enterprises to changes in the prices of raw materials depending on the direction and scale of those changes. The studies covered the total of 91 enterprises located in north-eastern Poland, which represented the following sectors: feed production (12), grain and mill processing (9), baking (17), red meat processing (21), poultry meat processing (15) and milk processing (17).

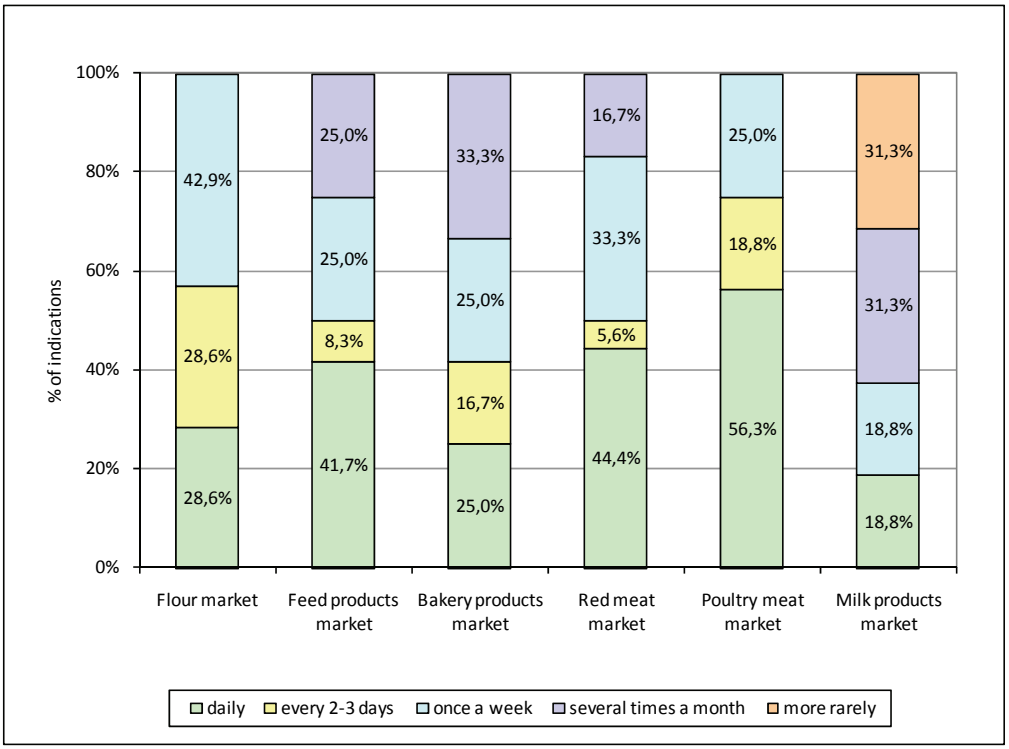
The results of the conducted studies indicate far-reaching differentiation of the importance of the essential factors shaping the price behaviour of processing enterprises, as well as of the rate and scale of changes in the prices of final products compared to changes in the prices of raw materials (Figures 1.3-1.8). The most important factors determining the decisions on changing the level of final product prices in the examined enterprises turned out to be changes in the purchase pieces of raw materials and the price pressure from the competitors. These factors were pointed out as those having large or very large influence of the price decisions by over ¾ enterprises.

Figure 1.3. Evaluation of the importance of factors influencing the decision to change the price level of final products in examined enterprises



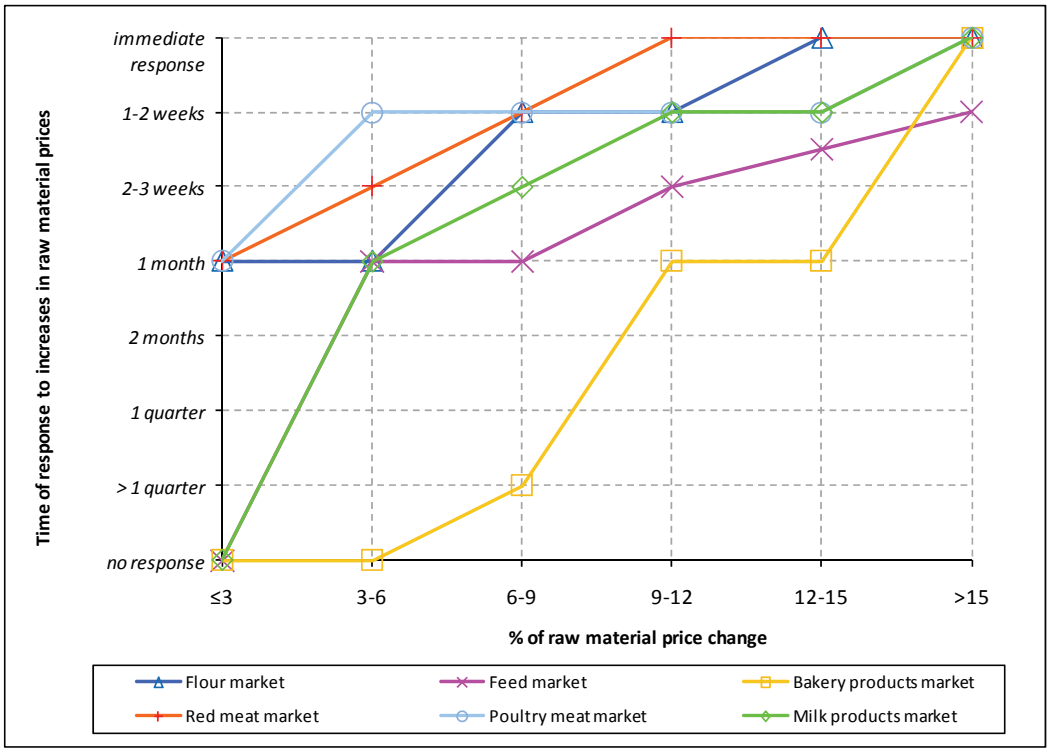
Source: own elaboration based on studies.

Figure 1.4. Frequency of monitoring price levels of agricultural raw materials by examined enterprises in analyzed markets



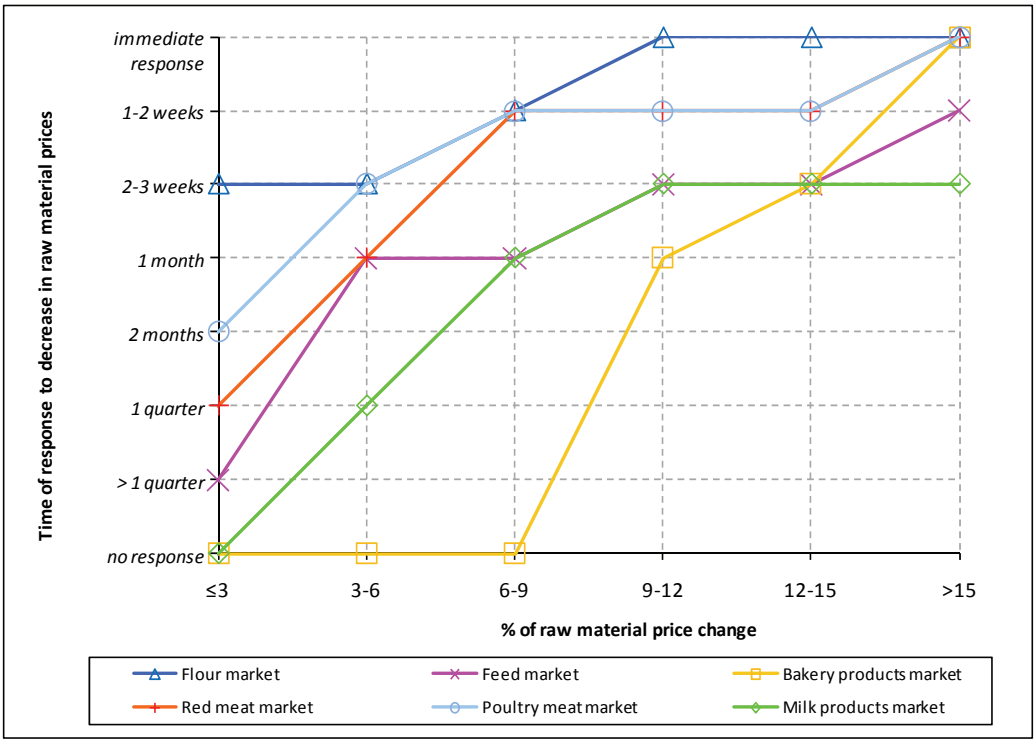
Source: own elaboration based on studies.

Figure 1.5. Speed of price responses of examined enterprises to increase in raw material prices in analyzed markets



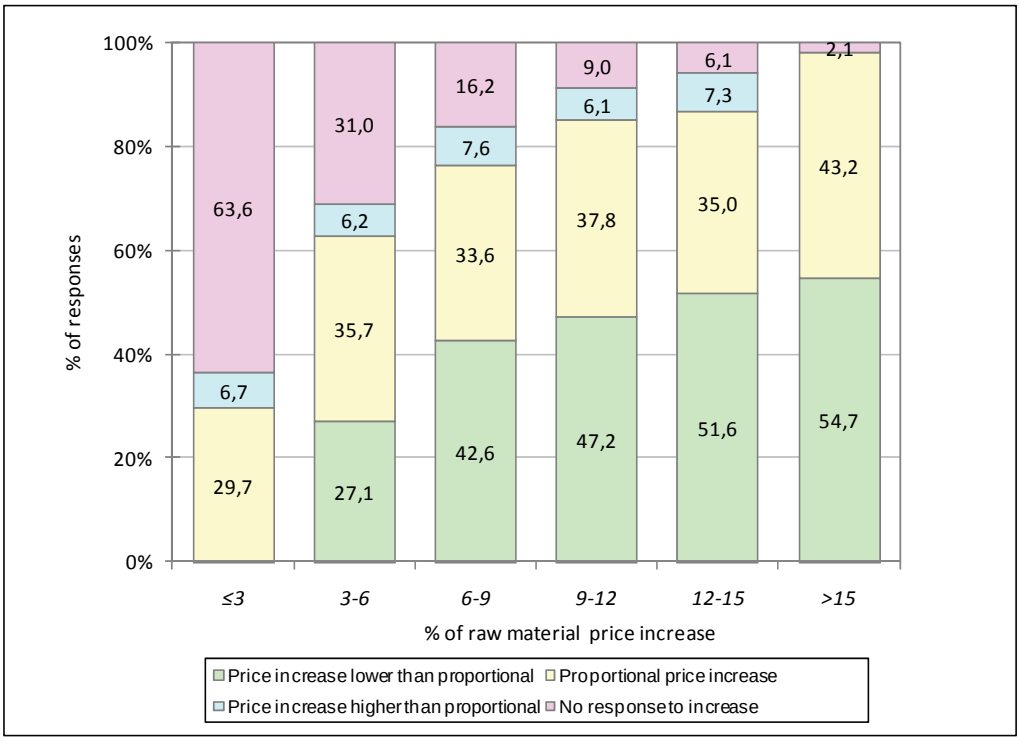
Source: own elaboration based on studies.

Figure 1.6. Speed of price responses of examined enterprises to decrease in raw material prices in analyzed markets



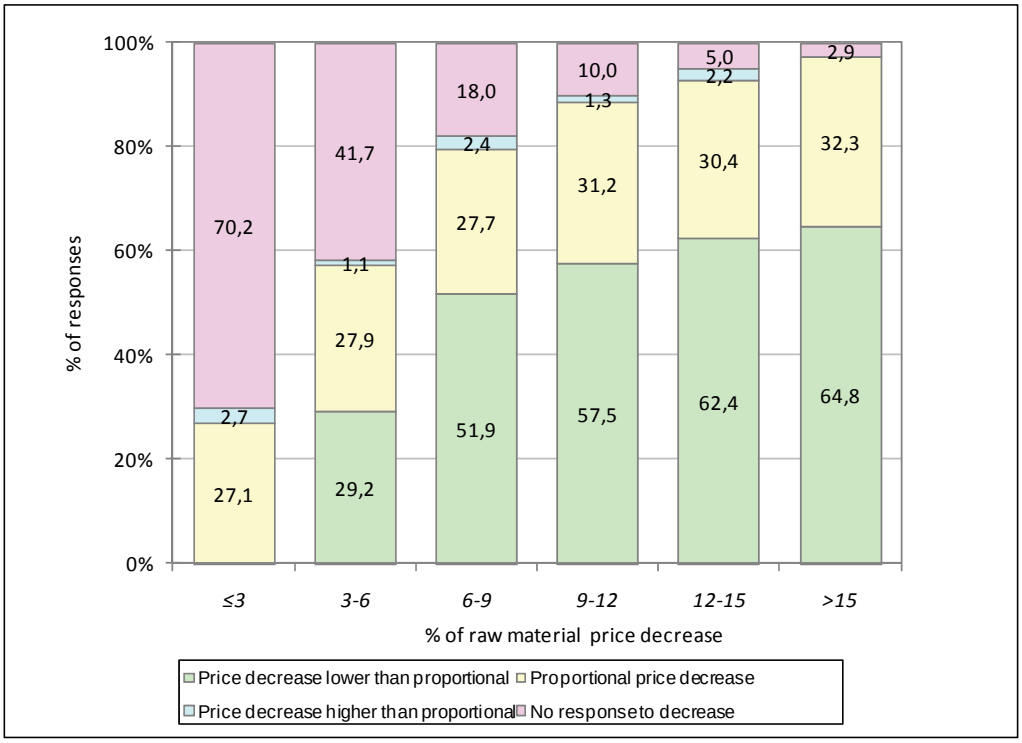
Source: own elaboration based on studies.

Figure 1.7. Strength of price responses of examined enterprises to increase in raw material prices



Source: own elaboration based on studies.

Figure 1.8. Strength of price responses of examined enterprises to decrease in raw material prices



Source: own elaboration based on studies.

The factors influencing the price decisions which were treated as less essential included: bargaining power of retailers, costs of changing the final product price, and prices in the international market. The examined enterprises placed a relatively high emphasis on monitoring the prices of raw materials in agricultural markets on a current basis. The greatest frequency of price monitoring was exhibited by enterprises operating in the meat markets, especially poultry meat markets (at least once a week). The grain processing and feed manufacturing enterprises did this relatively less frequently. The least frequency of monitoring occurred in enterprises operating in the milk products markets (over 60% of them did it a few times a month or even more rarely). One could think that such sector-related differentiation in the activeness of the examined enterprises in monitoring prices in the markets of agricultural raw materials is connected with the variability degree of those prices. However, one should also guess that the frequency of price monitoring is not without its influence on the speed of price responses of the enterprises.

Actually, it has turned out that the speed of price responses of the enterprises to changes in the prices of agricultural raw materials depends on the direction and size of those changes. Generally, the examined enterprises reacted faster to the increase than to decrease in the prices of raw materials. The responses were also the faster the stronger the price movements were, though a rather clear sector-related differentiation was also marked here. The greatest sensitivity to increases in the raw material prices characterized enterprises operating in the meat and flour markets (immediate responses to increases within 9-12% and higher), while the least was noted in the milk products and the baker's goods markets (the latter enterprises did not respond at all to price increases lower than 6%). In case of raw material price decreases, the sector-related differentiation of the speed of price responses of the examined enterprises was very similar, whereby relatively small decreases more often did not trigger any response, and responses to greater decreases were decisively slower.

From the viewpoint of income allocation in the marketing chain of food, another essential factor is the strength of response of processing enterprises, which directly influences the course of the price transmission process, and in consequence shaping of the economic surplus of the agricultural producer and the consumer. Most of the examined enterprises did not respond to relatively small movements of raw material prices, which did not exceed 3%. This applied in particular to price decreases, which were ignored by over 40% enterprises even when they were in the 3-6% interval. The product prices were raised proportionally to the increase in the raw material prices – depending of the strength of the increase – by 29.7 to 43.2% enterprises, while no more than 1/3 enter-

prises lowered them proportionally to the decrease in the raw material prices. Price increases, and even more so decreases, exceeding the proportional ones were a rarity. The examined enterprises responded to changes in raw material prices by product price increases or decreases generally lower than proportional ones, whereby this happened more often in case of decreases. In general, we can state that the examined enterprises responded more frequently and stronger to increases than to decreases in the prices of agricultural raw materials. Such price behaviour of enterprises is a source of asymmetry in the price transmission process in the marketing chain of food, and in consequence might have negative influence of the income of agricultural producers.

2. Using the dynamic stochastic general equilibrium models in the analysis and evaluation of the agricultural policy

2.1. Essence of the DSGE models

The DSGE models, which by definition are based on the concept of general equilibrium, focus on three main sectors: the household sector, the enterprise sector and the public sector (monetary authority). The household and enterprise sectors are assumed to function rationally and the utility and profits are supposed to be maximised in mid-term perspective and in uncertainty conditions. The monetary authority fixes the interest rates in accordance with the specific rules or maximizes its own function of the objective. The DSGE models are dynamic and, therefore, allow studying the economy changes in time. As the economy is exposed to sudden shocks, such as technological change, price fluctuations, or macroeconomic policy errors, the models were also given a stochastic character, conversely to the static models of equilibrium.

The traditional macroeconomic forecasting models, used by central banks since the 70's, allow to estimate, often using thousands of variables, the dynamic correlations between prices and volumes of goods in various sectors of the economy. On the other hand, the equations in DSGE models are more difficult to be solved and analysed from the technical point of view, but they focus on a considerably lower number of variables that are the most important for each sector. The theoretical DSGE models involve only a few variables, though the experimental forecasting models, developed for example by the central banks may cover hundreds of variables.

While devoid of sectoral details, the DSGE models are characterised by logical consistency resulting from the macroeconomic principles of decision-making process modelling. This comes down to the aspects of economy such as preferences, technology and institutional framework. Preferences consist in the specific objectives of business entities. For instance, the households maximize the utility functions through consumption and labour, whereas enterprises maximize their profit functions. Technology stands for the operators' production capacities which must also be precisely defined. Companies have production functions that determine the volume of manufactured goods depending on the amount of labour and capital invested. Technical constraints of operators' decisions take into account the costs of adjusting capital reserves, employment

and price levels. On the other hand the institutional framework means that the institutional constraints for the interactions between the operators must be defined as well. For many DSGE models this may simply mean that the operators make their choices within an externally defined budget framework whereas the prices adjust themselves until the market equilibrium occurs. This may also mean a specification of fiscal and monetary policy rules, or determination of the changes of budget rules and constraints change depending on the policy process.

A DSGE model solution consists in specification of the preferences (what the operators want), technology (what the operators may manufacture) and institutions (their reactions). Next, the actual output, trade and consumption can be predicted. Basically, it is also possible to predict the effects of the institutional framework changes. Contrary to the opinion of Lucas, such a prediction is unlikely to be valid in traditional macroeconomic forecasting models, since those models are based on observed past correlations between macroeconomic variables. These correlations can be expected to change when new policies are introduced, invalidating predictions based on past observations.

A standard DSGE model is a model of an open or closed economy with real and nominal price rigidity, based on microeconomic foundations. Households consume, make decisions how much to invest and are monopolist providers of different types of work that allows them to impose the remuneration level. Companies employ workforce, lease capital and are monopolistic suppliers of diverse goods, so that they may impose the prices. Fiscal policy is usually restricted in the Ricardian sense, while monetary policy is pursued according to the principle stating that the interest rate is set as a response to deviation from the inflation target and certain measures of economic activity, such as the output gap. A specified degree of interest rate smoothing is also adopted. The basic model is additionally provided with a stochastic structure which is associated with different types of shocks, such as supply-side shocks (productivity and labour supply), demand-side shocks (preferences, investment specifics, public spending), price shocks (price increase, salary increase, risk premium) and monetary shocks (interest rate and other targeted variables). It is also assumed that all types of shocks are a primary derivative of the autoregression process.

Generally, the framework of the DSGE model is created so as to reflect the business cycle dynamics in the economy in a reliable manner. At present, the problem of modelling financial markets, greater emphasis on the role of fiscal policies, improved interaction between trade and financial openness, modelling

labour markets and modelling inflation dynamics (e.g. as to the role of expectations and price formation) are the main challenges for its improvement.

The common argument for the use of DSGE models is that their microeconomic basis and separation of structural parameters covering, preferences, technology or describing aggregated shock movement law from preferences parameters depending on a given policy guarantee their usefulness policies analysis. In other words, DSGE models are resilient to Lucas' critique and may be successfully used for quantitative evaluation of certain policies.

To sum up, DSGE models are valuable tools which allow to establish a coherent framework of policy analysis and creation. They are helpful to identify the sources of fluctuations, to answer questions on structural changes, to forecast and predict the effects of changes to policy and to run counterfactual experiments. Those features of DSGE models arise interest of the central banks mainly. Some of them have worked out and use DSGE models for policy analyses and predictions. Nevertheless, it is believed that their use may not give rise to excessive expectations despite a great progress in development and use of DSGE models, mainly as far as their ability to fully explain empirical regularities is concerned.

2.2. Problem areas and examples of DSGE model use

DSGE models emerged in response to the needs of central banking systems seeking tools to evaluate and formulate the assumptions of macroeconomic policy, yet currently they are more frequently used for analyses focused on the functioning of certain important areas of the economy, such as the agri-food sector. There are five problem areas directly or indirectly connected with agricultural policy in which DSGE models may be used for analytical purpose. These are: nature, international trade, allocation of factors of production, progress in agriculture and economic development.

Research on interaction between nature and agriculture is a relatively new area of interest for the analysts who use the tools such as the DSGE models. Focused on studying interactions between agriculture and nature, DSGE potentially allow to evaluate the effects of agricultural policy in this respect. The 'nature' problem area can be divided into three sub-areas: biodiversity, water quality and deficit, and climate change.

Research carried out in the framework of 'biodiversity" sub-area may be the source of valuable information on the changes in land use and farming inten-

sity. The analysis may cover the relations between restricted biodiversity and changes in agriculture as well as the effects of conservation programmes. It is possible to model the mutual impact of policy, land use and biodiversity as well as the impact of scientific progress on animal welfare.

