The Role of Agri-food Processor in the Food Economics[1]

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ABSTRACT

Theoretical description of the agri-food market allows for identification of three entities whose interactions determine the market balance. In this perspective, we can distinguish consumers, agri-food processors and agricultural producers. They form a kind of circular flow of interdependent entities. The behavior of each of them conditions the behavior of others.

The goal of the paper is to evaluate the role of processor in the food supply chain. We also raise the question of food processors in the context of their impact on the producers through prices of agricultural raw materials. The considerations are made basing on formal analytical models referring to the standards on the reasoning in microeconomics which are expand by the empirical evidence of analyzed problems.

The processor is crucial to the sustainability of growth in the agri-food sector, because by seeking to maximize his objective function he determines the price level of agricultural products produced by the producers, under the assumption that the price of agricultural raw materials is determined by their marginal utility for the processor. It is also the basis for isolating the intermediate demand, which is reported by the agri-food processor for agricultural raw materials and direct (final) demand reported by the consumer.

Keywords: *agi-food sector; agri-food processor; food economics.*

Introduction

Theoretical description of the agri-food market allows for identification of three entities whose interactions determine the market balance. In this perspective, we can distinguish consumers, agri-food processors and agricultural producers. They form a kind of circular flow of interdependent entities. The behaviour of each of them conditions the behaviour of others. Demand for finished food products provides market conditions for agri-food processors. They, in turn, create demand conditions for agricultural producers. Both these entities, i.e. both the consumer and the processor shape the market situation.

Agricultural products, before they reach the final recipient, are subject to increased processing, resulting in additional charges for these services. Agri-food processor responds to the preferences and needs of saving time on food consumption "by changing and adding to the form in which the product is ready for consumption and expanding the variety of products offered to the consumer from agricultural raw materials.[3] Generally, it is associated with changes in the consumer utility function" (Rembisz, 2008, p 77).

Agri-food processor shapes the conditions for other market participants, i.e. agricultural producers and the consumers.[4] Influence on the consumer results from the increased demand for processed products, which in turn entails the increasing role of the processor. The increasing importance of the latter is associated with

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[3] More on agri-food supply chain coordination which is achieved by applying coordination mechanisms (supply chain contract) in Handayati at al. (2015).
[4] More on agri-food chain relationships on the example of Europe in Fischer at al. (2008).

the role of prices of agricultural products, which are used by the processor as raw materials. In light of the foregoing, the growth of the processing sector creates the so called "price gap", which is the source of financing activity in the food chain, including funding of services related to the purchase of agricultural products, storage, processing and enrichment of value in use, primary, wholesale and secondary trade, distribution, retail trade, advertising, etc. As emphasized in accordance with the principles of sound management, the processor must either maximize the utility effect in the form of food goods from purchased raw materials, or minimize the consumption of raw materials for the given utility effect. It comes down to the cost of obtaining unit utility – the food goods.[5] At a given time, the level of isocost line for the processor mostly results from the price level of agricultural products purchased as food raw materials. This also affects the market-shaped part of the value of agricultural product in the food product. This process is done on the basis of mutual influence. In fact, it is the market settlement of conflicting interests of the agricultural producer,[6] as a supplier of raw materials and the interests of agri-food processor, as a producer of finished food goods (Bezat-Jarzębowska et al., 2011). The increased role of processing[7] is also reflected in the diversity of values of income and price elasticity of demand for food in comparison to the same ratios calculated for agricultural products (Cochrane, 1986, pp 63). They are, in fact referred to the two levels of the same agri-food market on the basis of the rolling principle, or one can adopt that they pertain to two separate markets.

The goal of the paper is to compare the role of the agri-food processor in chosen European countries. The analysis is made basing on analytical formulas with referring to the standards on the reasoning in microeconomics which are expand by the empirical evidence of analyzed problems. Due to the fact that we use mainly analytical rather than estimating approach, empirical study is relevant mostly to illustrate and confirm the analytical formulas adopted in the paper.