The subject of water quality and deficit belongs to the most frequently discussed issues among the problem areas referred to above. In the framework of the sub-area, DSGE models can be used to study the effects of phosphate and nitrate emission in agriculture. Other potential areas of application include: solving problems of water reallocation policy, relationships between trade reforms and operation of water markets, irrigation and water deficit, price policy and ownership policy.

Climate change analyses frequently face the problem of nitrogen surplus and pollutants spread in the agricultural sector. However, modelling of the effects of the policy to reduce greenhouse gas emissions is the leading topic in this sub-area. DSGE models provide information on and allow simulations of the changes in regional environmental pollution level as well as studying the potential economic, social, and environmental effects of specific policy instruments applied to reduce greenhouse gas emissions.

The increasing number of bilateral trade agreements under which new tariff rates are frequently introduced constitutes a serious challenge for the agri-food sector trade analysts using the DSGE models. In the majority of cases, third country price pressure on EU markets was not a result of tariff obligations of the WTO but of preferential trade agreements. The highly varied nature of the agreements, particularly bilateral trade agreements with the European Union, is the reason behind serious problems concerning data such as trade flows and the definition of products covered by the agreements. It is worth highlighting that the problem area is perceived as the most important one from the point of view of significance of issues connected with the future and development of the agri-food sector in a number of countries. As a result, the number of studies on these issues with the use of DSGE models is relatively the highest. They are focused primarily on the global prices, liberalisation of trade and the effects of reforms negotiated in the framework of WTO, or the impact of shocks.

Analyses concerning the operation of the agri-food sector that employ DSGE models frequently touch upon volatility of prices of agri-food products. High price fluctuations in the agricultural sector and their impact on stability of farmers' income as well as price interactions between particular sectors of agri-

culture are of primary interest. DSGE models also allow the analysis of the volatility of global prices of agricultural products to take into account factors such as the role of emerging countries, changing diets, the increase in demand for energy connected with the biofuels boom, unfavourable weather, speculation, agricultural policy and the volume of final reserves.

DSGE models are also quite frequently applied in the research on evaluation of the impact of trade liberalisation on agricultural markets of selected countries. Liberalisation of trade is closely connected with activity of the WTO. It is most frequently the case that DSGE models are used to evaluate the impact of liberalisation on agricultural markets of the European Union or the effects of bilateral agreements between the countries or groups of countries. Quite numerous studies in the area of international trade, either general or concerning specific states, are conducted with a view to evaluate the effects of reforms proposed by the World Trade Organisation (WTO) that were negotiated in the framework of the Doha Round, such as optimum tariffs, domestic support or specific trade agreements. DSGE models are also considered the best available tools for modelling of the impact of events which result in market shocks. These events mainly include outbreaks of diseases such as BSE, bird flu, foot-and-mouth disease and others, as well as bioterrorism and crises affecting non-agricultural sectors, such as the copper market.

Analysis of primary factors of production does not belong to the areas where DSGE models are traditionally used. More frequently investigated issues include the analysis of agricultural markets and selected tools of agricultural policy. On the other hand, reforms of the European agricultural policy considerably affect the markets of factors of production, resulting in a need to have these issues analysed. Therefore, developments in the application of the models, which allow to determine land allocation in accordance with the profile of production, and prediction models should be considered as striving at better understanding and prediction of land allocation, labour resources and capital in the agricultural sector. For the agricultural sector, studies using the DSGE models focus mainly on analysing the impact of particular factors of production on prosperity, development of rural areas and reducing poverty.

The researchers who apply DSGE models in their work are considerably interested in production of biofuels as the models allow to evaluate various market development scenarios and production profitability, taking into account the projected increase in demand for renewable fuels. DSGE models can also be

used to analyse the impact of an increase in bioethanol production on the economy and the environment. It should also be emphasised that interest in renewable energy sources increased in the recent years due to the concerns about the security of energy supplies and the environment. Due to the great significance of energy for each country's economy, the energy sector arouses great interest, but also great controversy. DSGE models can also be used to study the impact of the power sector deregulation on the economy, including the agri-food sector, but also to study the impact of energy prices on global agricultural markets in the long run.

Technological and organisational progress in agriculture has numerous implications whose comprehensive analysis is relatively difficult. In view to enhance the competitiveness of agriculture, the production and management methods as well as the agricultural holding operation are more and more frequently changed. DSGE models can also be useful for evaluation of the impact of these changes on productivity, efficiency and development of the agricultural sector and rural areas functioning. DSGE models can be applied in the research on the technological changes impact on the country development broken down into the agricultural and non-agricultural sector, as well as on phenomena such as the scale of poverty or regional differences.

Evaluating the impact of specific biotechnologies on productivity of agricultural sectors where new technologies are applied is one of important issues that attract researchers' attention. Biotechnologies reduce production costs and thus accelerate the growth and enhance efficiency of given sectors. Research using the DSGE models provides an opportunity to better understand and assess the nature and degree of biotechnological impact on the economy. For example, they can be used to study international diffusion of benefits of biotechnologies, the research on the impact of genetically modified crops on international trade results, and to analyse the policy of identifying genetically modified products.

Because DSGE models, as general equilibrium models, must take into account different sectors of the economy as well as economic development indicators, it is possible to study different aspects of relations between the agri-food sector and general economic development of countries. The analytic capacity of DSGE models in this respect is considerable and perceived equally by researchers and those who commission research. It is a result of certain advantage of general equilibrium models over partial equilibrium models. On the one hand, the agri-food sector can be looked at from a wider perspective, and on the other hand, it can be studied from the point of view of the sector changes impact on the economy of the whole country.

Table 2.1. Examples of potential applications of DSGE models for analysis and evaluation of the effects of agricultural policy according to problem areas

No.	Model description	Author(s) or place of origin	Example problem area
1.	G-Cubed	W.J. McKibbin from Australian National University, Brookings Institution	Environment
2.	Model by the Economic Development Center, University of Minnesota	X. Diao and T. Roe from the Economic Development Center, University of Minnesota	Environment
3.	INRA and UMR SMART	F. Femenia and A. Golin from the French National Institute for Agricultural Research INRA and UMR SMART	International trade
4.	Model by the US Department of Agriculture	A. Somwaru and D. Skully from the Economic Research Service, US Department of Agriculture	International trade
5.	Free trade model	G. Impullitti from IMT Lucca Institute for Advanced Studies and O. Licandro from the European University Institute	International trade
6.	Model by CIRAD-ES-UMR	F. Gerard and M.-G. Piketty from CIRAD-ES-UMR	Factors of production
7.	GTAP-Dyn model modified by the Ohio State University	E. Ianchovichina, R. McDougall from GTAP and Ohio State University	Factors of production
8.	Model by the Center for Agricultural and Rural Development, Iowa State University	M. Baker, D. Hayes and B. Babcock from the Center for Agricultural and Rural Development, Iowa State University	Factors of production
9.	TAIGEM-E	D.-H. Lee, H.-Ch. Lin and Ch.-Ch. Chang from universities in Taiwan in cooperation with Australian Monash University	Factors of production
10.	Model by the Michigan State University	E. Dinopoulos from the Department of Agricultural Economics and the Department of Economics, Michigan State University	Progress in agriculture and economic development
11.	ICES	A group of scientists from FEEM coordinated by F. Bosello	Progress in agriculture and economic development
12.	Dynamic-AAGE	Danish Research Institute of Food Economics	Economic development and sectoral implications
13.	Structural model by IBS	Institute for Structural Research (IBS) in Warsaw	Economic development and sectoral implications

Source: literature review.

Studies of impact of different policies and solution in the agri-food sector on economic development turn out particularly important for underdeveloped countries where the agri-food sector generates a considerable percentage of national product. Thus, any changes to the sector considerably impact the general condition of the economy and the quality of life of the citizens. DSGE models

can be applied in research on the emergence and impact of agricultural production surplus in economically underdeveloped countries as well as in studies aimed at establishing the role of agriculture of selected countries in the context of various development paths.

In the search for an appropriate development strategy for selected countries, the use of DSGE models can also be helpful to identify the likely effects of reforms of the industry protection policy and the agricultural policy. For example, it is possible to study the effects of the choice of certain production profiles in selected countries or the impact of the agricultural sector functioning in selected countries on their economic development. DSGE models may assess the impact of an increase in outlays on research and development on the given agricultural production trends in selected countries or the impact of development in the R&D sector of agriculture and industry on the economic growth in a selected country. Table 2.1 presents examples of potential applications of specific DSGE models for analysis and evaluation of the effects of agricultural policy in relation to defined problem areas.

3. Perspectives and effects of potential CAP changes in the light of modelling results

An important part of the research in this field consisted in modelling potential CAP changes and macroeconomic conditions to evaluate the impact of these changes on the Polish agri-food sector, and to evaluate usefulness and possibility of using various equilibrium models, including dynamic stochastic general equilibrium models (DSGE), as supporting instruments to formulate the national agricultural policy. The main reason behind the research was the discussion on the need to change the current shape of CAP in the context of adequacy of its goals and instruments, and in the light of social expectations and the requirements of international competition. The economic effectiveness and legitimacy of various intervention and support forms was an important topic in the discussion, which mobilised those who challenge very sense of the CAP and triggered proposals of its total abolition referred to as renationalisation.

The current cost of CAP implementation is about EUR 55 billion per year and accounts for 40% of the total EU budget. In the CAP critics opinion this amount is regarded as high and spent rather ineffectively, especially compared to its alternative purpose, for example for research conducive to the innovative economy development. On the other hand, the CAP supporters argue that it accounts for merely less than 0.5% of the GDP in the EU, i.e. about EUR 2 a week per each EU citizen. There are also opinions that CAP has to be kept up and continued in a practically unchanged form because of its beneficial impact on the economic condition of agriculture and rural areas that is particularly evident in the new Member States, such as Poland.

The importance of our country benefits in the form of transfers under the CAP is mainly associated with the fact that almost 15% of the total employed are involved in agricultural activity which accounts for about 4% GDP. Therefore, the share of subsidies in the income of agricultural holdings (according to FADN) is approximately 50% on the average. The position of Poland on the CAP explicitly in favour of further financing this policy at least at the current level, adopted finally by the Council of Ministers on 12 June 2009, reflects the natural tendency to keep the benefits in the form of EU transfers. However, the presence and the future shape of CAP will be determined by the positions of all EU Member States, which may differ from ours.

The variety of views on the CAP usefulness in various significant opinion-forming circles is caused mainly by the diversified degree of social and political acceptance of the present situation in various countries (supporters and

opponents), and the national balance of costs and benefits (beneficiaries and payers) is of considerable significance in this respect. With regard to the unavoidable differences in the opinions on the CAP, its future shape may be expected to be determined by a range of opinions, from those in favour of maintaining the status quo, through proposals (more or less radical) of changes, to those justifying its abolition (renationalisation).

3.1. Prospects of CAP changes in the context of the shared game model

The evaluation of the impact of potential CAP changes primarily sought an answer to the question what is the likeliness of these changes and how far-reaching they might be. To this end, a mathematical model of a shared game developed within the framework of the research carried out on this subject. The main concept underlying the model is the divergence of interests between the parties (players) which leads to coalitions whose members (coalition members) commit themselves to represent common position by making the same decision to pass a specific draft policy.

The potential premises for divergence in the perception of costs and benefits associated with abolishment or continuation of the CAP in its present form are reflected by the data shown in Table 3.1. representing the socio-economic importance of agriculture and rural areas in the particular EU Member States. The data analysis leads to a key conclusion that the polarisation of interests in the debate on the CAP future is virtually inevitable. It is associated with the very diversified broadly defined socio-economic significance of agriculture and rural areas in the particular Member States.

Table 3.1. Data illustrating the significance of agriculture and rural areas in the EU Member States

Country	Share in GDP (%)[1]	Share in employment (%)[2]	Share of the employed in total population (%)[3]	Share in exports (%)[4]	Share of rural areas in total area (%)[5]	Share of rural inhabitants in total population (%)[6]	Share of utilised agricultural areas in total area (%)[7]
Austria	1.61	4.08	1.9	6.55	81.71	4.2	38.02
Belgium	0.81	1.53	0.6	8.26	46.03	1.5	45.02
Bulgaria	9.39	6.84	2.6	10.13	36.82	5.5	27.48
Cyprus	2.57	8.33	3.5	19.82	19.46	6.8	15.78
Czech Republic	3.01	8.40	3.9	3.80	63.81	7.0	44.61
Denmark	1.30	3.27	1.7	17.17	69.09	3.1	61.78
Estonia	3.34	12.02	5.5	8.26	26.93	10.0	20.02
Finland	2.92	4.71	2.2	1.86	18.70	4.8	6.77
France	2.18	2.82	1.2	11.11	45.75	2.6	43.42
Germany	0.85	2.20	1.0	4.88	52.32	2.0	47.41
Greece	4.50	16.18	6.4	18.90	33.37	11.3	30.89
Hungary	4.19	11.05	4.3	6.45	64.54	10.1	45.46
Ireland	1.71	7.99	3.8	9.35	63.25	8.6	59.30
Italy	2.08	4.64	1.8	6.43	59.21	4.2	42.29
Latvia	3.85	12.87	5.8	15.22	44.12	10.4	27.48
Lithuania	4.74	12.21	5.2	14.80	44.54	12.1	40.57
Luxembourg	0.45	1.55	0.6	4.59	53.41	1.7	50.61

Malta	2.06	1.35	0.5	6.84	36.96	1.2	32.69
Netherlands	2.05	2.64	1.3	11.68	49.94	2.9	46.08
Poland	4.51	27.69	10.1	9.41	57.88	16.7	49.50
Portugal	2.55	11.15	5.4	9.28	47.87	12.1	37.71
Romania	9.51	13.59	5.7	4.68	64.03	10.8	57.69
Slovakia	3.65	10.74	4.4	3.25	62.30	7.9	39.49
Slovenia	2.70	1.26	0.6	4.27	45.44	1.1	24.11
Spain	3.00	5.88	2.6	12.90	65.70	5.7	49.31
Sweden	1.07	2.97	1.4	3.80	16.01	3.0	7.06
United Kingdom	0.91	1.69	0.8	5.47	69.68	1.6	65.89
EU	1.86	6.27	2.7	7.69	48.91	5.3	39.16

Source:

1. *Gross value added (at basic prices), Agriculture, hunting and forestry, in Millions of euro (2005) / Gross value added (at basic prices) All branches – Total in Millions of euro (2005) (EUROSTAT: http://nui.epp.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do)*
2. *Economically active population in agriculture in total employment in % (2005) (GUS (Central Statistical Office) 2008: Statistical Yearbook of Agriculture and Rural Areas)*
3. *Economically active population in agriculture in total population in % (2005) (GUS 2008: Statistical Yearbook of Agriculture and Rural Areas)*
4. *External trade of food, drinks and tobacco, by declaring country; Exports in 1000 million of ECU/EURO (2008) / External trade, by declaring country, total product; Exports in 1000 million of ECU/EURO (2008) (EUROSTAT: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tet00002&plugin=1)*
5. *Farmland: Total area (2007) / land area (2007) (EUROSTAT: http://nui.epp.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do)*
6. *Agriculture population in total population in % (2005) (GUS 2008: Statistical Yearbook of Agriculture and Rural Areas) / Employment (2005) (EUROSTAT: http://nui.epp.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do)*
7. *Farmland: Utilised agricultural area (2007) / land area (2007) (EUROSTAT: http://nui.epp.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do).*

Different attitudes towards the CAP in its current form may also result from a given Member State situation – whether it is a net payer or beneficiary, and which part of the transfers is received under CAP. In the years 2007-2013, the group of net payers included 10 countries, and that of net beneficiaries – 17 countries (Poland being the largest among them). The countries which are net payers and do not benefit under CAP naturally oppose the policy, while the largest beneficiaries of the CAP defend it.[1] In such circumstances a considerable difference in positions on acceptable character and scope of the CAP changes should be expected. The above represents a natural tendency to form coalitions aimed at maintaining the *status quo,* abolishing the CAP completely, or adopting a compromise solution lying in-between the first two extreme measures.

Each coalition member negotiates bilateral agreements concerning the scope of costs to be incurred for the benefit of the other player and the scope of benefits to be obtained from the other player. The perception and estimation of costs and benefits depends the sectoral interest resulting mainly from the importance of agriculture and rural areas in individual Member States on the one hand, and on the general economic and political interest resulting from other national objectives beyond the sectoral perspective, on the other hand. The model obtained assumes that the benefits of one player are the other player's costs, and that the estimation of the value of costs and benefits meets two premises:

a) it is identical for each pair of coalition members, therefore all the estimations may be considered in terms of value for a potential beneficiary or in terms of value for a potential payer;
b) it is 'fair' in terms of monotonicity, that is, a higher value is represented by a greater amount (quantitative property) of better quality (qualitative property).

Let us assume that $\mathbf{A}_i = (A_{i1}, A_{i2}, A_{i3}, \ldots, A_{in})$ is the cost vector of the coalition member i for i=1, 2, 3, … , n, where 'n' is the number of coalition members. Let us also assume that A_{ij} is the cost incurred by the player i for the benefit of the player j to adopt a common position under the agreement negotiated. The set of vectors $\mathbf{A}_i$ shall be expressed as $\mathbf{A}_{n \times n}$ and referred to as the Cost-Benefit Matrix (CBM) where:

[1] The Common Agricultural Policy reform orientation within the framework of the review scheduled for the years 2008/09 – the Polish point of view. Consultation paper prepared by the Foreign Agricultural Markets Monitoring Unit of the Foundation of Assistance Programmes for Agriculture (FAPA) in collaboration with the Department of Analyses and Strategies of the Office of the Committee for European Integration (UKIE), http://www.fapa.com.pl/gfx/saepr/dokument_konsult_na_www.pdf.

$$A_{n\times n} = \begin{pmatrix} A_{11} & \cdots & A_{1n} \\ \vdots & \ddots & \vdots \\ A_{n1} & \cdots & A_{nn} \end{pmatrix}$$

For CBM matrix the total cost incurred by one coalition member for the benefit of other coalition members shall be:

$$\mathbf{C_i} = A_{i1}+A_{i2}+A_{i3}+\ldots+A_{in}$$

Similarly, the total cost incurred by other coalition members for the benefit of the coalition member *i* shall be:

$$\boldsymbol{B_i} = A_{1i}+A_{2i}+A_{3i}+\ldots+A_{in}$$

The basic properties of CBM matrix are as follows:

a) diagonal matrix values equal zero (as a rule, the coalition member does not pay anything to himself);
b) the sum of matric values in row *i* equals $\mathbf{C_i}$ (costs);
c) the sum of matric values in column *j* equals $\mathbf{B_i}$ (benefits);
d) the sum of all $\mathbf{C_i}$ equals the sum of all $\mathbf{B_i}$.

In order to reflect the negotiation process let us assume that:

a) the coalition member *E* is the sole holder of a resource *e*, the coalition member *F* is the sole holder of a resource *f*, the coalition member *G* is the sole holder of a resource *g*, and the coalition member *H* is the sole holder of a resource *h*;
b) the beneficiaries want to acquire resources *e*, *f*, *g* and *h*;
c) each potential payer *E*, *F*, *G*, *H* sets out specific conditions which have to be satisfied in order to have access to the resources reserved under the exclusivity right;
d) Payers conditions depend on other fulfilled preconditions so that the second condition will be satisfied if the first condition is met; analogically, the third condition depends on the status of the second one, while the first one depends on the status of the last one.

This leads to situations that could be referred to as deadlocks. The deadlocks may be of two types:

a) short-term deadlock (the beneficiary considers one draft policy and does not take other coalitions into account);
b) long-term deadlock (the beneficiary participates in diverse coalitions – in one of them the cost-benefit balance is positive, in another one this balance is negative, and yet in another one it may be zero).

If the CBM matrix is approached solely as a matrix of mutual liabilities and receivables, it may be subject to the reduction procedure. In order to do that,

for each coalition member the value of $\mathbf{B}_i$ - $\mathbf{C}_i$ should be calculated, next, the coalition members should be arranged in the order of $\mathbf{B}_i$ - $\mathbf{C}_i$ value. A given coalition member is considered:

- a ‘payer’, if $\mathbf{B}_i$ - $\mathbf{C}_i < 0$;
- ‘neutral’, if $\mathbf{B}_i$ - $\mathbf{C}_i = 0$;
- a ‘beneficiary’, if $\mathbf{B}_i$ - $\mathbf{C}_i > 0$.

It should also be noted that the sum of costs borne by the ‘payers’ is equal to the sum of benefits received by the ‘beneficiaries.’ The calculation algorithm of the model consists in that a reduced cost-benefit matrix (RCBM) is built up according to the rule that the ‘largest beneficiary’ receives the transfer from the ‘largest payer’ (the rule is repeated until all the receivables of the beneficiaries are financed by means of all the liabilities of the payers). Zero value is assigned to the remaining RCBM elements. The CBM and RCBM matrices are equal in terms of balance, the only omitted information concerns the ‘equivalent transactions’ concluded as a result of coalition agreements.

The RCBM matrix has the following properties:

a) the row and column for the ‘neutral’ coalition member contain zeros only;
b) the ‘payer’ does not obtain any benefits;
c) the ‘beneficiary’ does not bear any costs.

Non-zero elements of RCBM matrix represent the short-term deadlocks. If $p>0$ is assumed to be the number of ‘payers’ and that $b>0$ is the number of ‘beneficiaries’, we obtain:

$$2 \leq p+b \leq n.$$

In other words, if there is at least one payer, there is also at least one beneficiary.

Let us assume that the set $\mathcal{ZK}$ is composed of elements consisting in pairs of indices (i,j) of the RCBM matrix such that A_{ij} is the element of the RCBM and $A_{ij} > 0$. It can be readily noticed that the number of elements in $\mathcal{ZK}$ satisfies the following inequality:

$$b \leq |\mathcal{ZK}| \leq p \cdot b,$$

where: | | refers to the cardinality of the set.

If we assume that X_{ij} is a Boolean (binary) variable associated with A_{ij} of the RCBM matrix so that (i,j) is an element of $\mathcal{ZK}$, and then X_{ij} has the value of 1 (truth), whereas otherwise its value is 0 (false), the following conclusion regarding the short-term deadlock may be made in the form of the following Boolean expression:

$\forall$ (i,j) of the element of $\mathcal{ZK}$, $X_{ij} = 1$.

The fulfilment of this condition is tantamount to the conclusion that the debated draft CAP will be accepted if each deadlock is realised.

Assuming that RCBM becomes open to the public, a number of produced draft policy versions should be taken into account as both the supporters and the opponents of the current version of the RCBM will try to conclude new bilateral agreements. Assuming that *k* versions are produced, after the negotiation period an $RCBM_k$ will be created for each version where $k = 1,2,3,..,K$. The analysis of the set of all $RCBM_k$ may allow predicting a probable solution. Namely, a version of the draft policy will be adopted for which the number of coalition members is sufficient to achieve majority, the total value of benefits is the lowest, and the number of payers is the highest. It means that each payer chooses the most advantageous version to have the lowest possible liability, and each 'beneficiary' wishes to keep the *status quo* or at least to gain as much as possible. The simulations carried out with the model show that a compromise draft policy will be elaborated and adopted with the support of the coalition constituting the current RCBM. Furthermore, it was found that the probability of CAP changes is characterised by variation in time which depends on the dynamics of the configuration of powers and economic and political interests (pressure for change and resistance to change), and the dependence on the possible scope of changes (relatively low possibility of no changes or radical and far-reaching changes).

3.2. Results of the analysis of potential effects of CAP changes using the AGMEMOD model

This section presents evaluation of the effects of CAP changes resulting from the Health Check (HC), and evaluation of the impact of possible abolition of direct support for agricultural producers, carried out with the use of the AGMEMOD partial equilibrium model. The first evaluation is set in the reality, while the second one (abolition of payments) is a potential or hypothetical. Research results are intended to provide a quantitative evaluation of the impact of the CAP changes on the balance items (production, consumption, foreign trade) of individual agricultural products and their prices. It should be borne in mind that these results depend to a considerable extent on the adopted research method and type of instrument used.

The AGMEMOD model is an aggregate model of EU agriculture, being a combination of various Member States models and developed under the 5th and the 6th Framework Programme of the European Union. The national models are made up of sub-models for individual markets. The modelling covers the most important markets: cereal, oil bearing and root plants, milk and dairy products as well as meat. The structure of the AGMEMOD model has been designed to let it function as an instrument for the simulation of the agricultural sector behaviour, both for a given Member State and for the whole EU.

The AGMEMOD model can be briefly characterised as an econometric, dynamic, multi-product partial equilibrium model, comprising international links, where the results obtained at the local level are aggregated at the level of the EU regions or the whole EU. At the national level sub-models of each agricultural market are dynamic partial equilibrium models made up of the supply and demand elements, prices and the international trade relations. Apart from the endogenous variables, the model comprises also exogenous variables such as GDP, inflation rate, exchange rates, number of population, world prices, key prices, agricultural policy instruments (for example intervention prices, value of direct payments, production quota, variables referring to the trade policy, such as export subsidies etc.).

The AGMEMOD model involves interactions in two contexts: the regional context (among the states) and the context of products. Interactions among individual product markets within one country take place through substitution or complementarity of production or consumption.

The assumed regional relations between the states affecting the results obtained allow considering the analysed country as an open economy not isolated from the rest of the world and constituting an element of a larger entirety. Such approach is important both in the context of the analysis of effects of CAP changes and in the situation of progressing integration of the national markets with the European market. The model covers also the impact of the world markets on the situation in the EU agri-food sector, mainly through the prices. The process of modelling prices and their transmission among the markets is carried out in two stages. First, a price is determined on the so called EU key market (in one of the EU countries). The prices of a given product in particular Member States are related with it. The key price is based on the assumption of the so called “small country” and depends on the internal supply-demand relations, world prices and the agricultural and trade policy variables (CAP, WTO).

The analysis has been based on the research assumptions for exogenous variables (identical for all scenarios) and assumptions for the trends in the CAP changes that determine the nature of the considered scenario. Exogenous vari-

ables have been assumed on the basis of forecasts and projections developed by OECD, FAPRI, European Commission, statistic bodies and ministries of particular countries etc. The projections of the Polish GDP changes assume that its dynamics will fall to 1.1% in 2009, to 2.2% in 2010 and afterwards it will oscillate between 3.3% and 4.5%. The exchange rate has been assumed at the constant level of EUR/PLN 4.43. The world prices of the agricultural raw materials have been assumed according to the FAPRI forecasts from the first half of 2009.

The projection assuming changes of the CAP instruments determined during the November 2008 HC has been compared to the projection assuming maintaining the CAP status quo established before the HC arrangements came into force. The comparison was made as a part of the evaluation of the CAP HC impact on the Polish agricultural sector. The most important modifications of the agricultural policy instruments refer to further decoupling of direct payments (in the case of payments under SPS), increase in modulation level, abolition of the obligatory set aside in the countries where it has been applied to date, and gradual reduction of the milk quota leading to its final abolition. In its present shape, HC is a part of the CAP development tendency observed since the eighties on the one hand, and on the other hand it is meeting halfway challenges of the international marked and the changing global conditions. HC proves that the modifications of the EU agricultural policy are put in place consequently and that they are of evolutionary and gradual nature.

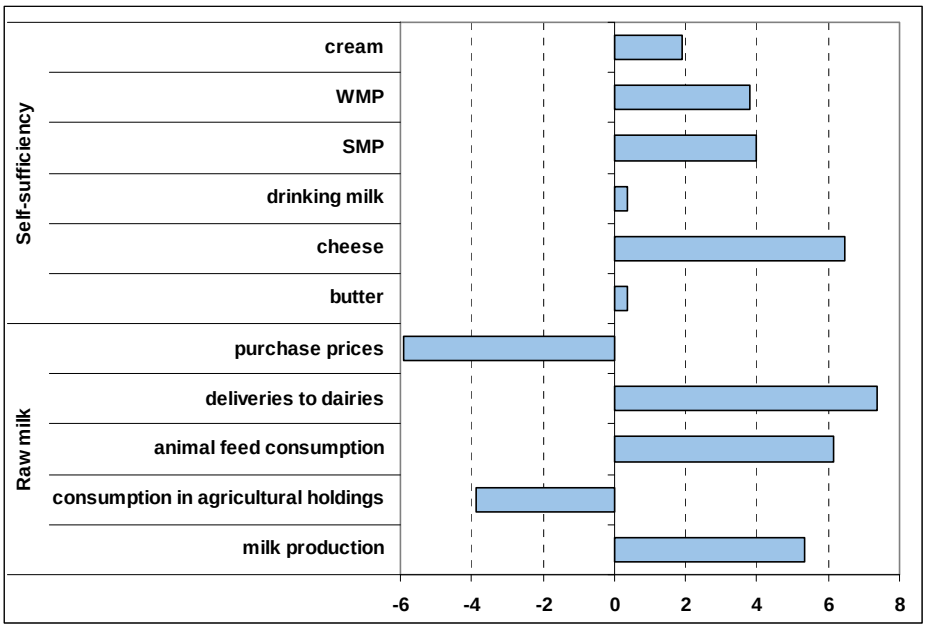
Apart from the evaluation of the HC impact, the research was intended to identify the impact of potential abolition of direct payments under the SPS and SAPS on the prices and volume parameters of the Polish agricultural sector. To this end, two scenarios of potential abolition of direct payments have been assumed. According to the first one ("one-time abolition") the total abolition of the support would be carried out in 2015. According to the second one ("linear abolition") the support would be gradually reduced from 2015. In 2020, the support would be zero. A quantity evaluation covers the comparison of the results of the above scenarios with projections obtained on the basis of the HC scenario. To simplify the diagrams only the differences between scenarios for 2020 are presented.

Results of the simulation carried out with the use of the AGMEMOD model indicate that the impact of CAP changes as determined under HC on the supply-demand structure of the main agricultural markets in Poland will differ, depending on the analysed market. The HC was only supposed to correct the 2003 reform. SAPS applied in Poland is largely in line with the CAP goals, as it involved practically a total decoupling of payments from the very beginning. Potential impact of changes in the modulation rate approved under the HC also

seems insignificant due to the structure of Polish agricultural holdings. The national agricultural markets can be indirectly affected by the changes on the community market following the modification of the agricultural policy in other EU countries.

The most significant modification of regulations under the HC occurred in the milk market and was associated with the gradual increase and subsequently abolition of milk quota. Its effects are visible not only in the milk and dairy products market, but also in other markets in consequence of the changes in demand for feed and in supply of meat. Simulation with the use of AGMEMOD model shows that the reform may lead to an increased milk production (by approximately 5.4% in 2020), in purchase volume and in consumption decline in agricultural holdings (Fig. 3.1). As a result, the production of dairy products may increase, their prices may drop while the national consumption may increase. As the consumption rate is estimated to grow slower that the production, an increased self-sufficiency should be expected.

Figure 3.1. Impact of the Health Check on the milk sector in Poland in 2020 (%)

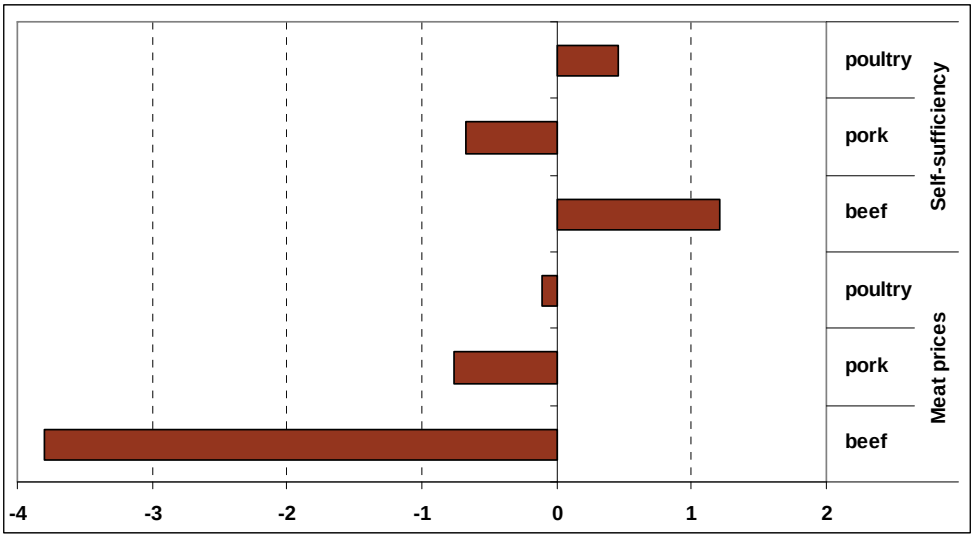


Source: calculations based on the AGMEMOD model.

Changes in the meat market can be a direct consequence of this change in the milk market (Fig. 3.2). They will be visible in the beef market in the first place, because an increased quantity of raw material for meat production is expected following an increase in the number of cattle. Thus, the production of beef and veal can grow by about 4% and the prices may drop by 3.8%, as a result of the reform. The reduction of prices will also allow increasing national consumption of this type of meat by over two percent. Other meat markets,

mainly pork and poultry market, may experience a slight production drop following HC, mainly because of a drop of prices.

Figure 3.2. Impact of the Health Check on the meat sector in Poland in 2020 (%)



Source: calculations based on the AGMEMOD model.

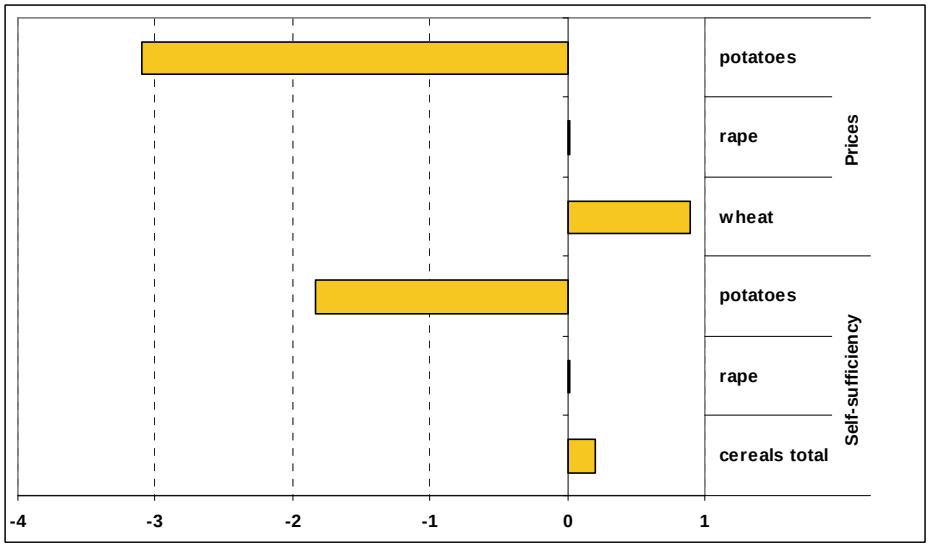
In the case of plant product markets, changes in production and consumption resulting from HC are very small because the reform does not affect the conditions in these markets in Poland. Lack of changes in the direct payments scheme and in the rate of coupling the support with production, as well as introduction of modulation calculated according to the new scheme do not trigger changes in the level of total cereal production (Fig. 3.3). Slight differences may occur in the case of particular cereal species (for example wheat production growth by 0.4% or drop in maize production by 0.9%). However, they are rather caused by price changes in the community market. A slight decrease in the national consumption of cereals (by about 0.1%), and consequently a reduced feed consumption (by about 0.2%) can be expected, resulting from changes in the production structure in the animal market (more cattle and less pigs).

Consequences of HC for the rape market are a little more significant than those in the cereal market (production drop by about 0.4% and decrease in the national consumption with no change in prices). Because of the expected changes in the market of products of animal origin, the use of extracted rapeseed meal for feed may drop by about 1%.

The HC impact on the potato market can be more significant than in the case of cereal market. HC target is to abolish the support for potato starch production. Therefore, the production of potatoes in 2020 can drop by about 1.1%, while the expected increase in demand is about 0.8%. Following an uneven rate of production and consumption changes, the indicator of self-sufficiency may

fall to about 1.8% in 2020. The main reason for these changes would be an expected relatively considerable drop in prices (by about 3%), resulting from the changes on the EU market in the first place.

Figure 3.3. Impact of the Health Check on the plant sector in 2020 (%)



Source: calculations based on the AGMEMOD model.

Since the possibilities to assess accurately the costs of production in particular sectors of agriculture under the AGMEMOD model are limited, no analysis of the impact of HC on the agricultural producers' income has been carried out. However, according to calculations based on the FAPRI model, in which the assessed price and quantity implications of the milk quota abolishment are similar to those under the AGMEMOD model, the potential income decrease in the Polish agriculture is assessed as about 2%, and 5% for farmers producing milk. The reduction of agricultural income can be particularly strong in the regions and agricultural holdings specialised in milk production.

For other production types it should be expected that income will decrease where the prices of goods drop, and this drop is not compensated by an increase and lower costs of production. It is true for the beef, veal and potatoes markets. Due to the falling prices and decreasing production, farmers' income may also be reduced in the pork market, although, due to the diversified changes of prices of feed components, it is difficult to guess what the final tendency of income change will be. However, because of the growing prices of the majority of cereals, it can be expected that the farmers producing them will experience a slight growth of their income. Thus, it can be assumed that some agricultural producers will lose, and other will benefit as a result of the HC.

Apparently, the consumers will gain the most significant profits from the HC. Consumers are often the greatest beneficiaries of the economic policy liber-

alisation that is usually accompanied by the falling prices. Since it is not possible to carry out a comprehensible analysis of changes in social welfare, it is difficult to assess unambiguously what the balance of losses and gains at the level of the entire society will be.

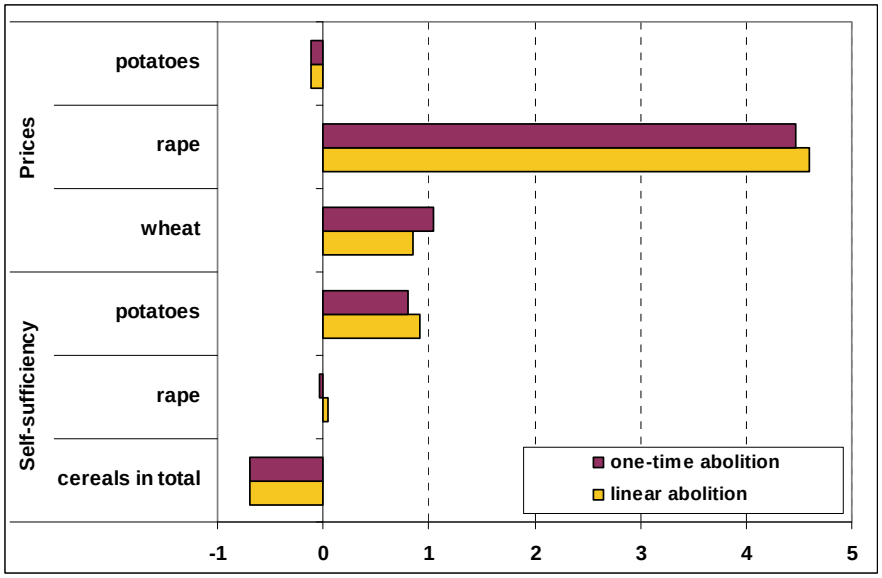
Based on the comparison of the simulation results and the situation on the agricultural market in recent years, it can be expected that, in the face of progressing globalisation, the changes of instruments of the EU agricultural policy will have much less impact than the world supply-demand situation and its price consequences. The role of the European Union, and the role of Poland all the more, remains limited in many world markets of agricultural raw materials. However, it should be emphasised that the changes introduced are an important and comprehensible signal of the CAP development tendency, although the expected response of the Polish agri-food markets to the HC approval is limited. This means that the producers should make their decisions increasingly taking account of the national and international market situation.

The analysis indicates that the potential abolition of direct payments can lead to the change in the supply-demand structure on agricultural markets, as in the case of HC. However, these changes can differ in terms of scale and tendency, compared to the effects of HC implementation. The main reason of the observed differences is the nature of the CAP modification. The most important adjustments of the agricultural policy instruments under HC related to the market of milk and dairy products in the first place, and they affected the markets of meat and plant production in the second place. The abolition of direct payments in Poland will affect mainly the markets directly connected with the land. This is the case of the plant sector and, consequently, of the cereals, oil-bearing and other plants markets. Some direct effects may also occur in the market of animal products as a result of abolition of subsidies to grassland and pastures, but the majority of these changes in the meat and milk market would be secondary, and their extent would be much smaller (Fig. 3.4, 3.5, 3.6).

It can be predicted that as a result of direct payments abolition, the cereal production will be reduced by 0.6-0.7% on average during the 2014-2020 period. The most significant decrease in production may take place in the case of rye, barley and wheat. On the other hand, production of rape and potatoes is expected to rise (by 1.1-2.0% and 2.0-2.6%, respectively). An increase in national prices of the majority of plant products, resulting mainly from HC effects at the EU level, can partially alleviate the negative impact of the subsidies abolition on the farmers' income per production unit. However, the reduction of the cereal sowing area could conduce to certain crops intensification, which could also be enhanced by the price growth referred to above. The area reduction could be the

case mainly for smaller agricultural holdings, which have limited possibilities to improve their production effectiveness. It is expected that in the case of direct payments abolition the total national consumption of cereals would remain at the level similar to that from the HC scenario, and the consumption in the market of potatoes and rape could rise.

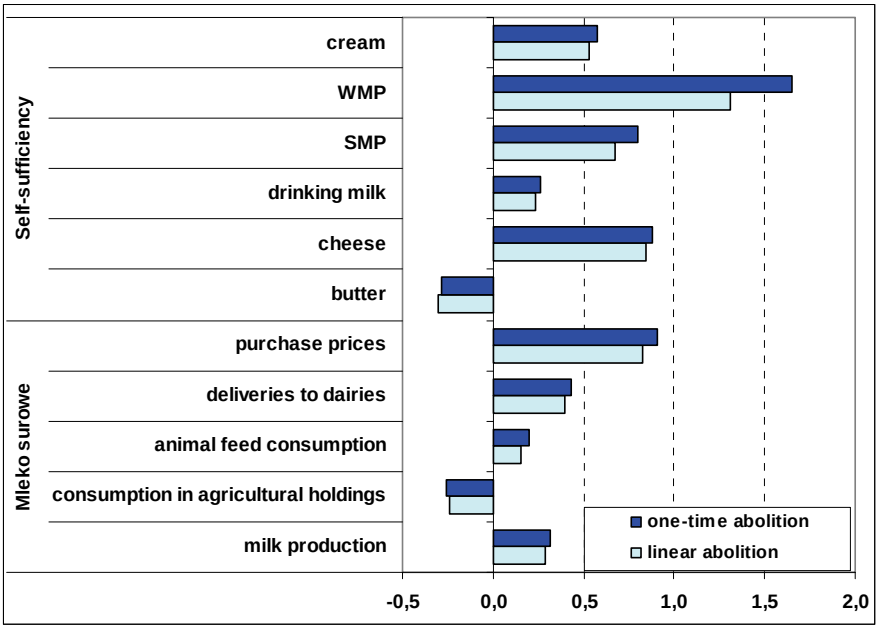
Figure 3.4. Impact of potential abolition of subsidies on the plant sector in 2020 (%)



Source: calculations based on the AGMEMOD model.