Analytical considerations

Agri-food processor is responsible for the demand side on the market of agricultural raw materials and the market of inputs associated with the processing of agricultural products. He is also responsible for the supply side on the market for food products. For it is the agri-food processor that determines demand conditions for the agricultural producer. The producer should adapt to these conditions.[8] Referring to the terminology used in management sciences, the processor can be classified to the nearest market environment of the producer as the most important business partner. The processor creates a market for the agricultural producer (Seremak-Bulge, 2006, pp 72).[9]

The agri-food processor, by making decisions regarding the use of inputs, in particular regarding the relationship of raw material and its processing, takes into account not only the level of prices of these mutually substitutable inputs, but also other factors (quality norms and standards, health requirements, which are included in costs associated with the processing of agricultural raw materials). From the micro-economic point of view, the behavior of the agri-food processor is recognized in terms of the choice of the producer for maximization of his profit function. Inputs, which he uses in operations are, in addition to agricultural raw materials (agricultural products), also the inputs associated with the processing of agricultural raw materials. We assume that the processor acts rationally and has rational expectations. Thus, in a situation in which he anticipates an increase in agricultural prices he will intensify its processing, to obtain the maximum effect from the same individual effort (objective functions). The prices of these inputs, i.e. of agricultural raw material and its processing with a given financial limit are components of the budget constraint, i.e. isocosts. This sets pricing terms for agricultural raw materials. We should note here that agri-food processors, increase their efficiency of processing these agricultural raw materials (they maximize utility, i.e. profit from the input – agricultural raw

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[5] From this point of view demand can't be considered as a growth dynamization factor of agri-food production. This places a greater requirement for efficiency, both in terms of the agri-food processor and the agricultural producer.

[6] On the market for agricultural products as raw materials for the production of finished food products the elasticity of demand is relatively low and there is a price gap. This creates certain problems when it comes to the implementation of the objective function of agricultural producers. They cannot count on an increase in demand and, consequently, an increase in production and prices, as a source of growth of income. This source may be the improved production efficiency.

[7] Due to the increasing role of the processors as discussed above, and the recessive nature of the market, agricultural producers who seek to improve their income are forced to use the possibilities in the field of productivity of production factors, for more see Bezat-Jarzębowska and Rembisz (2015).

[8] Producers and processors make their decisions primarily or exclusively on the basis of signals from the market and the production and processing of food are increasingly subject to market risk (Seremak-Bulge, 2006).

[9] We do not include here the importance of direct markets: agricultural producer-consumer.

material). As a result, this leads to a decrease in demand for agricultural products and their prices, which in turn restores equilibrium conditions on processors' side and, in effect, on the market for food products.[10]

Let us then analyse the choice of the agri-food processors. The objective function of the processor is to maximize profit, expressed by the formula:

$$p_F \cdot g(R, I) - (p_R \cdot R + p_I \cdot I) \ \to max$$

where:

p_F – price of food product,

R – agricultural products (agricultural raw material),

I – inputs related to the processing of agricultural raw materials,

$g(R, I)$ – supply of food products,

p_R – price of agricultural raw material,

p_I – price of inputs associated with the processing of agricultural raw material.

The agri-food processor seeking to maximize the profit replaces relatively more expensive input by the relatively cheaper one. This has implications for the agricultural producer. The processor, in fact, seeks to use agricultural raw materials in a most rational way in order to maximize profit. He processes them more completely adding value in use. This creates demand and limits increase in prices of agricultural products. Decision variables in this approach are the inputs associated with the processing of agricultural products used by the processor as raw materials and the agricultural products. In the latter case, of course, the most important is the buying price of the agricultural product as a raw material.

It is assumed that the objective function of the processor is to minimize the cost incurred to obtain food product for a given amount of production (demand) thus:

$$p_R \cdot R + p_I \cdot I \to min$$

Prices (pay) for each input must be equal to their marginal productivities, which is the canon for the producer in terms of competitive balance. Then, only the processor has endogenous sources of funding, because the assumption that the price of the product of the processor is fixed is implicitly held. It is assumed, therefore, that – particularly in the short term – the prices of agricultural raw materials depend on their marginal utility for processors. This is also determined by the purchase price of the agricultural producer, i.e. the maximum price the processor can pay to the agricultural producer. Therefore, the processor is crucial to the sustainability of growth in the agri-food sector, because by seeking to maximize his objective function he determines the price level of agricultural products produced by the producers, under the assumption that the price of agricultural raw materials is determined by their marginal utility for the processor.