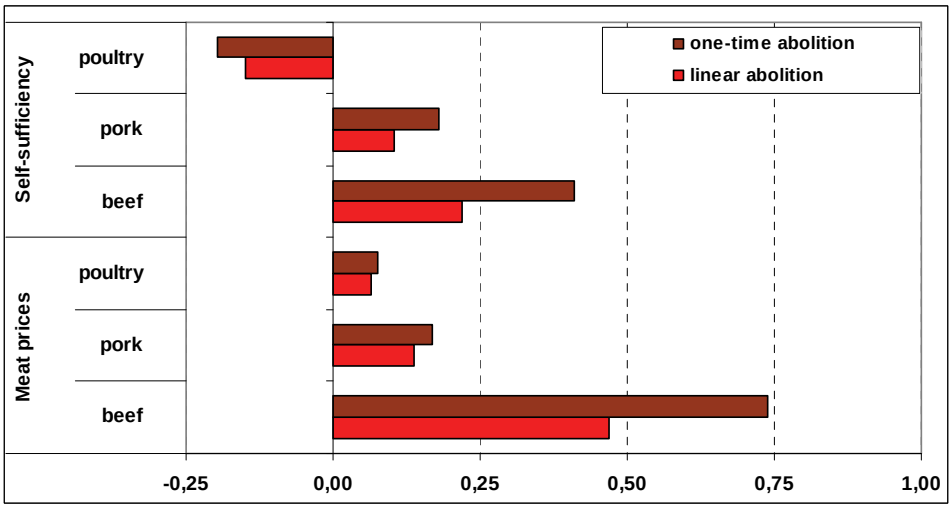
Potential changes in animal production sector are smaller by one order of magnitude than those in plant production sector. A slight increase in production may be expected in 2020 for pork (by 0.1-0.2%) and raw milk (by about 0.3%) and, consequently, also in the majority of dairy product markets. A small decrease in production should be expected for beef and poultry meat (by 0.1-0.2%). The changes in supply and demand proportions in the EU market may lead to an increase in national purchase prices of live animals and milk as it is the case of the plant sector. As a result, the consumption of dairy products as well as beef and pork may fall. A slight increase in poultry consumption may be a result of a relatively smaller increase in its prices and of the effect of substitution between various types of meat. The impact of the subsidies abolition on the sheep sector should also be mentioned. Since the production is carried out mainly on the less-favoured areas (LFA), it is strongly dependent on the amount of direct payments. If they are to be abolished, the self-sufficiency (and thus the production of mutton) in 2020 could be even by 7-10% lower than in the HC scenario.

Figure 3.5. Impact of potential abolition of subsidies on the dairy sector in 2020 (%)



Source: calculations based on the AGMEMOD model.

Figure 3.6. Impact of potential abolition of subsidies on the meat sector in 2020 (%)



Source: calculations based on the AGMEMOD model.

Results of the simulations show that the changes of the majority of variables describing agricultural markets would be less significant in the case of linear abolition than in the one-time abolition scenario. One-time abolition of subsidies in 2015 could trigger a more rapid and stronger response in many markets during the first years after the CAP modification. In the longer perspective, however, its effects could be mitigated, and the final scale of changes would be similar to the effects of linear abolition in many cases. In other words, a CAP

reform consisting in one-time abolition of subsidies would spell relatively rapid market adaptations, and subsequent search for new, more effective equilibrium.

3.3. Results of the analysis of Poland's accession to the EU using the MODROL model

MODROL is an econometric model of main Polish agricultural markets created by the Systems Research Institute of the Polish Academy of Sciences, Warsaw, at the request of the Institute of Agricultural and Food Economics, National Research Institute, in order to analyse the impact of particular economic policy instruments, including CAP, on the Polish agriculture outcomes. These outcomes primarily include prices and volumes as well as economic results achieved by Polish agricultural holdings in the context of the Polish agricultural sector development prospects. Thus, the MODROL model may become a useful tool for the analysis of agricultural policy options carried out from the point of view of reasonable arguments which provide a basis for the Poland's position in negotiations on the future shape of CAP.

MODROL addresses basic economic mechanisms which affect agricultural production volume in Poland, mainly through prices, demand and economic policy instruments as well. There is no intention to perceive agriculture and the relevant variables as a homogeneous aggregate, since certain product disaggregation of the model has been assumed. MODROL is a bottom-up built system, i.e. starting from the models of major agricultural markets. This approach allows taking into account both basic domestic and external supply and demand balances in the Polish agriculture. Co-existence of substitutability and complementarity along with vertical relations impose an assumption of appropriate links between the markets. Furthermore, the particular markets show specific characteristics associated with the production system and demand side characteristics (volatility of consumer preferences, substitutes).

The basic relationships are as follows:

a) Demand for the Polish agriculture products is generated both by the domestic and foreign operators;
b) Domestic operators' demand also turns towards abroad because other countries constitute a competitive supply source;
c) Preferences and price relations are the decisive factor behind the structure of purchases made in Poland vs. abroad;

d) Demand is also affected by the economic policy instruments (domestic policy and CAP);
e) Domestic supply is targeted at Poland and at other countries, but preferences and price relations are the decisive factor behind the structure of sale;
f) Production, consumption, exports and imports affect changes in reserves.

In the MODROL model the impact of economic policy on the Polish agriculture is taken into account through changes of these policy parameters which directly affect the particular economic categories. The subsidies (which do not directly affect consumers) received by the producers are taken into consideration in two stages in modelling. First, the effect for an effective price paid to producers is calculated. The consequences of the effective price changes generated by argument changes in the supply function are reflected (with appropriate delay) by the income level. The model also takes into consideration the income-related effects of changes in direct costs (fuel, feed, fertilizers) and the results of changes in subsidy amounts based on the effective prices paid to the producers, though incorporation of these effects into the model requires a preliminary estimation of the relative change in direct costs and the relation of changes in the costs to the price obtained by the producer.

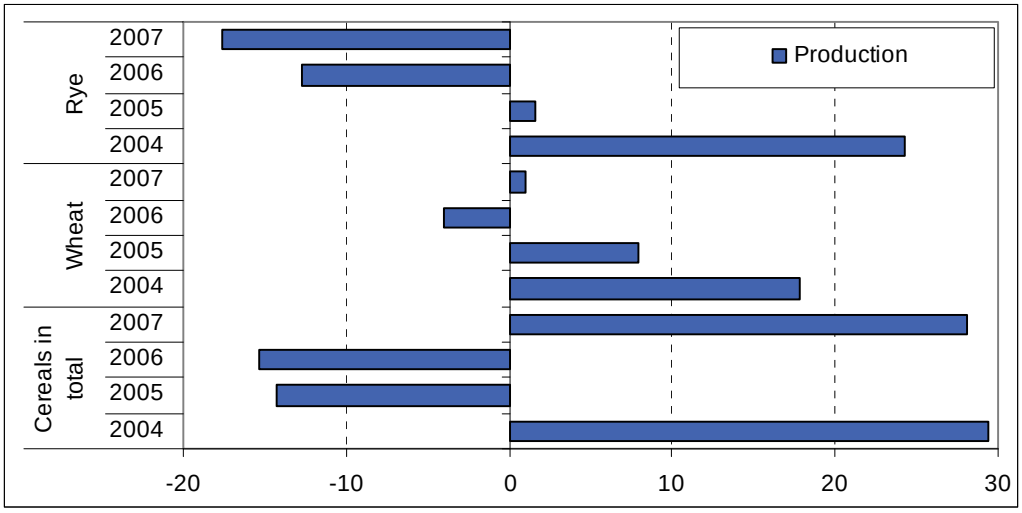
Inclusion of agricultural policy instruments in costs as the factors which reduction these costs is not a technical measure only, but at present is simply more realistic (although not entirely). It should be noted that in the majority of cases, analysis of subsidies in terms of income may be placed in any place of the income expression, because we actually consider subsidies as a separate financial flow virtually independent of all other economic factors. At the present stage of work the model takes into consideration only direct payments and other instruments which may be considered financial flows that make up current revenues of agricultural holdings in a business year. At the first stage of modelling simple partial models were obtained which were correct in terms of their technical interpretation. At the second stage, the role of agricultural policy instruments, mainly direct payments, was evaluated.

The analysis results show the impact of agricultural policy change following Poland's accession to the European Union on the selected sectors of the Polish agriculture. This was an ex-post analysis, but in a sense it can be considered a counterfactual analysis because its core simulations were intended to capture the difference between output volumes and purchasing prices following the EU accession and with a hypothetical assumption that the accession did not take

place. The results do not cover all markets under analysis as emphasis was placed on the markets with more significant dynamics and dependency on agricultural policy instruments.

On the one hand, the accession of Poland to the European Union led to opening of the EU market to Polish products and, on the other hand, a wide range of agricultural producers obtained access to direct payments. While the former effect impact was not so radical for the cereals market, the direct payments fundamentally changed the producers' income and led to an increase in cereals production. Analysis of the cereals production volume in Poland following accession to the EU shows that in the years 2004-2007 cereals production was considerably higher than it would have been without accession (Fig. 3.7). The difference is approximately 7%, the production cereals after the accession being considerably higher in 2004 and 2007, and in the years 2005-2006 lower than it would have been without accession.

Figure 3.7. Impact of Poland's accession to the EU on cereals production volumes [%][2]



Source: based on the results of calculations obtained using the MODROL model.

The results of the simulation for the period under analysis indicate that direct payments are an important determinant of farmers' decisions to take up cereal production. It may not be clearly concluded whether the cereals production fluctuations would be lower in a closed market than in the opened market. How-

[2] Calculated according to the following formula: *Difference = (Actual production – Production without integration)/ Actual production * 100.*

ever, the differences show other producers' reactions to prices in the past. Considering the results of simulations, we must bear in mind that the cereals supply equation was estimated for production, not for crops, therefore, it does not take into account the important factor of yield level. Having taken the adjustment into account, the integration effect would be considerably lower (in proportion to the changes in cereals yields) in particular years.

The research also attempted a partial disaggregation of products in the cereals market model by analysing the market of wheat and rye separately. Despite a positive impact of accession on the production in the years 2004-2007 (wheat and rye production increased by 6.6% and 1.5%, respectively), the particular markets reacted slightly differently. In wheat sector, the impact of the EU accession on domestic production level was diminishing. While in the first post-accession years the subsidies were an important factor behind any production-related decisions and were pushing up the production, in the subsequent years they lost their appeal. In rye sector, the production considerably increased in 2004 following Poland's accession to the European Union, however, 2005 saw a significant weakening of the positive integration effect, and the effect turned out negative in the years 2006-2007. Thus, in 2007 production of rye without Poland's accession would be 17% higher than the actual production. This tendency was partially backed up by low yields of rye production as compared to other crops and sooner abandonment of its production. The policy of afforestation of arable land under EU programmes implemented in the framework of RDP and the resulting changes in the use of poor quality land in Poland have also certain influence.

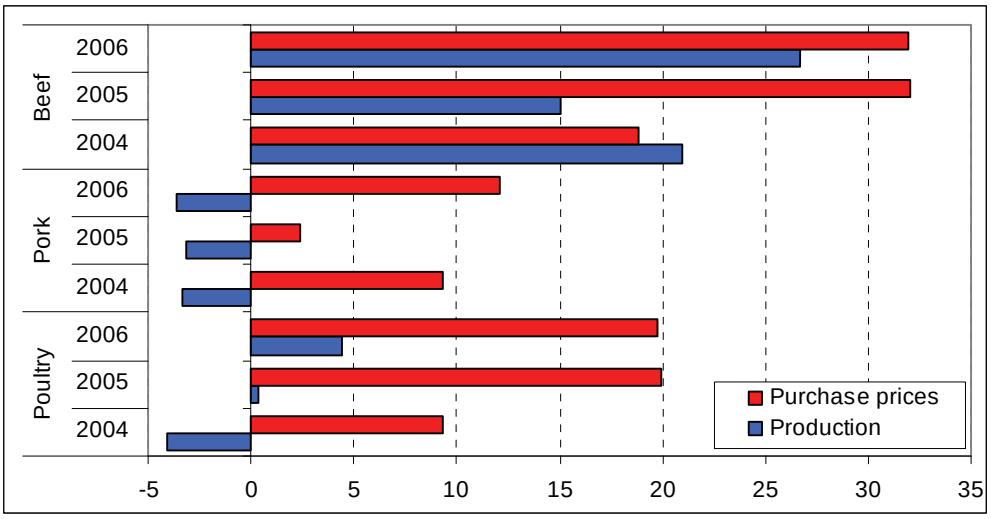
Because of statistical insignificance of the accession impact on the cereal prices, the revenues of cereal producers (in other words, the size of the sector in Poland) are proportional to the production volume in the framework of the estimated models. Because of the direct payments, Poland's accession to the EU led to a considerably higher increase of the cereal producers' income rather than to an increase in market revenues or production volume.

Results of for cereal markets estimation show high dependency of production volumes on agricultural policy instruments (direct payments). This relation is an evidence of the significant role that the instrument plays in increasing agricultural income as well as production. To some extent this is, contrary to the idea behind making this form of support to European agriculture conditional on production volume.

The estimations also allowed evaluating the impact of Poland's accession on the Polish poultry, pork and beef markets, i.e. on the production volumes and purchasing prices. In general, accession brought an increase in revenues generated by those sectors (Fig. 3.8). It should be noted, however, that in case of meat markets the impact of accession is obviously largely connected with full access to the EU market and its specificity rather than with instruments such as direct payments.

According to the results of calculations carried out using the model, poultry purchasing prices are almost 20% higher on the average as compared to the scenario of non-accession. This fact also translated into increase in poultry production. As a result, an increase in the producers' revenues following the accession being a derivative of changes to the product of prices and production amounted to 5% in 2004 and approximately 23% in 2006.

Figure 3.8. The impact of Poland's accession on livestock production and purchasing prices [%]



Source: based on the results of calculations obtained using the MODROL model.

Similarly to the poultry market, also the pork market was analysed from the point of view of Poland's accession. According to the calculations carried out using the model, the accession resulted in the increased pork purchasing prices in the years 2004-2006. It is surprising considering the strengthening of the zloty at that time.

According to the model, the accession also resulted in a decrease in production by approximately 3.3% in the years 2004-2006 as compared to the scenario of the inaccessible EU market. The result seems correct considering the decline in the number of pig population and higher competitiveness of foreign

operators. The revenues of pig producers (the pork sector as a whole), which are a consequence of changes in prices and the production volume, increased by about 4.8% on the average following the accession.

Although in the case of beef it was expected that the impact of direct payments would be higher, the economic situation of this sector also was influenced to the greatest extent by the very opening of the European market. The impact has been clearly visible since 2003. As shown by the results of calculations carried out using the models, the influence in qualitative terms is different than that exerted on the market of live poultry and live pigs. Against this background, the beef market depended on external stimuli to a greater extent. It was mainly due to the fact that domestic producers seized new export opportunities stimulated by considerable differences in prices.

Poland's accession to the EU resulted in a sudden and considerable increase in the prices of live bovine animals by approximately 50%. In the two first years of the EU membership of Poland, the price increase resulted in an increase in the number of bovine animals purchased, particularly in an increase in the weight of slaughtered animals, thus translating into higher production. Changes in the volume of beef production were also attributed to structural changes in the milk production sector, particularly to milk production abandonment by the smallest holdings as they were unable to meet the requirements of the EU market. Considering the relative increase in market revenues of the sector as a whole that was higher than the price increase, beef producers can be considered those who benefited from Poland's accession to the EU to the greatest extent among all Polish agricultural producers.

3.4. Results of analysis of potential effects of changes to CAP using a DSGE structural model of the Polish economy

Taking the Polish economic reality into account, an attempt was made to use the DSGE structural model of the Polish economy to evaluate the impact of significant changes in agricultural policy along with macroeconomic factors on the agri-food sector.[3] The analysis focused particularly on the effects of consid-

[3] The detailed theoretical and technical description of the model along with the results of simulations is provided in the paper by M. Bukowski entitled *DSGE Model As a Tool to Sup-*

erable reduction of direct payments in agriculture as well as the impact power of the following macroeconomic supply and demand shocks on the sector and the economy as a whole:

a) Exogenous price shocks triggered by changes in the prices of agricultural commodities on global markets;
b) Changes in the costs of production (e.g. the prices of energy and fuels);
c) Supply and demand shocks that impact exchange rates and interest rates.

The basis for particular simulations consisted in a multi-sectoral DSGE structural model of the Polish economy, calibrated directly on Polish data and adapted specifically for the purpose of the analysis. It was devised by the Institute for Structural Research (IBS) in Warsaw. As the model is based on microeconomic foundations, the behavioural formulas it comprises directly result from solving a complex of dynamic optimisation problems, with restrictions that describe the behaviour of operators (households and commercial companies) in the conditions of uncertainty. According to DSGE assumptions, operators make economic decisions by maximising the discounted expected utility or the discounted expected profit against their own multi-period budget restrictions and their knowledge on the economy as a whole, including on the types of decisions made by other parties to exchange, restrictions and principles defining government policy, the conditions in which particular markets clear, etc. As a result, the multipliers that measure the strength of response of the economy to macroeconomic shocks as well as fiscal multipliers connected with the agricultural policy, e.g. the direct payments scheme, are estimated by DSGE models much more precisely than by other types of models.

In line with the main trend of macroeconomic methodology, the model has been formulated on the assumption (which simplifies reality) that the companies that operate in the selected sectors and households are identical (e.g. as to individual preferences, sectoral production technology, etc.). The assumption allows substituting total households with one representative and the total population of companies by one representative company (for each sector separately).

The model distinguishes between six production sectors: the agri-food sector (AGR), transport sector (TRN), power and heat sector (ENG), fuel sector (FLS), services sector including construction but excluding transport (SRV), in-

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port Formulating Agricultural Policy Assumptions, prepared in the framework of research conducted on the issue.

dustrial production excluding energy, production of food and beverages (IND). The goods produced by these sectors are called consumer staples. In each of these sectors, a company with certain monopolistic power produces the given good and sells it at a specific price. In the production process, the company uses capital, labour and raw materials. The company is also a VAT and CIT payer. The function of objective is to maximise the expected discounted cash flow from production.

The goods manufactured by consumer staple companies can be sold within the country or exported. Sectoral trade companies that maximise one-period profit assume the role of the intermediary. A trade company operating in the given sector sells its product to companies which produce a final product (final demand), to companies which produce a consumer staple (intermediate demand) and abroad. Sectoral aggregates are used for production of final goods. The model distinguishes between three types of such goods: consumer goods (CNS), investment goods (INV) and government goods (GOV). Consumer goods are purchased by households and used for individual consumption. Investment goods are purchased by production companies that participate in capital accumulation. Public goods are purchased by the government and thus generate public consumption. In the model, the government's revenues come from the tax on consumption (VAT), corporate income (CIT) and labour (PIT), as well as from the sale of bonds. Then, the revenues are used for public consumption, transfers to households and debt repayment.

The market equilibrium condition also translates into the need to balance supply and demand on product markets, labour and international trade. Equilibrium on the product market in the primary sector means that the demand for its output from the trade company which acts as the intermediary for selling consumer staples within the country and abroad must equal the production volume. The trade company sells its products in the sectors which produce final goods (final consumption), primary sectors (intermediate consumption) and foreign companies (exports).

Equilibrium must also extend to markets of final goods, i.e. demand for projects must equal the supply of an investment good, and public consumption must be balanced with the supply of government good. Equilibrium in the consumer good market is automatic when it is assumed that its price constitutes a reference point for other prices in the model (the so-called *numeraire*) and thus equals 1. Total profit transferred from the companies to the households is equal to the sum of profits of all companies. It is also assumed that the global prices are established in units of the consumer good which serves as the *numeraire*,

which determines other relative prices in equilibrium. Equilibrium on the product market is compounded by equilibrium in the open economy.

A general form of macroeconomic and fiscal shocks implemented as first-order autoregressive processes was assumed for the model. The model is parameterised on data. Similarly to other DSGE models, its parameters may be divided into three main classes:

a) parameters determining the levels of variables in the steady state;
b) parameters controlling the elasticities of substitution between selected variables;
c) parameters of exogenous stochastic shocks taken into account in the model.

The basic method for carrying out the simulation is to specify the shocks and determine the dynamics of the exogenous variables defined. The simulation process consists in determining the dynamics of states for the path of shocks specified and the additional variable present in the solution, determined by the exogenous variables. Quantitative evaluations were made by means of two methods: analysis of the impulse response function and the Kalman filter. The first one was applied for the analysis of standardised macroeconomic shocks impact, and the second – for evaluation of the precisely specified agricultural policy instrument, that is, direct payments under the first pillar of the CAP.

From the point of view of agriculture, the particularly important macroeconomic distortions affecting the income situation in the sector are the price shocks altering either the expected revenues or the production costs. The shocks of this type implemented in the structure of the model include shocks changing the relative prices of agricultural goods outside and inside the country, thus affecting the terms of trade in export and import of Polish agricultural products on world markets. On the other hand, the shocks, included in the model structure, that affect the production costs comprise of sectoral technology shocks, including especially the ones affecting the agricultural, energy and fuel sectors. It was normally assumed in the analysis that all the shocks are brought about by stochastic processes with an autocorrelation rate equalling 0.95, which corresponds approximately to a 3.5-year-long period of half-life of a shock.

The simulations of the analysis carried out suggest that as a result of a 1% rise in the price of foreign agricultural production the competitiveness of domestic production increases as its price becomes relatively lower than the world market price. Consequently, the export of domestic agricultural products grows by approximately 0.6%, which causes an increase in the expected margins in the AGR sector. It is in turn an encouragement for the producers to boost investments which, however, increase three times less significantly than the exports. A greater demand for capital in the sector and the expected increase in the in-

comes lead to a rise in employment, which is negligible due to the rigidity of labour supply. As a result, the increase in product of the agricultural sector is considerably lesser than the increase in exports (0.4%). Since the price shock is not technological in nature, it does not cause the global production capacities of the economy to increase. In consequence, the expansion of production in the agricultural sector has to be to the detriment of other sectors which reduce their own production and employment because of a rise in the production costs (increase in the prices of materials) and investments (increase in the prices of investment goods).

The energy sector is an exception here, because of the high energy intensity of Polish agriculture (measured as the consumption of energy per unit of generated value added). The sector's gross product is slightly rising in the mid-term as a result of the increased demand on the part of the agricultural sector. The domestic GDP is slightly decreasing due to a fall in the consumption demand which is supplanted by the investment demand in the face of a lack of increase in the production capacities of the economy. Consequently, global employment is falling and the unemployment is on the rise. Nevertheless, these changes considered on the level of the entire economy are very slight, concerning from a few to several percent of the strength of the price impulse alone or the price changes taking place in the agricultural sector. It is because a relative importance of the AGR sector in the generation of country value added is minor, hence, the impact of price impulses occurring in this sector on domestic production, investments, employment and unemployment is insignificant.