We equal the revenue of agri-food processor and the cots indicated in previous equation, thus we have:

$$p_F \cdot F = p_R \cdot R + p_I \cdot I$$

where:

F – food product.

With a given formula of revenue of the agri-food processor (above), we can determine demand for agricultural products and inputs related to their processing. The demand for agricultural raw material is as follows:

$$R = \frac{p_F \cdot F}{p_R}$$

The demand for other inputs related to the processing, transport and trade in food:

$$I = \frac{p_F \cdot F}{p_I}$$

Because the paper focuses on the relation between the agricultural producer and agri-food processor we leave on a side the analyses concerning demand on other inputs related to the processing. Using the equation of demand for agricultural material we get the following formula:

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[10] Wider discussion with evidence in W. Rembisz (1990, pp 65-67 and 83-89).

$$p_R = \frac{p_F \cdot F}{R}$$

and keeping the assumption of a constant price level of food products ($p_F = constant$), in relative terms we have:

$$\frac{\Delta p_R}{p_R} \Rightarrow \frac{\Delta F}{F} - \frac{\Delta R}{R}$$

The right side of equation (above) is the rate of change in the gap, which reflects the change in the degree of use of agricultural raw materials by the processor. The relationship above implies that the price changes of agricultural products determines the changes in the gap between the demand for food products and the supply of agricultural raw material. Nevertheless, the inverse relation might occur on the market, ie. behavior of the agri-food processor (change in the degree of use of agricultural raw materials by the processor) might in some extend influence the price level of agricultural products. Thus, the gap might determine the increase in prices of agricultural products.

The both reactions of the market were described in the above part of the paper. And hereby within the framework of the paper the problem of the role of agri-food processor in the agricultural economics was raised. Some empirical evidence on the scientific problem was shown in the next part of the paper. The detailed analyses will be a topic of further research.

Empirical evidence

Analytical considerations presented in the previous part of the paper were illustrated by using the data from FAO Statistics Data Base.

The above considerations concerning the changes analyzed in the above formula calculated for Germany, Poland, France and the Netherlands on the example of wheat were presented in the Figure 1-4. The choice of the good and the time period was influenced by availability of data.

In all the analyzed countries the production volume is increasing in years 1991-2011, the most significant increase was observed in Germany. On the other side the wheat and products supply was remaining on the similar level (slightly increasing) within the time period 1991-2011 in all the countries. The prices of wheat in Germany, France and the Netherlands shows the declining trend from 1991 up to 2002 and after increase was noticed. In Poland significant increase was observe in 1995-1997 and after the EU-accession, since when the price level is more or less the same as in case of other countries.