A one-percent growth of production effectiveness of the agricultural, energy or fuel sectors, and the resulting *ceteris paribus* fall in the unit price of the sectors' production, has a visible impact on the entire economy and the agri-food sector in particular. At the level of entire economy, a positive sectoral technology shock leads to an increase in the overall production capacities and, thus, to a rise in the expected profit of companies, investment activity and employment, as well as, finally, the total output. The scale of impact exerted by a one-percent sectoral technology shock on the entire economy depends on the relative economic role played by a given sector.

Technology changes limited to relatively small sectors such as the agricultural, energy and fuel sectors are naturally less important for the whole economy than analogous shocks in more broadly-defined sectors (such as industry or services). As a result, also the strength of all the impulse responses analysed is comparatively minor in the scale of the entire economy, even though it is still relatively high in the scale of a given sector. It especially concerns the technology shock in agriculture. It brings about an increase in agricultural production,

which leads to overproduction in the agricultural sector and a fall in prices of its sold production due to the lack of an analogous efficiency increase in other sectors of the economy. It reduces the expected margins of producers and discourages them from investing and causes a drop in employment despite a decrease in the production costs (intermediate consumption in agriculture is to a considerable extent based on the production of the agricultural sector itself). These effects are relatively strong on the sectoral scale, with a deviation from the original value of relevant numbers ranging from approximately (+/-) 0.2% to (+/-) 0.6%. However, a decrease in the investment demand from the AGR sector and negative pressure on remunerations caused by unemployment increase attributable to agricultural employment decline contribute also to a reduction of business costs in other sectors, which in turn (due to the lack of adequate pressure on price reduction in these sectors) leads to an increase in the expected margins. Therefore, while the drop in prices of agricultural production causes a fall in investment activity and employment in agriculture, other sectors observe growth of these parameters, which is, however, strong enough to bring about a global positive effect solely in the case of investments. It constitutes the difference between a sectoral technology shock and a global shock as the latter would cause the employment and investments to increase in the entire economy. It is worth noticing that a positive technology shock in non-farming sectors, that is, a decline in relative prices of goods they produce (of energy and fuels in the case analysed), results in a drop of agricultural production costs, increase in the expected profits and investment boost in agriculture. Yet, since these effects spread over other non-farming sectors, their quantitative impact at the level of the relatively small agricultural sector is limited.

The model used to carry out the simulation is a model of real economy, that is, without money. Therefore, it features a real exchange rate and real interest rate. They are fixed in an entirely endogenous manner, thus their value is a resultant of the market supply-demand relations in the international trade and on the assets market, respectively. For this reason, the shocks that directly change the level of the exchange and interest rates constitute precisely the supply or demand shocks that influence the supply of or demand for traded goods or the supply of or demand for savings, respectively. The analysis focused on the demand shock in exports and on the shock modifying the household preference rate and, thus, the supply of savings.

As to the economic consequences of the increase in the aggregate foreign demand by 1%, firstly rise the expected profits of export companies and, hence, their demand for sectoral goods. Consequently, the expected profits of producers increase also, and this induces a strong investment impulse in the entire econ-

omy, including agriculture. The generality of this impulse is due to the aggregate (i.e. concerning all the sectoral markets) character of the demand shock considered. As a result, the product and salaries also increase (owing to the distribution of the producer's surplus among the employees and employers). Nonetheless, as it is only the average and not the marginal productivity of labour that augments (the technology remains unaltered), the rise in remunerations provokes a minor fall in employment, which mitigates the overall product growth. As the demand shock originates from abroad, the national currency is strengthened (the exchange rate drops), which in turn prevents the increase in exports.

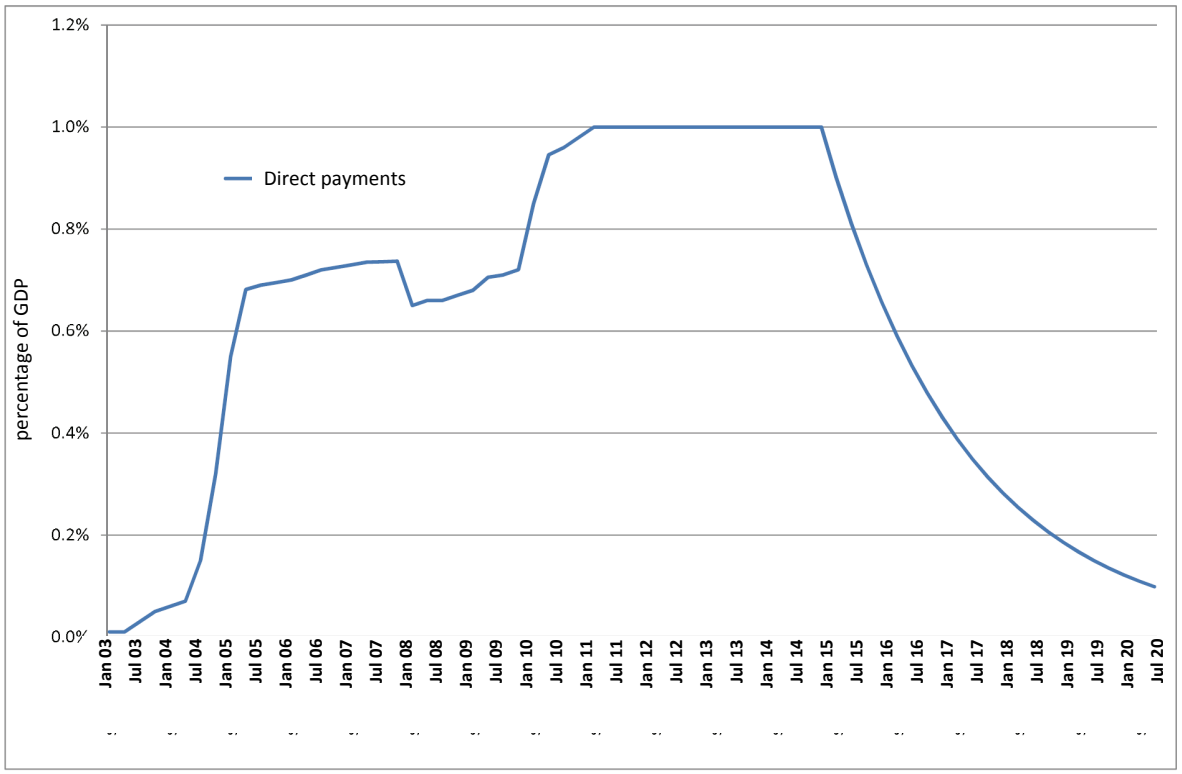
The shock changing the time preference rate of households reduces their desired level of savings, making the capital less accessible. Thus, in order to balance the investment demand with the supply of capital in the form of savings, it is necessary to raise the real interest rate, which increases by 1.5% yearly. It brings about an investment decline in the national scale by 0.4%, this phenomena being mostly attributable to sectors in which the investment demand is globally the most elevated, that is, the service sector and industry. In smaller sectors of the economy such as the agricultural, energy and fuel sectors, the decrease in investments is a half below the national average. The reason behind it is that the growth in the global consumption demand induced by the savings reduction concerns primarily the sectors where it is the least flexible, that is, the food sector, as well as the energy and fuel sectors, which have an input-output relation with the food sector. As a result, provided that the GDP in services and industry is falling, both the GDP and labour productivity in agriculture increase because, due to a rise in the consumption demand, the prices of agricultural products are increasing.

The simulations concerning the impact of gradual reduction and abolishment of payments were implemented in two ways differing slightly in their economic aspects. The first variant assumed that the direct payments go to the agricultural sector in the form of direct support addressed to active farmers. The second variant assumed that the expenses are not a pure subsidy to improve employment in the sector, but rather a general subsidy which is not directly connected with the number of persons working in a given holding. It should be underlined that on the basis of the very form of the actually functioning CAP instruments it is difficult to determine precisely to which of the two variants of the model a given instrument should be allocated. On the one hand, direct payments depend on factors not primarily related to the number of persons working in a holding (which would support the second one of the interpretation presented), on the other hand, owing to the current agrarian structure direct payments are granted mainly to individual farmers running small or medium

holdings and, what follows, in the Polish reality this policy provides in fact a subsidy to employment.

The analysis assumed that the instruments under the agricultural policy constitute special cases of sectoral government subsidies increasing the level of profits earned and the pace of accumulating capital in the sector. The introduction of the EU funds into the model also implies the necessity to modify the balance equation in foreign trade because from the economic point of view the EU funds are associated with the account of capital flows, which by definition has to equalise the trade balance corresponding to the difference between exports and imports. As mentioned above, the simulation was carried out with the use of the Kalman filter, and the information used in filtration-prediction is provided by the full path of (quarterly) expenditure on direct payments in the period of 2003-2020 (Figure 3.9).

Figure 3.9. The assumed path of direct payments



Source: Bukowski, M. (2009), Model DSGE jako narzędzie wspierające formułowanie założeń polityki rolnej, 2009 (opracowanie niepublikowane), "DSGE model as a tool to support the forming of agricultural policy assumptions" (unpublished paper).

For the years 2003-2009 (historical period) this path is reconstructed on the basis of yearly data from the Ministry of Agriculture and Rural Development with the use of the Boot-Feibes-Lisman interpolation algorithm (the so-called

BFL algorithm). It was assumed that before 2012 the expenditure on direct payments will reach 1% of the GDP in comparison to approximately 0.7% in 2009 and the predicted 0.9% in 2010. It was also presumed that this level will be maintained until the end of the current financial outlook, that is, until 2013, whereas on the turn of the years 2014 and 2015 the gradual lowering of payments by 10% on a quarterly basis will begin. Such an approach allowed for performing a conceptual experiment allowing to simultaneously track the economic impact of introducing the payments (years 2003-2014) and of their gradual liquidation (years 2015-2020) during the next financial outlook of 2013-2020.

The simulations carried out suggest slightly different economic effects of direct payments depending on whether the model treats them as direct subsidies to employment or general subsidies for the sector. These differences appear at the sectoral level, while the strictly macroeconomic effects (that is, visible in the scale of the entire economy) are of similar quality in both cases and the possible differences are of a purely quantitative nature. The simulation reveals particularly that in the years 2003-2014 (that is, in the period for which it was assumed that the expenditure on direct payments will be, generally speaking, characterised by an upward tendency) the GDP, consumption and salaries will be on the rise. The values of these variables will be higher at their peak by approximately 2%.

In both variants direct payments will lead to a fall in employment at the macroeconomic scale but this fall will be more moderate in the variant in which the payments have the character of subsidy to employment in agriculture. As a result, in the circumstances of growing GDP labour productivity is also rising from 2% to 3% depending on the variant. A drop in employment in the situation of an increase in the GDP and salaries has its source in the income effect on the side of households whereby people tend to devote relatively more of their time to leisure when they receive a free transfer in the form of direct payments that boosts their consumption possibilities in the goods markets without the need to take up work. This effect is strengthened by a fall in the demand for work on the side of companies confronted with rising salary demands and salaries, which, should the technology employed remain the same, would present a threat of a decrease in profitability, provided that their demand for work is not reduced.

Employment is growing only in agriculture, provided that the payments principally take the form of subsidies to employment. Otherwise, also in this sector a fall (*ceteris paribus*) in employment should be expected in consequence of the introduction of payments . It should also be emphasised that the employment decline is the reason why the increase produced by the payments in the

product generated at the aggregate level is limited only to agriculture and the sectors that it is most tightly connected with by means of indirect demand, i.e. the energy sector and (to a lesser extent) services, which benefit from the growth of consumption and investment demand in substantially higher degree than, for instance, industry. It is also worth highlighting that as a highly procyclical variable the investments respond to demand impulses related to direct payments particularly intensely and particularly fast. Especially companies, in anticipation of a possible reduction of payments past 2014, start even a few years earlier to limit their investment expansion so as to avoid the situation of overinvestment when the aggregate demand fuelled by the CAP diminishes.

4. Price and income risk in agricultural markets

4.1. Reasons and effects of price risk

The problem of risk in agriculture cannot be analysed without taking into account competition, which is the essence of market economy. A spontaneous reaction of many agricultural producers, who provide products for the market independently of each other and on their own accounts, often results in disproportions in the supply-and-demand balance. The reactions to prices in current production period are also diversified, which leads to situations characterised by permanent deviations from the state of balance, resulting, in turn, in unavoidable price fluctuation. Relatively small price flexibility of supply and demand for agricultural raw materials results in a situation where small changes of amount lead to relatively significant changes of prices. This phenomenon is a basic source of the price risk affecting the income of agricultural producers.

Incomplete information, limiting the rationality of producers' behaviour in such circumstances, leads to economic decisions being taken on the basis of expectations concerning future results and effects of such decisions, and in conditions of uncertainty as regards economic parameters, mainly prices. Consequently, there arises a risk that market entities would fail to reach their assumed goals. In this case we can talk about risk exposure, which means that the goal of activity of an entity depends on unpredictable market parameters.

It should be noted that not all price changes express the price risk. It is assumed that the symptoms of risk should be deemed as unexpected and unexplainable changes, to which it is difficult to adapt during a specific period by improving effectiveness. Determinants and reasons of such variations can be very diversified: ranging from natural in character (for example natural disasters) to political (for example trade sanctions), however they always result in price changes. On the other hand, the seasonal variations cannot be regarded as something unpredictable and, consequently, risky, because market operators are generally aware of them. However, periodic changes and changes in economic trends whose nature is more stochastic than deterministic, are in a sense the symptoms of risk. Such changes cumulate the operation of several factors, which are often seemingly independent of each other. Combined with the psychology of market operators' collective behaviour, they trigger rapid price changes. The uncertainty results from the fact that it is very difficult to catch the moment when the so called critical mass is reached causing the reversal of the trend (i.e. reaching a turning point), as this often happens when both analysts and market operators believe that the current trend is continuing.

From the point of view of agricultural producer, main sources of uncertainty and risk, affecting the level of obtained income, can be classified in different ways. From the practical point of view, the following areas where risk occurs may be distinguished: production activity, trade (market, price risk), and macroeconomic environment (changes in parameters of economic policy, including rural policy). OECD suggests a two-dimensional approach to the risk in agriculture. On the one hand, the above mentioned categories are considered, and on the other hand – their scope is analysed. The distinction between systemic risk (macro scale) and specific risk (micro scale) in agriculture is essential from the perspective of risk management strategy at the level of agricultural holding, as well as from the perspective of agricultural policy.

The production risk, typical for agri-food sector, is connected with the uncertainty as to the quality and quantity of the final product. This risk results from uncontrollable phenomena such as floods, droughts or diseases, and also from the specific character of production process. According to agricultural producers, natural and weather factors are the main source of hazard, even more significant than the price risk.

Price- and income-related impact of production risk is enhanced by biological determinants of plant and animal production, as a change of decision requires time to be implemented, which in economic terms is reflected by small flexibility of supply. This type of risk is visible in micro, meso and macro scale. Indeed, in case of factors causing changes only at the level of agricultural holding or region, there will be no natural hedge in the form of price changes. If a risk (e.g. a drought) occurs on a macro-scale, the negative effects of production risk are often reflected in the growth of the prices obtained.

Potential changes of policy can also be a significant source of risk. Such changes include, among others: instruments of agricultural and trade policy, taxes, interest rates or other important regulations. Policy-related risk affects the behaviour of agricultural producers both in long and short-term perspective. Examples of policy-related risk include the liberalisation of global trade in agricultural products as well as the reforms CAP making agricultural sector more market-oriented. As a consequence of these changes, agricultural producers in the EU will have to manage the price risk, which had been previously eliminated by the policy of market intervention.

It should be borne in mind that intervention measures, such as excessive market administration, payments, tariffs, etc. disturb the market signals making the producers' decisions less rational. At the same time, other operators may suffer losses caused by rapid administrative changes of market parameters. In this context, the participation of the State in regulating agricultural sector becomes

essential and, because of the State being a substitute of market instruments, appropriate model of income risk management is also very important. It should be underlined that the character of decisions taken by market operators is individual, optimizing their objective function. The policy-related decisions, on the other hand, should be taken in an objective way that would not disturb the natural market regularities.

Most reasons of uncertainty, such as production risk, endogenous fluctuation or policy-related factors, are reflected by the price risk. Because of biological, natural and technical determinants the price risk in agriculture is especially high. It is also significant that the production process in agricultural holdings cannot be stopped, and the supply cannot be regulated by increasing or decreasing the volume of final production. Factors, such as the impact of changing world prices and the risk connected with fluctuating exchange rate also have to be taken into account in analysing risk.

Price risk is generally connected with two phenomena: the drop in prices obtained for the goods produced, and the rise in prices paid for the purchased production means. This means that the production profitability is reduced in a short period, which results in lower income and, in consequence, the objective function is not fulfilled. The term “short period” is important in this context, as it refers to time period when the producers are not able to adjust to the changing prices. For agricultural producers this period is strictly determined by the natural character of agricultural production.

The risk resulting from changes in the prices obtained, faced by each agricultural producer, is that a future market price, shaped by supply and demand, does not necessarily ensure sufficient income to cover the costs with given, individual production effectiveness. Expectations on the future price are also individual, and they derive from a combination of the cost incurred and the profit planned.

Prices paid for the production means include first of all prices of purchased raw materials and services, being the outlays in processing and the main component of production costs. Considering those two aspects, it can be stated that the uncertainty results from the changing relation between prices of products purchased and prices of products sold. The risk lies in adverse price changes, and in particular changes in their mutual relation, which may impair farming efficiency, due to decrease in profitability resulting in lower income or losses. Consequently, the price risk translates into a possibility that the producer will not achieve the financial results planned.

It should be borne in mind that the price risk has certain cost-related effects, because a decrease in obtained prices or a increase in paid prices, and in

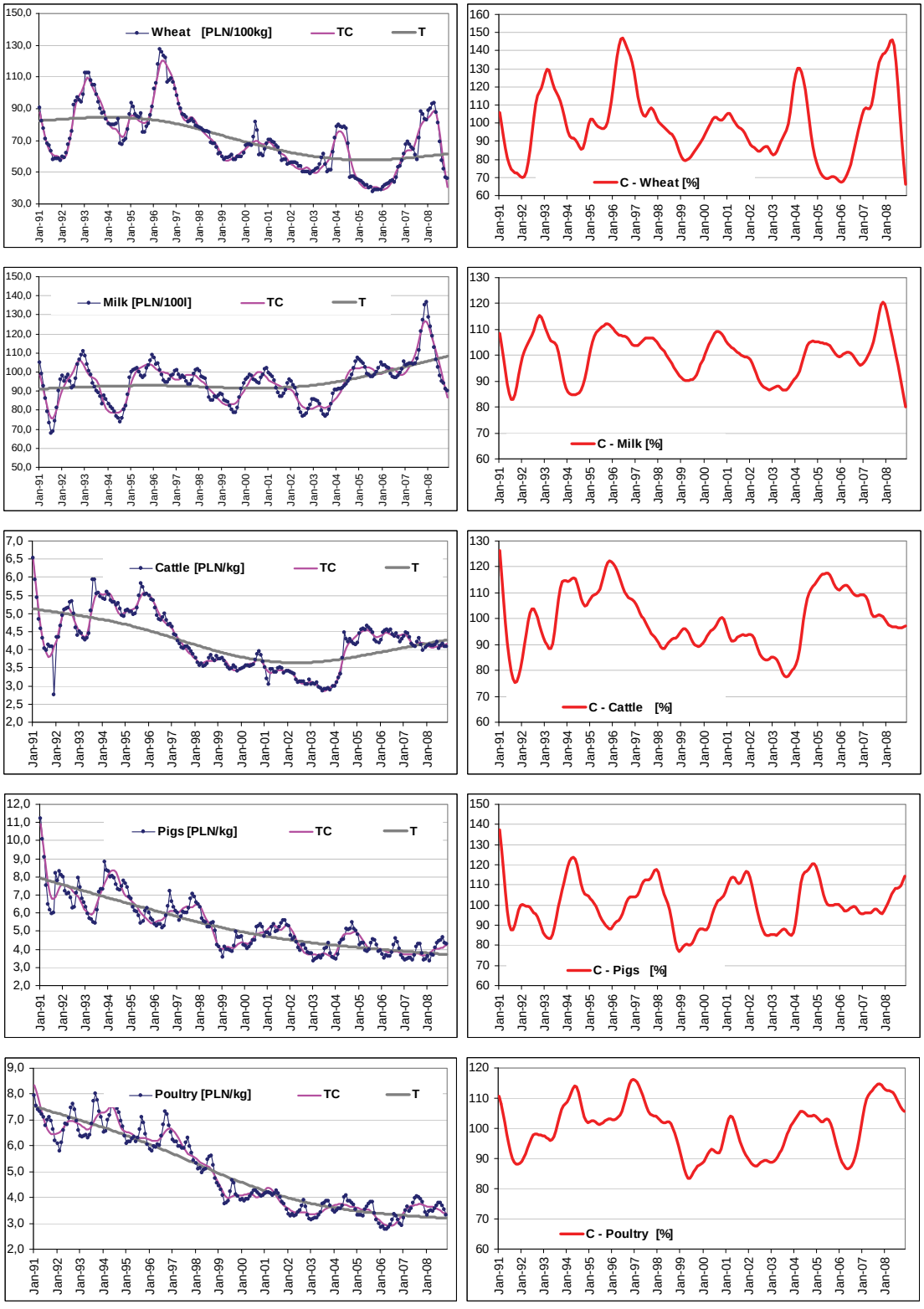
particular a combination of the two, is always reflected by a growth of share of costs in the income, which in turn results in a lower profitability of production or sales. This usually is a short-run phenomenon, occurring in certain market conditions, determined by the state of competitive balance, which means – in simple terms – that a given entity is a price-taker. Although changes in prices obtained and paid have the same impact on profitability for both, the producer and the processor, the effects of such changes differ for them. The producer and the processor have different expectations as to the directions of change of purchase prices, as for the former those prices are the obtained ones, while for the latter the same purchase prices are the paid ones.