Figure 1. The value of wheat prices on the producer level (p_R), production volume of wheat, (R) and wheat and products supply (F) in Germany in years 1991-2011
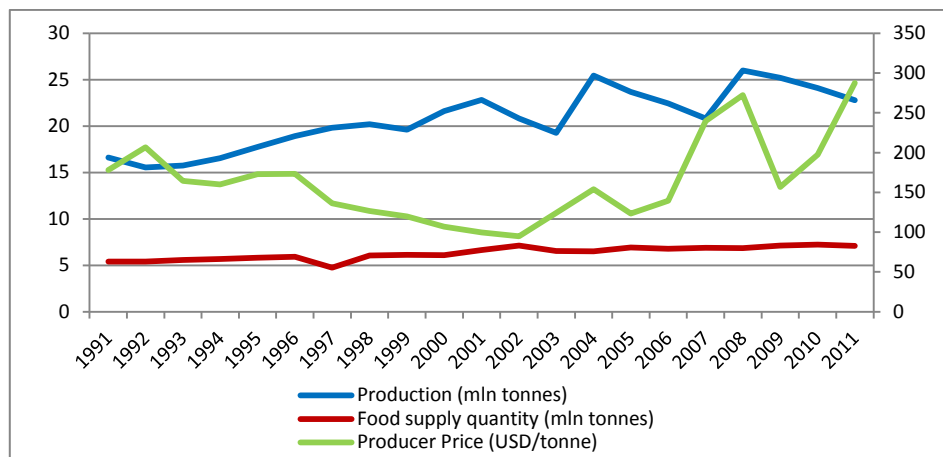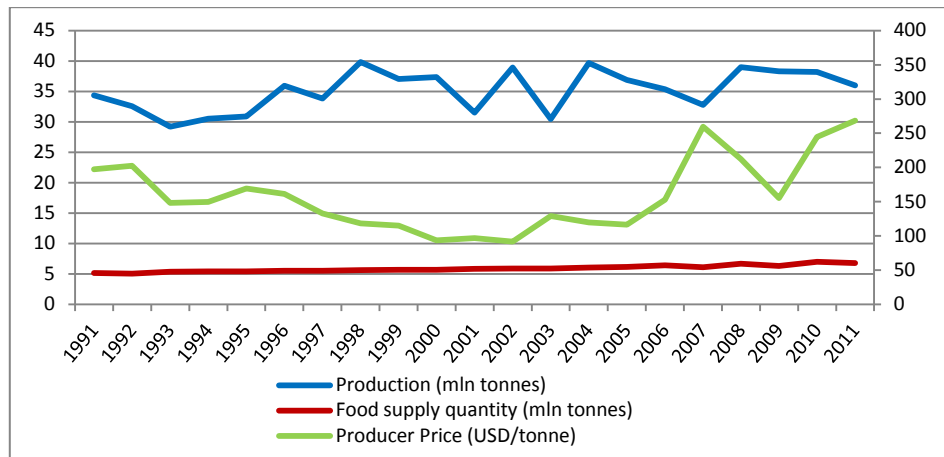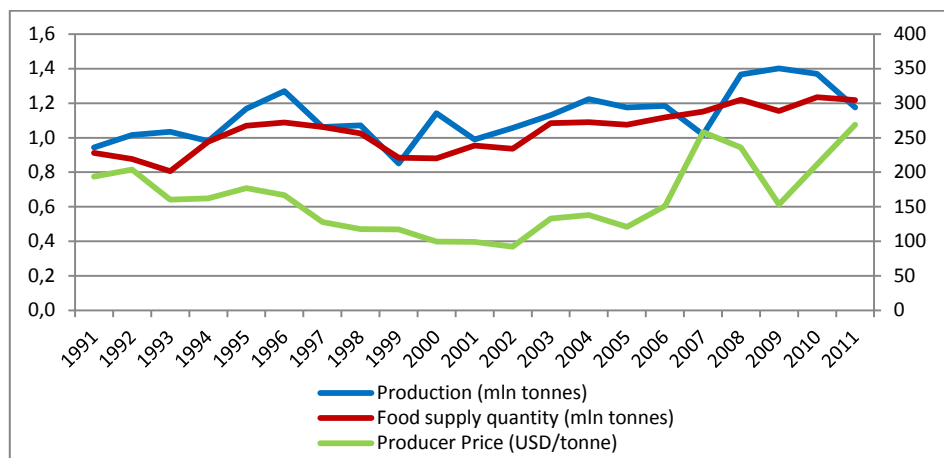

Source: Own compilation based on the FAO Statistics Data Base.