A basic economic ground of price risk exposure is that entities of agricultural market, especially agricultural producers, are not able to compensate or neutralise in a short run the decrease in profitability by raising effectiveness, e.g. by investment, changes in organisation or structure of production, innovation or other non-investment activities. The improvement of effectiveness is determined by endogenous factors and it takes a long time to be achieved. Whereas the changes in profitability are determined by exogenous factors and in this sense they are of a more short-term character. Changes of factors affecting the profitability and effectiveness of production are mutually conditioned. Their final effect consists in changes in the level of income or of profit. In this context, the risk lies in making the improvement of effectiveness parallel with changes in production profitability, ensuring at the same time that adverse short-term price changes do not spoil the efforts to raise effectiveness, and do not pose a threat for existence of individual market entities. To achieve this goal, agricultural producers must take appropriate measures to neutralise the cost effects of adverse changes in the relation between prices of products and of production means.

4.2. Price risk level on main agricultural markets

In risk management it is necessary to identify and measure the risk, making it possible to effectively implement investment strategies or create institutional framework for risk management. The decisions neutralising the negative effects of risk depend mainly on the scale of uncertainty as to price changes. If changes are slight and acceptable for agricultural producer or for other market operator, no protection measures are needed, as the objective function of such agricultural producer or market operator is not threatened. On the other hand, a high level of uncertainty increases the will to protect oneself against negative effects of price volatility. The risk is most commonly measured on the basis of historical price variability. A range of methods to assess past risk are used.

Figure 4.1. Real procurement prices of agricultural raw materials in Poland in 1991-2008, their development tendency [T], and cyclical fluctuations [C]



Source: own calculations on the basis of GUS data with the use of Census X-11 method.

The research shows that prices of basic agricultural products in Poland were highly volatile in the years 1991-2008 (Fig. 4.1). On theoretical grounds, one may claim that price volatility is a natural phenomenon, connected with the market mechanism, and that not every price change is a symptom of a risky situation. Changes that do not reflect risk are those showing a trend. Long-term trends are conditioned by inflation (nominal prices), i.e. regularity consisting in a slower growth of prices of raw materials than of prices of manufactured articles (reflected in behaviour of real prices), and by adapting national prices to world and EU prices (milk, beef). Consequently, changes being a part of a trend are not a sign of price risk, as such price risk is conditioned by changes within one production cycle; whereas a trend is an indicator of structural and technological changes to which agricultural producers can adept. If they are not able to do that, they can be eliminated from the market as weak and uncompetitive entities, which, in fact, is the essence of the market functioning.

Considering long-term changes, one may assume that structural changes, resulting from policy-related changes, may be a source of risk. The very accession do the EU, which was a permanent structural change, was visible the most on beef market. The consequence of price convergence related to this event was a permanent growth of prices by over 30%. The systemic changes, shocking in character, could have taken place in the case of milk prices.

Another type of changes that should not be regarded as a symptom of price risk are seasonal changes. The seasonal character of prices is related to climate and biological factors which directly affect periodically changing volume of production and supply. Practically every market player is aware of seasonal excess supply, and takes this fact into account in own calculations.

In recent years, the most seasonal character within total volatility of prices, expressed in percentage, has been observed the prices of pigs. The amplitude of seasonal changes is approximately 24%. The seasonal character is slightly less significant for the prices of poultry (16%) and wheat (14%). The beef market is least affected by seasonal changes (8%). The pattern of seasonal fluctuation was changing considerably in 1991-2008. The biggest changes in seasonal fluctuation, throughout that period, were observed in prices of cattle and pigs. For cattle, the change was relatively rapid and took place between 2002 and 2004, which may have resulted from adjusting national prices to trends on the EU market. For other agricultural products the changes were smaller and gradual.

The development of price risk is to the greatest extent affected by cyclical fluctuations. The amplitudes of cyclical changes reach over 70% during the whole development trend. The research shows that prices of wheat, rye, milk,

pigs and poultry are determined within 3-5 year long cycles. The cyclical fluctuations result from both macroeconomic factors and from the so called commodity cycles on individual markets and interdependence of those cycles. Additional factor generating cyclical fluctuations are sudden production fluctuations, caused by weather conditions. They result in deviations from the state of market balance, and achieving such state again is a relatively slow process. Although there is wide knowledge on this kind of changes, they can be regarded as a symptom of uncertainty. That is because they are highly irregular, both in terms of duration and amplitudes, which makes it difficult to predict them.

Table 4.1. Selected data on the historical variability of the real prices of agricultural raw materials in Poland in 1991-2008

Specification		Wheat	Milk	Cattle	Pigs	Poultry
Time horizon of changes:		Average price changes in given periods (%)				
1 month		4.25	2.50	2.93	5.10	3.43
2 months		7.74	4.61	4.66	8.57	5.96
3 months		10.73	6.33	5.82	11.09	7.90
6 months		17.16	9.84	8.79	14.68	10.71
9 months		21.85	10.42	10.63	15.08	10.26
12 months		24.86	10.66	11.13	14.95	9.88
Kind of a variable		Standard deviation of the rate of return within 12 months (%)				
Real prices		21.17	10.62	12.74	22.57	14.20
Seasonally adjusted prices		18.79	7.09	11.17	16.80	9.70
Period	Statistics (significance)	Results of Engle's LM-ARCH test for Real prices				
12 months	LM	8.46	28.31	50.19	0.18	10.81
	p	0.73	0.05	0.00	0.99	0.54
24 months	LM	15.25	38.15	124.33	0.43	13.07
	p	0.91	0.03	0.00	0.99	0.96
48 months	LM	53.49	74.77	111.6	23.84	117.36
	p	0.27	0.00	0.00	0.99	0.00

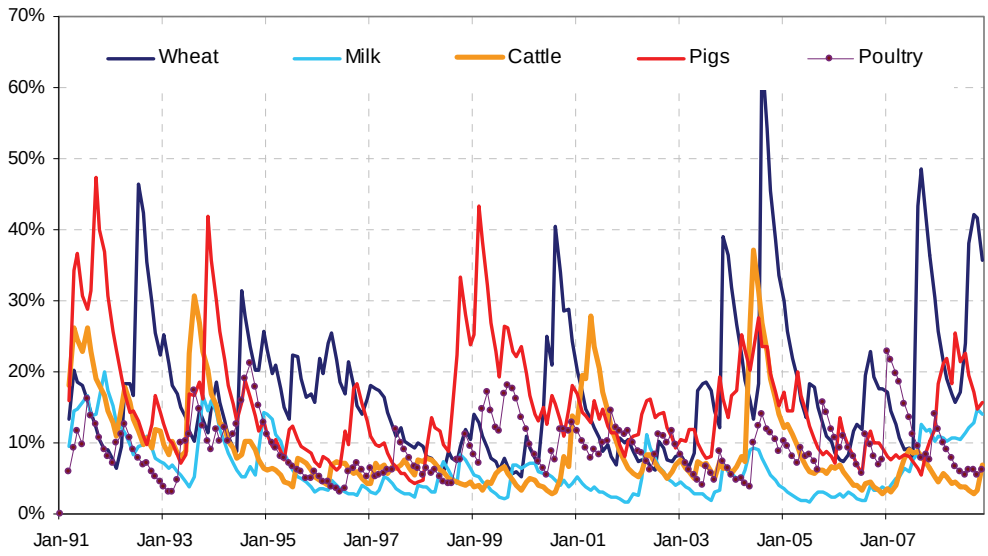
Source: Source: Own calculations based on data of GUS (Central Statistical Office).

The average change of real prices exceeding 10% was observed already after three months in the case of pigs and wheat, after six months for poultry, and after nine months for milk and cattle (table 4.1). The results of those calculations indicate that the biggest price risk affects the wheat market, followed by the swine market. Similar conclusions can be drawn from an analysis of the results obtained with the use of standard deviation of log returns $r_i = \ln(Y_t / Y_{t-1})$ as a measure of variability. The elimination of seasonal fluctuations, which, as is well known, do not reflect uncertainty, lowers this indicator by several percentage points.

Distribution analysis of a stemplot of prices of agricultural raw materials indicates that they are leptokurtic, especially in the case of wheat and cattle. Consequently, the probability that an untypical phenomenon will be observed is bigger than in case of normal distribution. In other words, the probability of rapid price changes is relatively high, which indicates a higher price risk.

Using average values of historical variability for all the examined period makes it possible to illustrate the price risk, however, the diversity of market situations in individual sub-periods is not reflected. Assessment of historical variability, based on the Exponentially Weighted Moving Average method (EWMA), shows sub-periods of enhanced variability alternating with sub-periods of stabilization, in particular on the wheat, swine and milk markets (Fig. 4.2).

Figure 4.2. Historical variability of real purchase prices in Poland (corrected by seasonal fluctuations) measured with the EWMA_0.7 model



Source: Source: Own calculations based on GUS (Central Statistical Office) data.

In order to identify the effect of the so called ARCH conditional variance, the Engle's LM-ARCH test has been applied, based on LM statistics and the GARCH (p, q) model. Models consistent at the level of real prices and their log returns have been used in both tests, and their remainders have been modelled. The results of the LM-ARCH test have confirmed that the ARCH effect occurs in case of real prices of milk and cattle (table 4.1). Results obtained using the GARCH (p,q) model depended on the solution applied, i.e. on the fact whether price levels, price differences or log returns have been taken into account. The ARCH effect has been confirmed in each case for milk prices. An acceptable

GARCH model has also been assessed for conditional variance for log returns of real wheat and cattle prices.

The theory of international trade states that opening of economy, which was the case when Poland accessed the EU, gives an opportunity to make up for shortages and to liquidate market surplus on foreign markets. This should result in smoothing the amplitude of fluctuations and in reducing price volatility of agricultural raw materials, which in consequence should improve the effectiveness of economic entities. Results of an analysis indicate that although integration of national and EU markets in terms of prices is advancing, the hypothesis that price risk is thus reduced cannot be confirmed. Stochastic variability of analysed purchase prices has not changed (excluding beef), contrary to expectations, which means that the related price risk has not been reduced after Poland's accession to the EU.[4] Thus, it can be stated that introducing agricultural market regulations coherent with the EU ones has not significantly reduced this kind of risk in the situation of growing liberalisation of agricultural markets. It does not mean, however, that farmers' income sensitivity for these changes has not been changed due to the introduction of direct payments and other CAP instruments. It should be underlined that agricultural producers in taking their production-related decisions should take account of the global situation on a given market of raw materials and on related markets, as such farmers are particularly susceptible to global price risk and to currency risk.

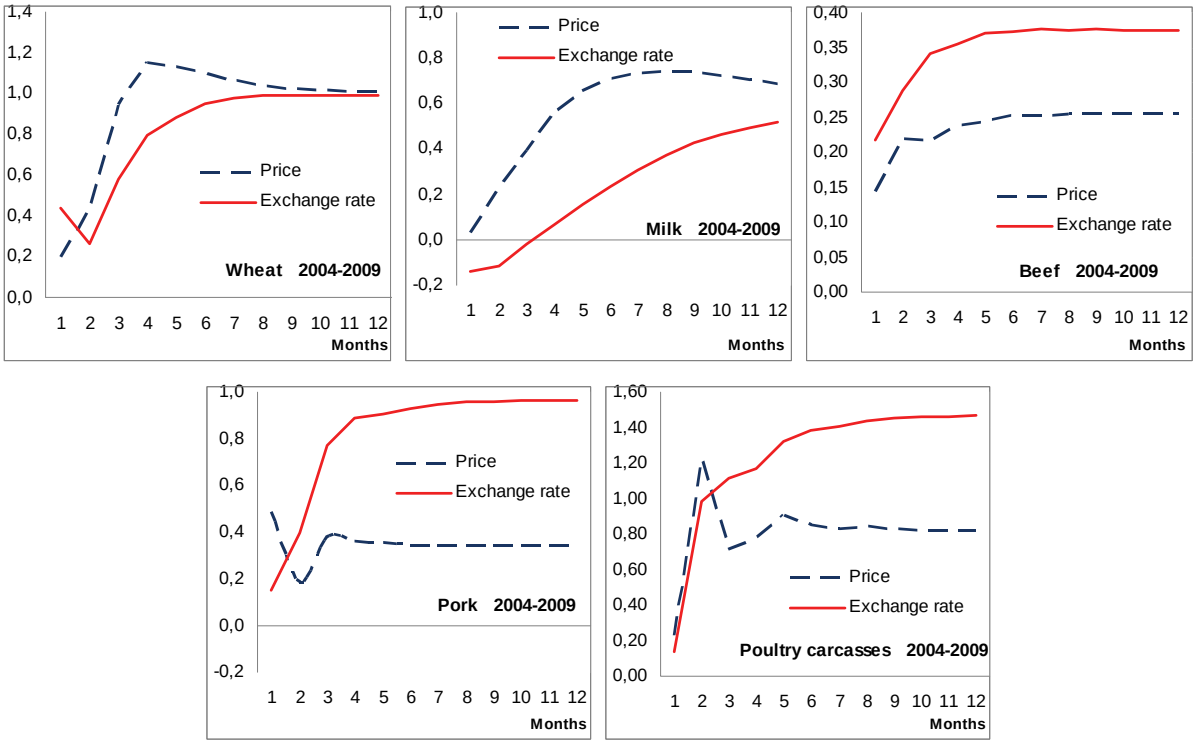
Global price risk is caused by the fact that national prices are to a considerable extent determined by their world counterparts, which may contribute to extending the scope of risk factors. That is because in such situation there is no natural hedging, i.e. the prices do not fall in case of overproduction and *vice versa* as much as it would be the case in closed economy. Consequently, it is possible that when the yield in the country is low, the prices will not be high because of the situation in the rest of the world (high yield and low prices all over the world). On the other hand, there are opportunities to gain extra profit, which was the case for cereal producers in 2007 in Poland, when high production was concurrent with high prices because of low yield in other EU countries.

[4] Additionally, the analysis indicates that standard deviations of rates of return of real purchase prices (without taking account of the seasonal component) in the period between July 2004 – November 2008 were by 25% higher for poultry, by 48% higher for wheat, and by 53% higher for milk than in the period between January 2000 – April 2004. The price volatility for pork did not change, and for beef it was by 58% lower.

There are three kinds of currency risk affecting agricultural producers. Firstly, the level of direct support for agricultural producers, and consequently the level of their income, depends on the ECB exchange rate assumed for the calculation of payments. Secondly, the exchange rate affects the level of prices obtained for sold products. Weakening of Polish zloty, *ceteris paribus*, results in the growth of nominal national prices, while strengthening the currency results in their decrease. Thirdly, the exchange rate determines the level of costs and, consequently, the profitability of production. However, the income effect of changes in exchange rate is opposite compared to the situation when it affects prices of raw materials. Furthermore, income effects of depreciation and appreciation both in terms of income and costs may partly neutralise each other.

A distributed delay model and VAR model were used in empirical evaluation of the influence of world prices and exchange rates on prices in Poland. In both cases log returns have been analysed in respect of monthly prices of agricultural raw materials for three different periods: January 2000 – April 2004, May 2004 – May 2009, January 2000 – May 2009.

Figure 4.3. Impulse response functions of national prices for one-percent shocking price changes in Germany and the PLN/EURO exchange rate from May 2004 to May 2009



Source: Own calculations on the basis of data of GUS (Central Statistical Office) and of the European Commission.

In general, research results prove that specific markets should be considered individually, because the price transmission process is significantly affected

by the degree of processing of raw material, the scale of foreign trade turnover, the character of marketing chain, and the degree of competitiveness of a given market. The most important conclusion stemming from the research is that national and foreign prices are becoming increasingly interrelated. In terms of price risk, that means that the spectrum of risk factors keeps widening. Since Poland's accession to the EU, in the case of wheat, we can observe a practically full transmission of both prices and exchange rate. A 1% change of German wheat prices or of EUR/PLN exchange rate results in almost equal change in prices of Polish wheat within about 5-6 months since the impulse occurrence (Fig. 4.3).

On the meat market, on the other hand, reaction of national prices to exchange rate changes is stronger than that to changes in world prices. Compared to the response of prices on the milk market, it may be concluded that the more processed the product, the greater currency risk. Low elasticity or low rate of response to currency or price impulse in the case of beef prices are probably caused by weak marketing relations with foreign partners as well as by a considerable significance of livestock in Polish export structure.

4.3. Perspectives on income risk changes

Character of agricultural policy is an important factor affecting the income of agricultural producers – in terms of both price and income risk. The increasing openness of EU to world agricultural and food markets as well as withdrawal from export support system is of special significance for the future farming conditions. Thus, global determinants should be regarded as increasingly important while the internal situation in individual European Union countries should be viewed as less important.

Growing access of third countries to the EU market, accompanied by insufficient competitiveness of EU agricultural products, noticeably results in a decrease of internal prices of products which used to be covered by support schemes, leading at the same time, due to relations with the global market, to greater susceptibility to price fluctuations, typical for world prices. This phenomenon is reflected by a growing dependence between national and world prices, and by quick responses of prices of raw material in Poland to changes of prices on major foreign markets as well as changes of exchange rates.

The CAP, and direct payments in particular, are an important factor stabilising income of agricultural producers in the EU. In the context of risk management, CAP means that the responsibility for the effects of an adverse situation is taken by agricultural policy and, consequently, by the taxpayers. How-

ever, it is commonly expected that CAP measures will be liberalised, making the agricultural sector more commercialised. The question remains open of evaluating price and income effects of such change, as well as the degree to which agricultural producers in UE will have to take over the responsibility for risk management.

Table 4.2. Assumptions for agricultural policy scenarios

Name of scenario	Assumptions
Baseline 2007 [BASE]	Currently applicable CAP mechanisms.
Continuation of the current CAP 2018 [CAP]	Extending the CAP mechanisms over the subsequent financial perspective, with implementation of reforms initiated in 2003-2006. The target level of direct payments applicable in 2013 as a result of phasing-in, and 10% modulation of payments higher than EUR 5 thousand per holding.
CAP liberalisation 2018 [WTO]	Further liberalisation of CAP, resulting in reduction of support for and protection of agricultural markets in EU countries. Simultaneously, the model assumptions include a 20% modulation of direct payments and a limit of EUR 100 thousand per holding, considering a possible budget reduction for the CAP first pillar.
Liberal 2018 [LIB]	Total liberalisation of agricultural policy on a global scale, and practical withdrawal of financial support for agriculture. This scenario assumes giving up direct payments and other forms of direct support.
Protectionist 2018 [PRO]	High level of price support through market protection instruments applied so far, and maintaining maximum level of direct payments (without modulation) of 2013.

Source: own assumptions.

In order to answer this question, the income risk in Polish agriculture has been assessed for individual agricultural policy scenarios up to 2018. Model calculations have been made on the grounds of agricultural policy scenarios presented in table 4.2. The assumed scenarios cover a sufficiently wide range of conditions for financial support of agricultural income. In order to determine the level of agricultural income variability a Monte Carlo simulation and a static simulation model of an agricultural holding have been used. The most important results of model solutions comprise: minimum and maximum values of agricultural income, income in the 5^{th} and 95^{th} percentile, standard deviations from the average and the probability of reaching a certain level of analysed variable (value at risk).

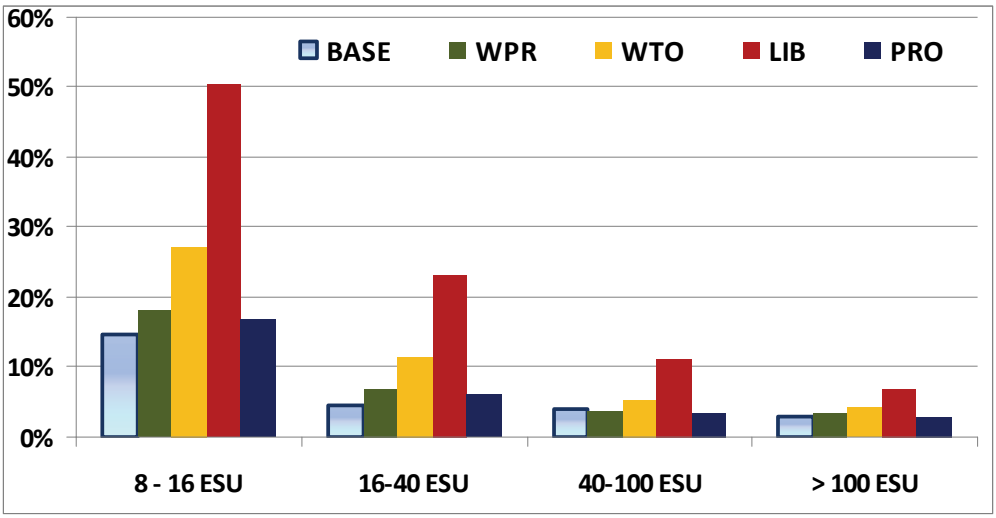
Agricultural holdings have been grouped according to their economic size; the following size groups have been applied: 8-16, 16-40, 40-100 and over

100 ESU. The analysis excluded the 2-8 ESU group of agricultural holdings, as the income of families from this group depends to a large extent on non-agricultural sources. Agricultural holdings types most common in Poland have been selected for the analysis, namely: cereal crops (TF 13), dairying (TF 41), pigs breeding (TF 501), mixed cropping (TF 60), mixed livestock (TF 71), and mixed crops and livestock (TF 81-82).

General regularities resulting from the simulation indicate that potential CAP changes can differently affect farming parameters. The main elements determining the influence of changes in agricultural policy are: the scale of production, the type of production, and the current level of protection of individual commodity markets.

Irrespective of the agricultural policy scenario and type of farming, holdings from the lowest economic size group are most exposed to the risk of loss. The higher the economic size group, the lower the value at risk of negative financial results. The high risk of low income in agricultural holdings from the smallest economic size group results from their low average agricultural income, and therefore greater susceptibility for the shock of price and costs fluctuation. Consequently, the liberalisation of CAP for 50% of holdings with production scale of 8-16 ESU would mean a probability of losses (figure 4.4).

Figure 4.4. Value at risk for various scenarios of agricultural policy changes, broken down by economic size (average values)

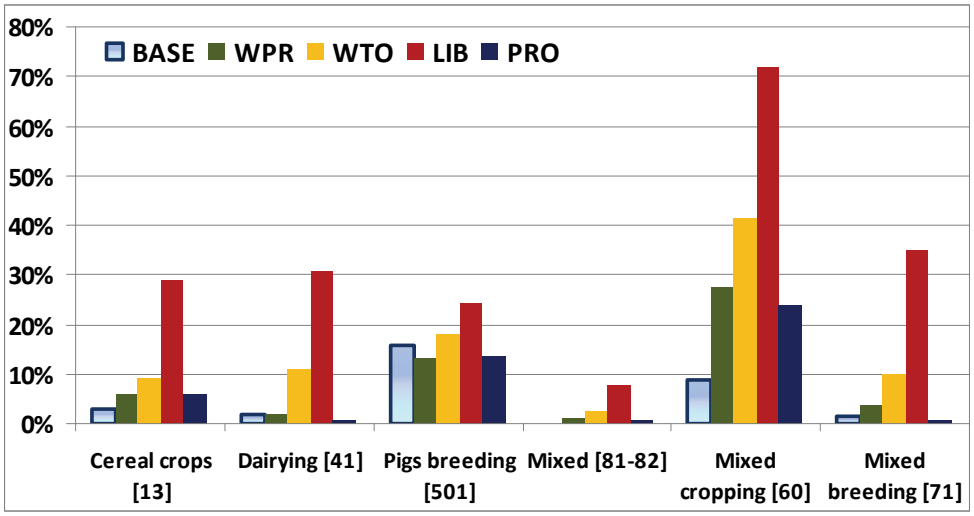


Source: model calculations.

With the current CAP, the highest level of income risk is typical for holdings specializing in pig rearing (figure 4.5), which is caused mainly by significant income variability resulting from the cyclical nature of production and prices. However, the cereal market is characterised by a similar price variability,

but by much lower income risk. This fact proves that area payments considerably contribute to the reduction of income risk.

Figure 4.5. Value at risk in the analysed types of holdings (16 to 40 ESU) for various scenarios of changes in agricultural policy



Source: model calculations.

Typically, pigs rearing holdings are to a small extent threatened by CAP liberalisation. It is proved by a moderate range of *value at risk* indicator, both for scenarios and for holding economic size. A similarly low susceptibility to agricultural policy changes is true for holdings with mixed type of farming TF 81-82.

As regards other types of agricultural holdings, liberalisation of Common Agricultural Policy may lead to a significant reduction of income of agricultural producers, and, consequently, to an increase of income risk. The above is also true for dairying agricultural holdings, which were historically characterised by a relatively high income stability, when the milk supply was controlled and the market was supported under a more protectionist form of CAP. Mixed-crop type holdings (TF 60), especially those from the lowest economic size group (8-16 ESU), are also characterised by unfavourable indicators. However, in comparison to cereal crop holdings (TF13), the size of their agricultural area is nearly by half smaller and their agricultural income is definitely lower.

Across the scenarios, the risk of low income raises, just as income volatility, along with the liberalisation of agricultural policy and with general decrease in average value of agricultural income. If CAP liberalisation is advancing, the income risk in agriculture will grow with this process, mainly due to a reduced financial support and susceptibility to more intense price fluctuations on the world markets.

The progressing liberalisation of CAP can pose a permanent threat for some smaller commercial farms in Poland, in terms of their economic viability; it is also possible that farmers managing such holdings will have to look for additional sources of income or will be forced to withdraw from agricultural production. Nevertheless, it should be underlined that even under a full liberalisation scenario, and with unfavourable price forecasts, the decrease in agricultural income and the growth of income risk is fairly moderate.

In the light of the obtained results it can be concluded that gradual reduction of financial support for agriculture under CAP and greater openness to the world markets will help to accelerate the concentration process, which is currently proceeding relatively slowly in Polish agriculture. Increased scale and optimised production structure may result not only in an improvement of profitability of agricultural holdings, but also in a reduction of income risk.

It is probable that the predicted increased volatility of income, combined with a more restricted role of CAP, will additionally raise the farmers' interest in various instruments limiting the effects of both income and production risk. This proves that agricultural income insurance instruments, practically unavailable on the Polish market, should be developed.

5. Possibilities of stabilising the income of agricultural producers

5.1. The role of analyses and forecasts in price risk management

Entities pursuing economic activities in the current uncertain situation, including agricultural producers, have to apply management methods, permitting to respond appropriately to changes in the environment. An entrepreneur cannot care about the production alone, he/she also has to carry out analyses on an ongoing basis and anticipate the future in order to determine the scope and directions of investments. Analyses and forecasts can provide information on development trends that shape the examined phenomena and processes, as well as on the way such phenomena and processes are affected by various factors, on the strength and kind of interdependence between processes, on development opportunities and restrictions, and on probable development of economic phenomena in the future. Forecasts are understood in this context as a substitute for other kinds of risk limitation. Forecasting is also of a complementary character, considering active protection of business against risk associated with a given investment item, which depends on the forecasts of the market participant concerned.

The main function of forecasts in business is to support the decision making process by providing additional decision premises. In this respect, the information obtained from forecasts makes it possible, easier or faster to set goals and determine conditions of a given activity. Forecasts can also provide advance information on possible changes, adverse from the point of view of a market operator, on the direction or intensity of the examined phenomenon which may be encountered in the future. Such forecasts offer a possibility to undertake measures to prevent or limit the effects of adverse events.

The list of entities of agri-food sector interested in using forecasts comprises: agricultural producers, purchasing and processing enterprises, as well as trade enterprises and institutions (private and public) providing market services. The baseline scope of forecasts is not different from that in other sectors of economy, although the specific character of agriculture has to be taken into account. Agricultural producers need forecasts of two kinds. Firstly, forecasts that would help to answer the question what should be produced, and secondly, forecasts that would help in taking best operational decisions. The answer to the question what should be produced is not direct, and it consists in forecasting prices for the next season or production cycle. Production decisions are

also based on anticipated production costs, thus the forecasts on prices of production means are vital, as the price of raw materials determines the costs for processing plants.

Agricultural producers and other market operators carrying out actual trade or speculative transactions want to know when they should sell their products and at what price. This information affects the decisions on the storage of products, the choice of sales channels and, consequently, the choice of a wide range of methods to secure business against price and income risk. Such decisions enable the planning of cash flow, conditioning financial liquidity. Thus, if an agricultural producer, basing on own forecasts or on forecasts obtained from an adviser, decides to store products, being positive about obtaining in the future prices higher than the current ones, such a producer also has to guarantee adequate financing of current activity. Therefore, forecasts are an alternative to hedge against price risk, for example with the use of derivatives.

The basic question in this context is whether the forecasts should be formulated by the agricultural producer or should he/she be assisted by some other institutions. It is a justified assumption that forecasts are individual by nature, and that no commonly available, accurate forecasts at the national or global level could be made, as they would trigger the activity of market operators leading to their self-fulfilment or self-destruction. Each producer individually evaluates the market situation, and it is the producer who determines how to use available information and what decisions to take to optimise the income.

Obviously, it is desirable that farmers be supported by a system of market information, comprising both public institutions and private entities. Commonly available sources of market information include: quarterly purchase price forecasts for basic agricultural products as well as sale price forecasts for products provided by Agricultural Market Agency based on expert opinions. A description of supply and demand situation on specific agricultural markets and their development perspectives can be found in market analyses by IAFE-NRI. Integrated System of Market Information of the Ministry of Agriculture and Rural Development describes the situation in terms of prices and quantity on individual markets in the country and in the EU. Short-term forecasts are also provided by some producers associations or institutions (for example BGŻ Bank) which support farmers or processing plants. Available analyses and forecasts play a important role in improving the effectiveness market information, making it more clear and facilitating the decision making process. Forecasts from various sources are therefore individual in character; they are an intellectual property of certain value, which allows to develop competitive advantage. However, it

should be borne in mind that the decisions taken and their consequences are a private matter of economic entities.

The choice of strategy that would guarantee the development of correct forecasts is a basic challenge for individual experts and institutions preparing such forecasts on their own. In general, there are no proven methods of forecasting and no application of such methods can ensure the reliability of the obtained results. Nevertheless, there are certain rules that can reduce the risk of preparing faulty forecasts.

Forecasting is a process comprising certain steps, namely: determining the goal, collecting data, applying relevant forecasting methods, assessing the forecasts applicability in practice, and monitoring market situation. It should be remembered that it is the human factor, knowledge and experience in the field of analysis and forecasting that is of key importance. Thus, deep understanding of the problem, as well as data analysis skills are absolutely essential for forecasting correctly economic phenomena, especially price formation.

In order to prepare an accurate forecast, it is necessary to make a correct diagnosis of the reality, i.e. to establish the past and present state of the forecasted phenomena, of existing interdependences and linkages, as well as limitations and directions of internal and external factors. Available information in the form of statistical data, results analyses and studies and legal acts, is used to this end. While establishing forecasting premises on empirical grounds, the point is to determine what kind of data does the gathered information provide, i.e. is there a trend, or seasonal or cyclical fluctuation, and what is the nature and intensity of linkages between variables (for example in the scope of substitution or complementarity). As indicated by the analysis of regularities and models of agricultural price formation, the most significant component of price fluctuation from the forecasting point of view are cyclical fluctuations. The cyclical changes of prices are caused by both national and foreign economic trends. Identification of turning points, as well as directions and pace of cyclical changes is essential for making accurate forecasts.

The essence of forecasting consists in selecting a method of transferring past regularities into the future. It can be done by extrapolation of regularities or by assuming the analogy of future events to what has happened so far, if the body of available information is sufficient. In practical economy most phenomena are durable because the market mechanism, irrespective of disturbances that may occur. Constantly repeating cycles of various duration are observed in the case of prices. In general, the very awareness among market operators that such phenomenon exists allows them to take more reasonable decisions. However, sometimes it cannot be assumed that the observed regularities are permanent. In

such a case, forecasting involves the search for present facts significant for the future. Such situation may take place in agriculture if there are changes in agricultural policy, unexpected market intervention, or tax changes.

When a forecast is drawn up, its accuracy is never certain. A procedure of its verification and evaluation in terms of admissibility should, therefore, be adopted. The point is to verify the merits of a given forecast in the light of current market situation, taking account of assessments made by independent experts and making comparisons with other available forecasts. Excessive deviations should encourage to reconsideration of the applied method. Market situation can change, so it should be constantly monitored; also the extent to which actual situation corresponds to forecast developed should be constantly verified. If considerable deviations are observed, a forecast should be made once again, whereas investment and operation decisions should be revised accordingly.

5.2. Potential use of futures and forward contracts

The price risk lies in the fact that when prices change and fluctuate, a given entity may not achieve the planned economic results. One of the possibilities for a producer to reduce income risk is to stabilise or plan own prices. It is important to note that such price stabilisation does not refer to the whole market but to a single entity in the situation of natural market changeability. To this end, financial instruments can be used such as forward contracts or derivative futures contracts or options. In the first case, the actual delivery of a commodity is made at a previously fixed price, while in the second case the price differences between the spot market and the futures market are cleared on a strictly regulated market (futures exchange).

Derivatives markets are specific institutions for concluding contracts at anticipated price. While entering transactions on a derivatives market, a given entity fixes an acceptable price of its products which it intends to sell or buy on a spot market. The point of trade on the market of derivative commodity instruments is to buy and sell contracts whose function is the transfer of price risk, not buying or selling commodities, which is the economic sense of transactions on the derivatives market, concluded by entities operating on spot markets.

A derivatives market is an important institution verifying the effectiveness of agricultural producers and agri-food processors, as well as their production profitability and broadly defined activities in a given area. Before the initiation of a production cycle, an agricultural producer attempts to open short positions at an expected price level, taking account of the costs and expected profitability and, consequently, the income. These expectations can be, nevertheless, verified

by the market if a futures quote for the planned sales period is significantly lower than the price based on the cost calculation. It is essential to understand this microeconomic function of the derivatives market in order to disseminate knowledge on this market among potential clients of the commodity exchange.

Futures contracts and options are the most commonly used derivatives. A futures contract is a contract made on a regulated market to buy or sell a specified (underlying) asset at a fixed price applicable on an agreed future date. Commodity producers hedge against unfavourable price changes by assuming short positions while buyers do it by assuming long positions.

Futures contracts are a derivative which allows to hedge the commodity price at the moment of the planned purchase or sale. However, if the commodity price change favourably on the market at the moment of exercising the contract, there is no possibility to gain additional profit. That is why commodity exchange contracts evolved to hedge the price in future transactions on the one hand, while giving an opportunity to take advantage of possible profit, when the market price becomes favourable, on the other hand. Such an opportunity is provided by options, which give the right, but not the obligation, to conclude transactions assigned to these instruments. In the case of a call option, a call seller is obligated to sell the underlying asset within an agreed future term, at a previously fixed price. The other party to such contract has the right to buy this asset, although it is not obliged to do so. In the case of a put option, a put seller has to buy the underlying asset, if the buyer uses his right to sell. The option buyer has to pay the so called premium, which is equal to the maximum value of loss that could be incurred in such transaction.

An agricultural producer selling goods (for example wheat) on a spot market, supplies the actual good. The same producer entering into transactions on derivatives market, selling a futures contract, only settles the price difference. The aim of such operation is to hedge against the risk related to unfavourable price changes on the spot market. It is called *selling hedge.* There are two basic interrelated functions of such protection: raising the profit (income) and transferring the risk of unfavourable price changes.

Agricultural producers may hedge against the consequences of risk that prices obtained fall. To this end, they open short positions at the level of futures price quote, if, in the opinion of a given market operator, this secures his/her farming objective. In the opinion of a producer the price level will most probably cover the costs incurred and ensures an acceptable profit, shaped by market conditions. An agricultural producer may also, instead of assuming a short position in futures contract, buy options to open such position (debt in put option).

Entities hedging against the risk of price growth, i.e. enterprises purchasing raw materials, may use the same strategy, but applied in the reverse direction. They intend to buy a given commodity, which is a raw material, e.g. cereal for the production of flour, and which is the main component of the cost. Such entities assume long positions in futures contracts or buy options to open such positions (debt in call option).

Hedging transactions on the derivatives market do not eliminate the price risk, however they can reduce it to a considerable extent. Entering a futures contract means that the risk of absolute change in price of a given commodity on the spot market is replaced by the risk of change of value of the equilibrium basis on the futures market. Considering the components of the basis, it can be stated that a relatively large risk is replaced by a considerably smaller-scale risk.

Managing price risk using derivatives is only possible on a commodity exchange offering such services. A well developed futures market is a specific indicator of prices for all agricultural market entities and operators, as well as for institutions related to this sector. Unfortunately, for several reasons no such market has been established in our country so far. Effective operation of derivatives market depends on a range of factors, such as: high price volatility, sufficient size and liquidity of the market, agricultural policy that does not disturb the free-market mechanism of price formation, and appropriate legal regulations. Most of these conditions are currently evidently favourable for establishing a futures exchange.

The level of state intervention is of great significance for developing the market in agricultural derivatives. If agricultural policy directly interferes with the level of commodity price on the market, the market mechanism is usually deformed, which results in the unwillingness to hedge against risk, as well as in the unwillingness of speculators to enter into transactions. It can be stated that the impact of CAP on prices is decreasing, and that it is relatively small on the wheat and swine market.

Research that has been carried out indicates that the condition of agricultural price volatility in Poland is satisfied. The greatest volatility of prices is observed in cereal and pork sectors. It is probable that other agricultural raw materials will also become an attractive object of futures contracts when the agricultural policy is reformed (liberalised). There are also appropriate quality standards determined for the main Polish products. Anyway, the significance of this problem for the settlement of price differences is only hypothetical, and it is formulated to highlight the possibility of exercising a contract through actual supply.

In order to ensure market liquidity, a large number of potential market operators (agricultural producers, processors, traders and speculators) is needed. Their activity assures liquidity on derivatives market, while the amplitude of price fluctuation on the spot market is reduced. It is advantageous both for agricultural producers and processors. However, what is most important, an agricultural producer, as well as a processor or trading company may, thanks to the activity of speculators, take any position in a futures contract or an option, not affecting the market price. This is one of the major problems, especially at the beginning of functioning of every exchange. The development potential of agricultural derivatives market in Poland, at least at the initial stage, is mainly connected with the market of cereal and pork. Reaching the widest possible range of investors with the offer of derivative transactions is of key significance for the growth of each commodity exchange. It is also very important to change the negative attitude of the public in perceiving the investment role played by speculators on the market.

Opponents of the derivatives market claim that it is the speculators who cause rapid price changes on the spot market. Theoretically, the supply-demand relations on a given commodity market determine the prices, and on the spot and on the futures market prices cannot be much diversified due to limited possibility of actual supply. The problem of (short-term) price alienation of the spot market and of the behaviour on the futures market can arise when the number of speculators is small, or when a small number of investor has relatively large number of open positions. Such a situation can result in monopolisation of the futures market and it carries the risk of deformation of the process of free price formation; so institutional regulations should be adopted to prevent it.

The European LIFFE market would be a significant competition for the national exchange, especially after the adoption of the common currency by Poland. Some big producers are already using this market, so it is essential to determine the sense of establishing a national agricultural derivatives market, taking account of the risk of its limited liquidity, and of soon adoption of the euro. Currently, as indicated by some research, the attempts of several producers to use foreign futures markets do not bring about expected effects, as there is no close price relation. It should be, however, borne in mind that the same problem will emerge on a national exchange, as the prices in Poland are significantly diversified between individual regions. A futures market is by definition a benchmark for a spot market operating in a certain place and time. A futures price is a reference price for spot markets, where the price level depends on local determinants of supply and demand (the so called price

basis), and is significantly different from the futures price level, not in the least because of the transport costs.

It is very important that if national agricultural derivatives market is established, it should be developed within certain, clearly defined organisational and institutional framework. It is not evident whether such market should take the form of specialized commodity exchange related to agricultural market, such as WGT (Warsaw Commodity Exchange), or of a stock exchange, like GPW (Warsaw Stock Exchange) with a relatively well organized market of derivatives of shares, stock indices, currencies and bonds - each of the two options is supported by certain premises. The following factors should be considered: habits of speculators and the way stock exchange is perceived by them (advantage of GPW), habits of agricultural producers and their perception of stock exchange (advantage of WGT), existence of organised spot market as a reference for futures market (advantage of WGT), *know-how* (advantage of GPW), and, finally, applicable legal regulations (advantage of GPW).

As opposed to futures, forwards are contracts to sell an agricultural product in predetermined amount and quality, at a fixed future date and at agreed price. In many countries, including USA, forward contracts are regarded as a basic instrument reducing the risk connected with quantity, quality and price of supplied commodity, even though futures and options markets are well developed. Forward contracts are so popular because they are simple, comprehensible for agricultural producer, who usually thinks in terms of production categories and specific volumes, not in terms of clearing deposits and prices, which is the case for futures. Thus, a forward contract corresponds perfectly to the producer's needs to plan production, based on delaying the production effect and supply in relation to the costs incurred.

Forward contracts are in a sense similar to the contracting system with possible advance payments, vertical integration, putting-out system, or building a supply chain within food marketing chain. The increasing role of such contracts in the integration process involves growing consolidation in terms of both economic entities and their production in agri-food processing and supplies for agriculture. The significance of availability and level of food prices is decreasing, while the importance of consumption quality and security is increasing.

A forward contract is usually offered to a supplier by a purchaser, i.e. a processing plant. These contracts are meant to satisfy expectations of the majority of agricultural producers, concerning planning production before it is commenced, while at the same time they are also concluded in the interest of the purchaser. The common interest of producers and purchasers is to ensure supplies on the one hand and the sales on the other. A forward contract, due to its

bilateral and individual character, can also provide for several specific solutions tailored to individual needs of both parties.

Forwards are the simplest way to limit price risk, as well as risk related to the volume of sales and of purchase. An important feature of a forward contract is its bilateral character and the fact that it is individually negotiated by the parties concerned, and agreed by both of them. Supply risk as well as risk related to the quality of supplied products is thus reduced, as agreeing on the quality standard for supplied goods and on the supply mode is a basic feature of such contract. The risk is reduced thanks to pre-financing the contracted production to ensure quality standards as well as supply volume agreed upon.

Usually, the executability of a forward contract is in practice guaranteed by a higher level of legal and economic sanctions, and by the fear of loss of market reputation. Economic arbitrage serves as guarantee in case of entities associated in trade producers' organisations. There are also less sophisticated forms of enforcement of contract execution, the advance payment being among the most popular ones. The problem in executing a forward contract is also related to the fact that at the moment of actual supply the pattern of prices may be less or more favourable for the supplier or for the purchaser. Thus it may turn out that it would be more profitable not to exercise the contract, and to sell the product at a higher price to another purchaser, or to buy it at a lower price from another supplier.

The pricing formula on which such contracts are based is also an interesting issue. Prices can be either predetermined, minimum or maximum, adjusted to market situation, referred to futures quotes, based on the FOB plus costs or CIF minus costs formula, or they may be fixed with advance payments from both parties to cover possible deviations. The price determined in a forward contract can be additionally secured by a put option or a call option for a futures contract. Individually agreed solutions can also be applied. The choice of solution depends on the goals to be achieved – is the aim of the contract to first of all reduce the risk of quantity of supply or rather the price risk; should both parties be protected against the risk equally or is one of them to favoured?

It is assumed that clear specification of price is a form of protection against its unfavourable change. Contractual relation, where the price is not clearly specified, and a contract only provides for a method to determine it at the moment of supply, does not eliminate the parties’ exposure to unfavourable price changes. However, predetermining the price in a contract does not eliminate the risk of loss of price related benefits, but, similarly as in the futures contract, it allows a given agricultural producer to plan prices and verify effective-

ness of production. Futures quotes are a helpful tool in this case, as they make it easier to determine the price reference for a spot transaction.