Figure 2. The value of wheat prices on the producer level (p_R), production volume of wheat, (R) and wheat and products supply (F) in Poland in years 1991-2011
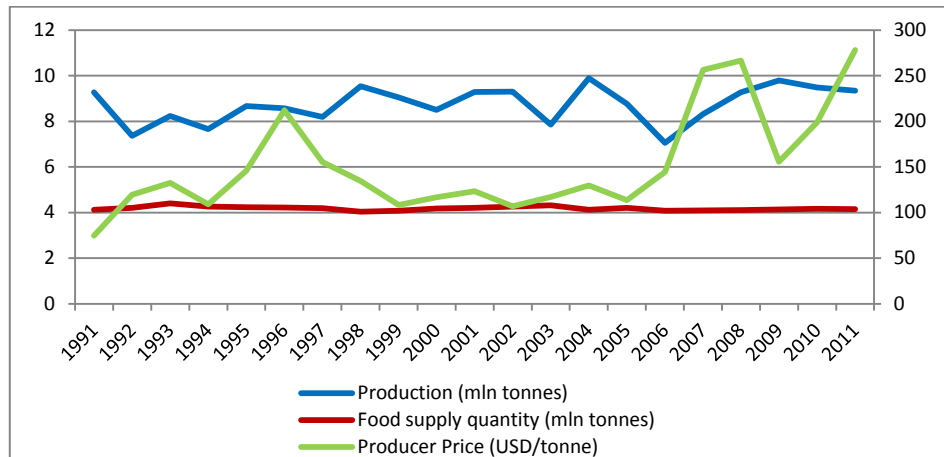
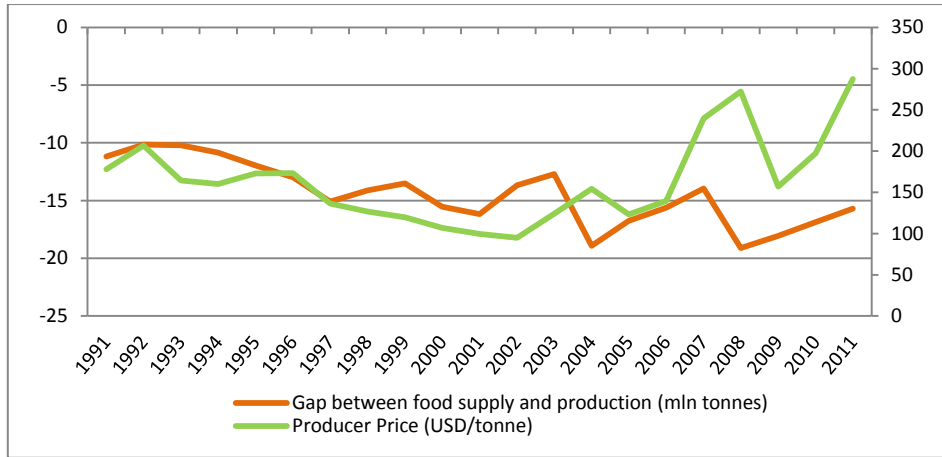*Source: Own compilation based on the FAO Statistics Data Base.*

Figure 3. The value of wheat prices on the producer level (p_R), production volume of wheat, (R) and wheat and products supply (F) in France in years 1991-2011

Source: Own compilation based on the FAO Statistics Data Base.

Figure 4. The value of wheat prices on the producer level (p_R), production volume of wheat, (R) and wheat and products supply (F) in the Netherlands in years 1991-2011

Source: Own compilation based on the FAO Statistics Data Base.
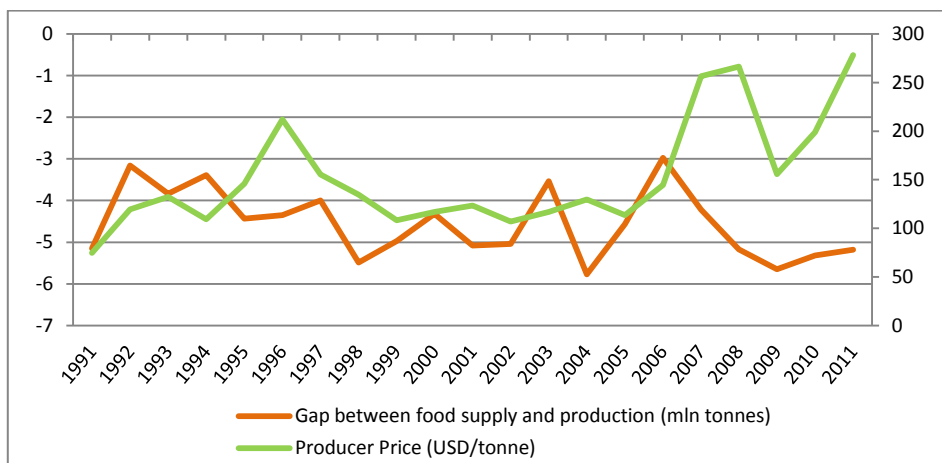
The difference between wheat and products supply and production of wheat (further on called the gap) was presented in the Figure 5-8 in order to analyze the relationships occurring between the gap and the price of wheat. As we can see, the is a similar trend changes of this two variables noticeable, mainly in Germany and in France. Only in case of the Netherlands up to year 2004 some differences were shown. Nevertheless, the volume of production is quite low in the Netherlands in comparison to the other countries.