Opinions on the effectiveness of forward contracts as a method of reducing quantity, quality and price related risk are diversified. Major problems may result from a possible supply failure, a bargaining position of the parties, and a formula adapted to calculate the price. We can observe a kind of substitution between a forward contract executability in terms of supply, which translates into reducing the supply risk on the one hand, and the price risk on the other. The main advantage of a forward contract is that it reduces the supply risk (and the quality standard), which, however, does not mean that price risk is reduced fully and for both parties. The price risk is reduced to the level of contractual price, which affects the planned costs. Only the risk of possible benefit loss is unlimited, i.e. the possibility to take advantage of favourable market situation (like in futures contract). Economic benefits resulting from sustainable supplies, ensuring the quality and price, seem higher than possible costs of lost market opportunities, considering the fact that most market operators aim to reach a sustainable level of income rather than a short term and occasional, extraordinary profit.

5.3. Insurance as a tool of price and income risk management

Income-related consequences of unfavourable changes, especially the natural and climate ones, which are usually visible in micro-scale (at a farm level), are usually individual and unrelated to the market situation. Local changes in the production volume have a limited influence on the market prices, and do not allow for natural hedging. Concluding contracts with fixed future terms is therefore not sufficient to ensure sustainable income for agricultural producers.

In spite of the apparent possibility to carry out a simple insurance calculation, not all kinds of risks on agricultural market can be insured by commercial insurance companies. This situation is caused by mainly two factors. The first one is related to the information asymmetry between an agricultural producer and an insurance company. The problem is that the agricultural producer willing to get insurance knows much more about potential production risk than the insurer. The asymmetry and the lack of possibility to assess actual risk may be connected with the so called moral hazard, reducing the inclination of insurance companies' to conclude such agreements. In effect the availability of agricultural income insurance is limited due to high price, resulting from the difficulty in assessing the level of risk transferred to the insurer. Consequently, it is usually as-

sumed that agricultural insurance should cover only effects of events causing unintentional losses, where a possible influence of a subjective factor, dependent on agricultural producer, can be excluded.

Insurance companies usually prefer to insure the income risk in individual branches of production, i.e. crop production or animal production, rather than to insure income of agricultural holdings. It is easier to objectively determine possible reasons and situations that would entitle producers to receive compensation in a specific case than to calculate the income of agricultural given no evidence of costs and income. In field production it is easier than in animal production to separate the influence of factors linked with independent, fortuitous conditions from the subjective factor (management quality). Thus, the insurance of income in crops production is more attractive, both for farmers and for insurance companies.

On the other hand, for agricultural producer it is more attractive to insure his income from the holding as a whole rather than the income from individual kinds of production. The reason is that income is strictly linked to farming objective and to the survival of a given holding as a production unit, and the family living on it.

Another factor limiting the possibility to insure production or agricultural income is internal correlation of risk and its effects in agricultural holdings at a given time and space. Thus, the losses are becoming a relatively mass phenomenon, which may result in a situation where the value of compensations paid may be higher than financial resources of the insurer. Classic insurance policies have proved unhelpful in risk management. Effects of a price drop affect all market operators at the same time, resulting in accumulation of claims, which the insurance companies would not be able to cope with. The amount of compensation paid in such cases is usually high, and would require a high insurance premium or adequate reinsurance in financial institutions, making the whole process too costly and basically unprofitable.

One of the reasons behind the unwillingness of agricultural producers to get insurance are its high costs. State's reinsurance and partial participation in irregular, extraordinarily high compensation payments, would help in reducing the costs of insurance borne by agricultural producers. Furthermore, there should be some incentives to encourage agricultural producers to insure the income risk independently, which would reduce costs of the whole system. Such incentives could consist in a possibility for commercial agricultural producers to include insurance premiums in deductible costs. A certain share of public resources in private income risk insurance for agricultural producers would be necessary. The argument for some form of co-financing is that governments anyway have to re-

lease budget support resources in the case of fortuitous events of natural and climate character, such as drought, flood or epidemic. Consequently, certain budget costs are incurred although there is no formal support. Public expenses for the payment of compensation could be saved if the costs of income insurance for interested farmers were co-financed. Co-financing seems necessary in the face of changes in the CAP mentioned above, and also due to the search for an alternative for the intervention programmes.

State aid in the form of contributions towards insurance premiums enables better (as compared to the interventions) targeting of public funds for co-financing compensations paid to those producers who insured a certain, reasonable level of income, but have not managed to obtain it for independent reasons. The government provides support from budget resources only to those agricultural producers who are insured, and only if their income falls below a specified portion or value in relation to the insured level. It is in fact a differently implemented and addressed income intervention, encouraging agricultural producers to take care of their own situation, or to put it differently, to insure own income. This way, the passive and demanding attitude of agricultural producers towards the government is eliminated.

If such system of support of income insurance for farmers was to be established, a question would have to be answered about the source of financing it. If it was financed from EU resources, the distribution of benefits among individual countries would be an important issue, because of diversified levels of changes in prices and income determinants in the EU. The use of national resources, which would involve renationalisation of agricultural policy, would lead to considerable diversification of benefits, depending on the budget possibilities of individual countries. The combination of the two above sources of financing seems to be the best solution.

It should be added that in result of the growing value of contributions towards agricultural insurance in countries such as USA, Canada or Spain, the WTO does not currently classify the majority of insurance programmes as green box anymore, but rather as amber box, which means that governments should limit their expenses for this purpose.

Insurance of agricultural income is among the types of insurance whose financing has been classified by the WTO as green box. There are several advantages of this type of insurance over traditional insurance against production losses. Compensation in case of such policies is paid only when the agricultural producer declares such need, because the compensation is associated with income, not with the revenues from any specific kind of production. Taking ac-

count of WTO restrictions, it is favourable that the support is less dependent on the volume of any specific kind agricultural production. Insurance companies designing such insurance policies may take advantage of the negative correlation between the yield volume in a given year and the prices of agricultural products, which would positively affect the value of compensation paid, and would additionally lower the cost of such policies. Designing most types of insurance policies, where the compensation payment depends on the level of prices, one should take account of the futures quotes, which allow insurance companies to assess the risk properly. The above restrictions result in the fact that income insurance, for which significant financial contributions are granted, is currently applied only in the USA and Canada. The attempts to offer insurance of agricultural income on free market principles in the United Kingdom and in Spain was unsuccessful, because very few entities were interested.

Index insurance is another type of policy, constructed in a way ensuring that it is not exposed to most of restrictions applicable to classical insurance policies. Functioning of index insurance can be compared to that that of options. The owner of index insurance contract gets a right to receive compensation, when the value of a specified index exceeds a threshold value. For agriculture, such an index can be for example the amount of precipitation or average yield in a given region. If the index value is correlated with production or economic results of agricultural holdings, the producers will be motivated to buy a given contract.

Index insurance contracts are free of disadvantages typical of traditional insurance policies associated with information asymmetry or moral hazards. Administrative costs involved in gathering data, liquidating damages, and distributing insurance policies are lowered. Furthermore, persons getting such insurance policy can include not agricultural producers but all the entities who believe that their situation depends on the situation in agriculture. Index insurance contracts, however, do not eliminate the problem of claims accumulation, and the basis risk is a disadvantage. Thus, they cannot be used as the only way of protection against fortuitous loss in agricultural production.

Apart from pilot programmes implemented in poor countries, index insurance is also popular in countries such as Brazil, USA and Canada. In the USA they have been available for over 15 years. Among others, the average yield in a given region is used as the index. For almost 10 years, some insurance policies have also been offered where average income from soya and maize crops in a given region is used as the index. European farmers are also interested in this type of insurance. A pilot programme has been implemented among others in Ukraine, Austria and the United Kingdom. In Austria, this insurance has been

used as a protection against the risk of draught, and the index value depended on meteorological data. In the United Kingdom, the data concerning average yield in a region multiplied by cereal prices have been used. To collect the latter, the LIFFE futures market has been used, which indicates the significance of the derivatives market.

Summary

The conducted studies made it possible to propose solutions and analytic methods useful in seeking answers to important questions related to the development perspectives of the national agri-food sector under the conditions of European integration, potential evolution of the CAP, and the changing macroeconomic environment. The results of the studies also made it possible to make interesting findings and to formulate important conclusions, which deserve including them in the evaluation of the assumptions and effects of the national agricultural policy and of the accuracy of selection of its instruments.

The primary determinant of the agricultural production growth, and in consequence of the agri-food sector income, is the consumer demand for food. This results from the derived character of the demand for agricultural raw materials and from the dependence of the agricultural producer's equilibrium on the agri-food processor's equilibrium, which is in turn conditional on the equilibrium of the consumer, who maximizes the usefulness. The rate of changes in the consumer demand for food is thus a resultant of the rate of population number changes and the rate of individual consumption changes.

Aside of the domestic demand, export can also be a source of income for the agri-food sector. Therefore, for forecast purposes or for examining various food demand growth scenarios, we can assume that the rate of changes in food demand resulting from the equilibrium conditions is the sum of the rate of population number changes and the rate of individual consumption changes, adjusted by the effect (positive or negative) of the trade exchange balance. Such an analytic approach can be used to determine the real growth capabilities of the agri-food sector income, determining in turn the growth capabilities of the agricultural producers' income. It should be noted that, in Polish conditions, these capabilities will depend in near future on the population income and export. Taking into consideration the limitations on the agricultural producers' income, both demographic ones and those resulting from the low income flexibility of the demand for food, the second factor will be especially important. The relatively high, positive balance of trade in agri-food goods, which developed after Poland's accession to the EU, is a proof of significant capabilities in this area. Hence, in order to maintain this position and to possibly endeavour further export expansion, our country needs carefully thought out and coordinated collective activities supported out of public funds which will promote Polish food products in the European and global markets.

The producers' income also depends on the allocation of income in the individual links of the food marketing chain. One of the manifestations of this allocation is the formation of the so-called price spreads, illustrating the differences between the prices of food products and the prices of agricultural raw materials utilized to produce them. In general, increase in the price spreads with simultaneous increase in the consumer expenditure on food has negative influence on the income of agricultural producers, resulting from the decrease in their share in the income generated in the whole agri-food sector. Based on the analysis of the price spreads in the markets of basic agricultural raw materials and food products encompassing the years 1996-2008, one cannot speak of any unambiguous model of their shaping in that period. The sizes of those spreads differed significantly depending on the type of agricultural and food products and their processing degree. It should be noted that, excluding the markets of rape, rape oil, margarine, milk and main dairy products, the price spreads in the remaining agri-food markets were showing a tendency for growth. All the analyzed spreads were characterised by high variability, attesting to the lack of immediate and full transmission of price impulses in the marketing chain.

The course of the price transmission process, and consequently formation of the price spreads over time, depends on the competiveness of the discussed market structures and on the market strength distribution in the marketing chain. The results of studies dealing with the price responses of agri-food processing enterprises to changes in the prices of agricultural raw materials indicate a far-reaching differentiation in the importance of the essential factors shaping the price behaviours of the processing enterprises, as well as in the rate and scale of final product price changes compared to raw material price changes, depending on the given market type and the market power of suppliers and buyers. In this context, the most important implication of the price behaviours of agri-food processing enterprises for the transmission process course, and in consequence also for the formation of price spreads over a longer period, turned out to be shifting of the price pressure, conditional on the competitiveness and consumer demand, from the retail link to the agricultural producer link. Such kinds of price behaviour of enterprises contribute to creating asymmetry in the price transmission process in the food marketing chain, causing negative income implications for agricultural producers.

The results of works devoted to modelling the character and effects of potential changes in the CAP made it possible to evaluate the impact of these changes and macroeconomic determinants on the functioning of the Polish agri-food sector. Simulations carried out with the use of a mathematical multi-player game model show that the probability of CAP changes is characterised by vari-

ability in time, conditional on the dynamics of the system of economical and political interests and on the balance of power (pressure for change versus resistance to change), and the dependence on the possible scope of changes (relatively small probability of the lack of changes, as well as of sudden and far-reaching changes). Analysis of the potential solutions in this context lead to determining that the most probable one is a compromise contained between the two extremes – leaving the CAP unchanged on the one hand, and abandoning the CAP on the other hand. Evaluation of the economical impact of potential changes in the CAP can therefore be reduced to comparing the effects resulting from keeping and continuing the current solutions (the so-called base scenario) with the effects created by the possible introduction of changes. Three models, complementary in terms of assumptions and their base methodology, were employed for this purpose: AGMEMOD, MODROL and a structural DSGE model of the Polish economy.

Comparing the results for the base scenario (lack of changes in the CAP) with the results for the Health Check (HC) scenario, simulated with the use of the AGMEMOD model, indicates a insignificant impact of this reform on the demand-supply relations in the main national agricultural markets, with the exception of the milk and dairy products market. The main effect of this reform is increase in the milk production and purchase, leading to increase in the production of dairy products, decrease in their prices and increase in the national consumption. Similarly as in case of the HC reform, elimination of direct payments would cause relatively small changes in the demand and supply structure in agricultural markets. They would be noticeable first of all in the markets of products directly linked to earth, and hence grain and other industrial crops. The course of these changes in the scenario of incremental abolishment of payments is milder than in the one-time liquidation scenario. Additionally, the results of simulation with the use of the AGMEMOD model show that, in the conditions of progressing globalization, change in instruments of the EU agricultural policy will have a significantly lower impact on the production and prices in the agri-food sector than the demand-supply situation in the world.

The results of estimation with the use of the MODROL model allow to presume that introduction of payments was not neutral to the shaping of the volume and the value of the national grain production in the period after accession to the EU, although their hypothetical lack need not have negatively influenced at all the level and the value of this production in each year of the analyzed period. A clear, positive impact of this instruments, not only on the grain producers' income, but also on the production volume, was revealed, which to some extent contradicts the conception of separating this form of support for agricul-

ture from the production level. The results of estimation of dependencies in the livestock and meat products markets show that Poland's access to the EU had also a significant impact on the production volume and the purchase prices, which resulted in income changes. It should be also noted here that this was not a direct consequence of introducing direct payments, but rather a consequence of the EU market influence.

Keeping in mind the scale of the CAP as a form of public intervention, we can assume that its implications are not limited just to the agri-food sector. This is confirmed by the results of simulation using the DSGE class model, showing that the CAP can generate strong effects in the labour market, inducing its beneficiaries to pension-seeking behaviours. By favouring increase in professional inactivity in agricultural holdings, it can limit the flow of workers from agriculture to other sectors. Investment subsidies should lead to increased accumulation of capital involved in the agricultural production, but with simultaneous inhibition of the human resources flow to other sectors of the economy, this can translate to decrease in the total productivity level of production factors in the agricultural sector, and in consequence to weakening of its competitiveness.

While direct payments in agriculture have an undeniable positive impact on the income of households (especially agricultural ones), as well as the remuneration and product levels on the national scale, their influence on employment outside agriculture is unambiguously negative. A relative – compared to the long-term declining trend – increase in employment resulting from introducing direct payments could appear only in agriculture. The price for this is the weakening of the incentives to modernize holdings by replacing work with capital, visible in the lowering (relative to the trend) of the investment rate in the agricultural sector. At the same time, even if the influence of the first CAP pillar on the GDP in agriculture and the power industry, connected to it by inter-branch flows, are positive, the situation is different in case of other economy sectors. Direct payments have an especially negative impact on the industry, which incurs losses due to increases in the prices of investment assets and energy, and which, as the economy sector most strongly oriented at export, does not benefit from the increase in the national consumption demand in a degree comparable to other sectors, such as power industry or services. Therefore, from the viewpoint of structural transformations in agriculture, limiting or abolishing direct payments would benefit the whole economy, in the short term speeding up reallocation of human resources and capital to sectors other than agriculture (especially services and industry). In the case of the CAP component subsidizing employment in agriculture, it would also favour stimulation of investments in the

sector, which are currently pushed out by “free” (that is, not requiring capital accumulation for the future) private consumption.

While looking into the prospects and effects of CAP changes, we should stress that its further liberalization can contribute to increasing the variability of prices and agricultural producers’ income. The conducted studies imply that the prices of the most important agricultural products in Poland are already significantly varied, which is a sign of price risk occurrence. The highest level of this risk occurs in the grain and pork markets, and is primarily related to cyclic changes. The occurrence of periods of relative stabilization of prices, as well as of their increased variability, is characteristic for all agricultural markets. It has turned out as well that access to the European Union did not cause a decrease in the price risk in the market of basic agricultural products. However, the sensitivity of agricultural producers’ income to the price changes has significantly decreased thanks to the introduction of direct payments and other CAP instruments. The results of studies also show that domestic prices are more and more determined by the level of European and global prices. Changes in currency exchange rates play an important role in the price transmission as well, which makes the agricultural producers exposed to the currency risk. Changes in currency exchange rates also determine changes in the means of production prices and influence the level of direct payments.

Taking into account the very real prospect of price risk increase in the conditions of the progressing processes of globalization and liberalization of the agricultural policy, we should assume that market instruments of risk management will become more and more important. Agricultural producers should individually and actively choose the appropriate strategies and instruments that will allow to reduce the market risk, and therefore to limit the uncertainty concerning achievement of the assumed income targets. We should not think, however, that all producers should apply price risk management instruments. Full protection against the price risk is not always necessary, and, based on the evaluations and forecasts, it can turn out that it does not pay to apply instruments of this type. In the conditions of uncertainty, analyses and forecasts can be therefore used as a substitute for other methods of limiting risk. The market information system plays an important role in this respect by increasing the transparency of market operations and facilitating individual decisions.

The primary method of risk management by agricultural producers is still an appropriate organization of the agricultural holding, together with the use of correct production techniques, adapted to the natural conditions. A proper diversification of the production has a similar character. These actions have a significant importance for limiting the production risk. Insurance is an important form

of limiting the production risk, and therefore the income risk, as well. However, due to problems related to asymmetry of information and the temptation of abuse, the tendency of insurance companies to sign such agreements is limited. Support for the insurance market provided out of public funds usually does not solve these problems, although it increases the degree to which farmers use insurance protection.

Standard derivative instruments, like *futures* and options, can also be employed in managing the price risk. They allow agricultural producers to protect themselves against the consequences of a decrease in the obtained prices (hedging) through stabilizing them at the level of the given entity in the conditions of natural market fluctuations. Because such contracts can only be signed at a commodity exchange, their use to manage the price risk in practice requires either establishment of such an institution in the country or provision of a wider access to, for example, the pan-European LIFFE stock exchange. Despite the indisputable advantages of derivatives, it appears that *forwards* can be used more widely in price management. As they are directly related to the commodity market, they fulfil the expectations of the majority of agricultural producers in terms of limiting the price risk at the stage of production planning.

ANNEX

Annex no. 1

List of publications created under implementation of topic No. VIII used in developing the synthesis

1. LTP Report no. 113: *Managing price risk and the possibilities of stabilizing the income of agricultural producers [Zarządzanie ryzykiem cenowym a możliwości stabilizowania dochodów producentów rolnych]* (2008), Hamulczuk M., Stańko S. eds., IERiGŻ-PIB Warsaw.
2. LTP Report no. 137: *MODROL model of Polish agriculture for analyzing the effects of agricultural policy for the profitability of agricultural holdings [Model rolnictwa polskiego MODROL do analizy skutków polityki rolnej dla dochodowości gospodarstw rolnych]* (2009), Gadomski J., Owsiński J.W., IERiGŻ-PIB Warsaw.
3. LTP Report no. 148*: Managing price risk and the possibilities of stabilizing the income of agricultural producers – cognitive and application aspects [Zarządzanie ryzykiem cenowym a możliwości stabilizowania dochodów producentów rolnych – aspekty poznawcze i aplikacyjne]* (2009), Hamulczuk M., Stańko S. eds, IERiGŻ-PIB Warsaw.
4. LTP Report no. 149: *Analysis, forecasting and management of the price risk in basic agricultural markets – possibilities of stabilizing the income of agricultural producers (synthesis of the research task) [Analiza, prognozowanie i zarządzanie ryzykiem cenowym na podstawowych rynkach rolnych – możliwości stabilizowania dochodów producentów rolnych (synteza zadania badawczego)]*; (2009), IERiGŻ-PIB Warsaw.
5. LTP Report no. 164: *Dynamic stochastic general equilibrium state model as a tool supporting formulation of agricultural policy assumptions (synthesis of the research task) [Model dynamicznego stochastycznego stanu równowagi ogólnej jako narzędzie wspierające formułowanie założeń polityki rolnej (synteza zadania badawczego)]*; (2009), IERiGŻ-PIB Warsaw.
6. LTP Report no. 166: *Equilibrium of production growth in the agri-food sector – development of analytic methods and their ex-post and ex-ante verification (synthesis of the research task) [Równowaga wzrostu produkcji w sektorze rolno-spożywczym – rozwój metod analitycznych i ich weryfikacja ex-post i ex-ante (synteza zadania badawczego)]*; (2009), IERiGŻ-PIB Warsaw.
7. LTP Report no. 169: *Premises of production growth in the agri-food sector – analytical and empirical approach [Przesłanki wzrostu produkcji w sektorze rolno-spożywczym – ujęcie analityczne i empiryczne]* (2009), Figiel S., Rembisz W., IERiGŻ-PIB Warsaw.

8. LTP Report no. 170: *Analysis of price spreads in main agri-food markets [Analiza rozstępów cenowych na głównych rynkach rolno-żywnościowych]* (2009), Figiel S., Popiołek R., IERiGŻ-PIB Warsaw.
9. LTP Report no. 171: *Competiveness of price behaviours of agri-food sector enterprises [Konkurencyjność cenowych zachowań przedsiębiorstw sektora rolno-spożywczego]* (2009), Figiel S., Kowalkowski A., Kozłowski W., Michalak J., Popiołek R., Rudzewicz A., Szulc R., IERiGŻ-PIB Warsaw.
10. LTP Report no. 172: *Applications of equilibrium models in the analysis of the agri-food sector [Zastosowania modeli równowagi w analizie sektora rolno-żywnościowego]* (2009), Bezat A., Figiel S., Klimkowski C., Kufel J., IERiGŻ-PIB Warsaw.
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Annex no. 2

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Annex no. 3

List of institutions cooperating within implementation of topic no. VIII of the Long-term Programme

Agricultural Market Agency

Institute for Structural Research

Systems Research Institute

Ministry of Agriculture and Rural Development

National Bank of Poland

Warsaw University of Life Sciences - SGGW

Warsaw School of Economics

University of Warmia and Mazury in Olsztyn

Poznań University of Life Sciences

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