Figure 5. The value of wheat prices on the producer level (p_R) and the gap between wheat and products supply and production of wheat in Germany in years 1991-2011
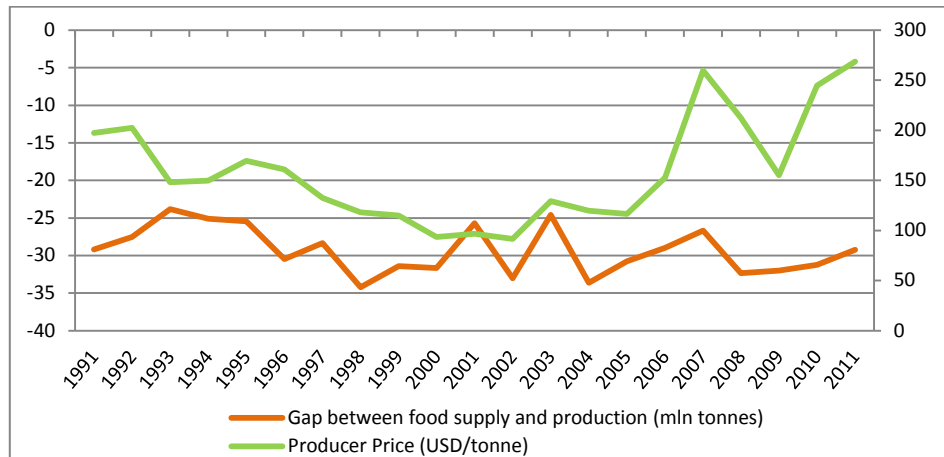

Source: Own compilation based on the FAO Statistics Data Base.

Figure 6. The value of wheat prices on the producer level (p_R) and the gap between wheat and products supply and production of wheat in Poland in years 1991-2011
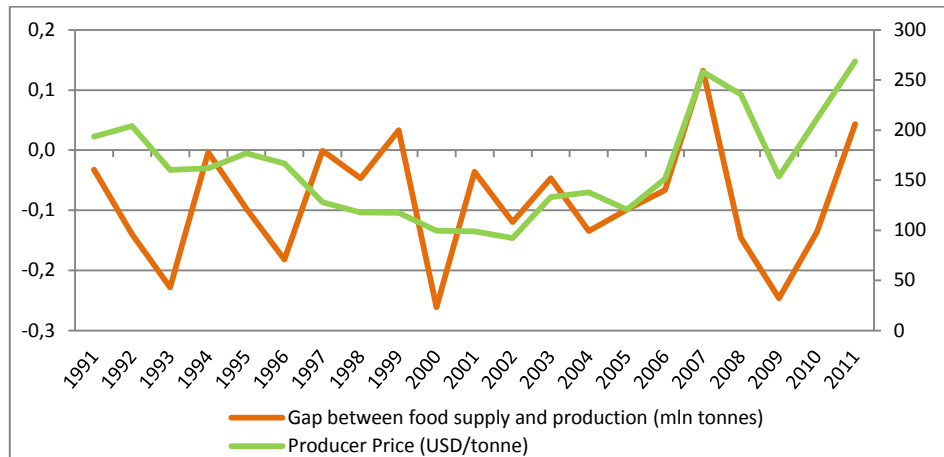

Source: Own compilation based on the FAO Statistics Data Base.

Figure 7. The value of wheat prices on the producer level (p_R) and gap between wheat and products supply and production of wheat in France in years 1991-2011

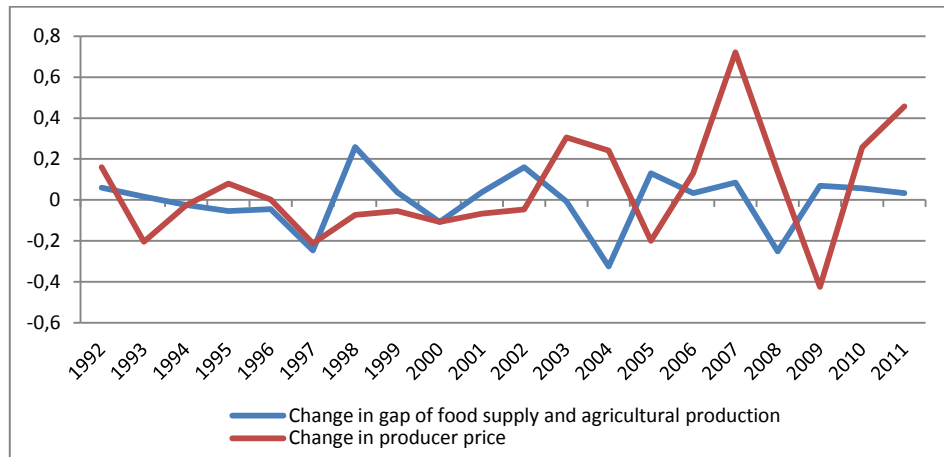*Source: Own compilation based on the FAO Statistics Data Base.*

Figure 8. The value of wheat prices on the producer level (p_R) and the gap between wheat and products supply and production of wheat in the Netherlands in years 1991-2011

Source: Own compilation based on the FAO Statistics Data Base.

In order to compare the changes in price level of agricultural producers with the changes in gap of food supply and agricultural production (the last formula described in the previous part of the paper) the empirical illustration were presented. The analysed price changes and changes in gap of food supply and agricultural production were shown in Figures 9-12. As an example, similar as in case of previous illustrations, the wheat market was used.

Figure 9. The change in producer price of wheat and change in gap of wheat and products supply and production of wheat in Germany in years 1992-2011

Source: Own compilation based on the FAO Statistics Data Base.

Figure 10. The change in producer price of wheat and change in gap of wheat and products supply and production of wheat in Poland in years 1992-2011
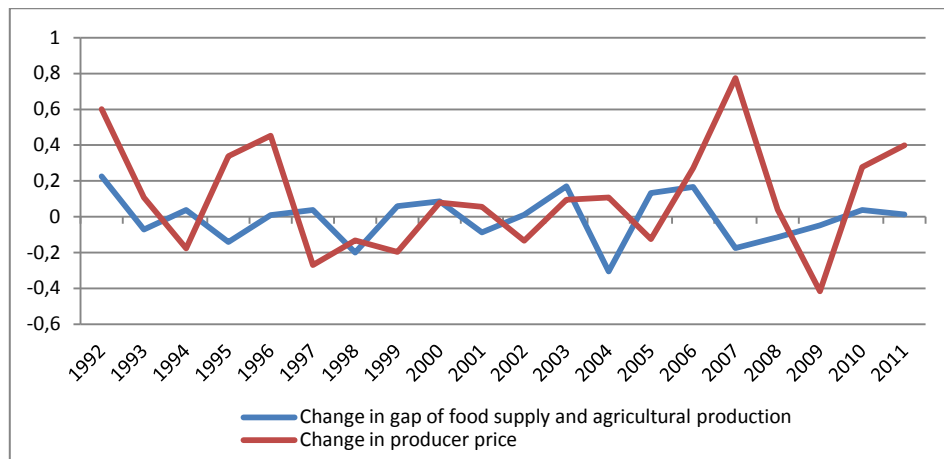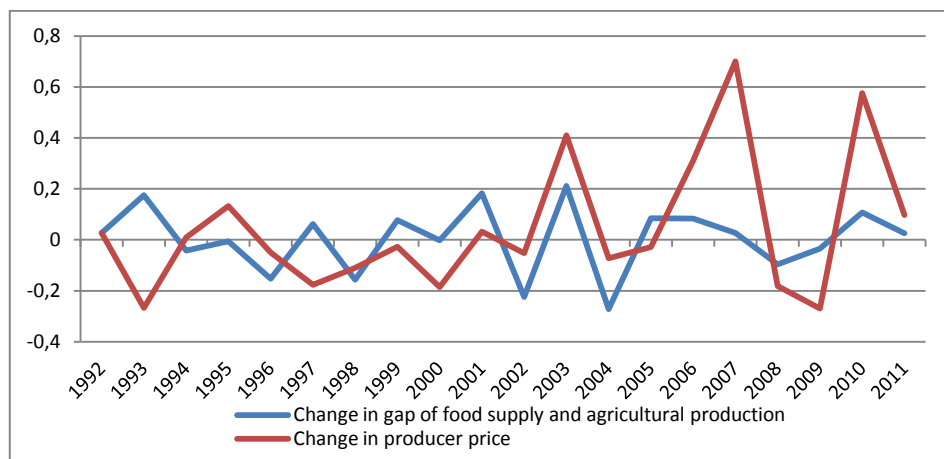

Source: Own compilation based on the FAO Statistics Data Base.

Figure 11. The change in producer price of wheat and change in gap of wheat and products supply and production of wheat in France in years 1992-2011
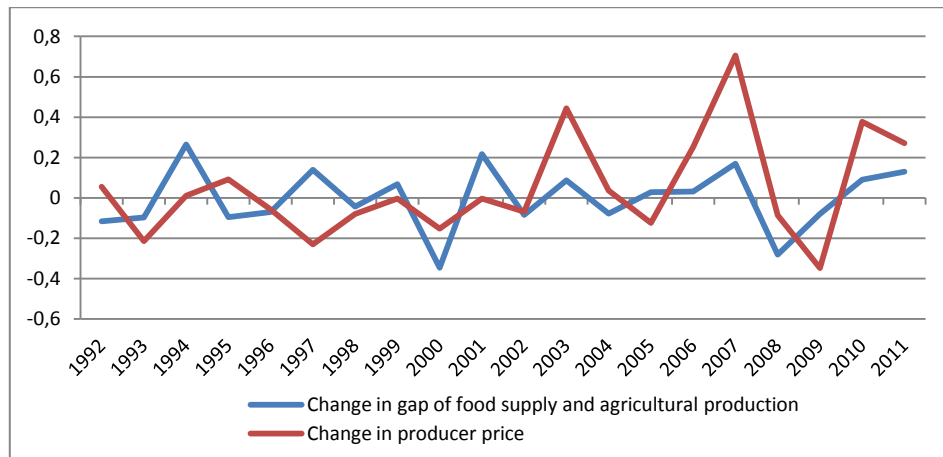

Source: Own compilation based on the FAO Statistics Data Base.

Figure 12. The change in producer price of wheat and change in gap of wheat and products supply and production of wheat in the Netherlands in years 1992-2011

Source: Own compilation based on the FAO Statistics Data Base.

In case of Germany, Poland and the Netherlands the behavior of agri-food processor (change in gap) seems to influence in some extend the change in price. Thus, the processor behavior (the role of agri-food processor) which is presented in the study (what we have seen as the gap between wheat and products supply and the production of wheat) is related to the price level of agricultural products. Nevertheless, in France in some years an opposite reaction is observed, ie. the price level of agricultural products determines the agri-food processor gap. Thus, the changes in both analysed values might influence each other mutually what we have stated in the theoretical part of the paper. In this sense, empirical analysis and graphical illustrations, verify positively the assumptions and reasoning.

Conclusions

In the study we made a preliminary assumption to analyse the role of agri-food processor. We based on microeconomic analytical formulas describing the choices of the processor which has been subjected to a preliminary empirical verification. The data collected from international statistics (FAO Statistic Data Base) are mainly to illustrate regularities or conclusions derived from the selected analytical formulas.

On the example of selected countries of the European Union, we illustrated the key formulas of behaviour of agri-processor and we made a comparison between the analysed countries. We confirmed that the price level of agricultural products produced by the producers is related to the processor's behavior. Thus, the gap might determine the increase in prices of agricultural products. Nevertheless, the inverse relation might occur on the market, ie. the price level of agricultural products influences the behavior of the agri-food processor (change in the degree of use of agricultural raw materials by the processor).

The conducted study confirm that the increasing importance of the agri-food producer is associated with the role of prices of agricultural products, which are used by the processor as raw materials. As we have mentioned, at a given time, the level of isocost line for the processor mostly results from the price level of agricultural products purchased as food raw materials. This also affects the market-shaped part of the value of agricultural product in the food product. Nevertheless, this process is done on the basis of mutual influence. Thus, the agri-food processor reacts on the changes in agricultural products' prices trying to maximize his objective function (makes better use of agricultural raw materials, which relatively reduces the need for increased production of agricultural raw material and the possibility of an increase in its price).

Within the framework of the paper we opened the discussion of role of agri-food processor in the food supply chain, nevertheless, the detailed analyses and further research of the topic is needed.

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