DUOPOLY PRICE COMPETITION ON MARKETS WITH AGRICULTURAL PRODUCTS

M. Prášilová, L. Severová, L. Kopecká, R. Svoboda

Abstract

PRÁŠILOVÁ, M., SEVEROVÁ, L., KOPECKÁ, L., SVOBODA, R.: *Duopoly price competition on markets with agricultural products.* Acta univ. agric. et silvic. Mendel. Brun., 2011, LIX, No. 4, pp. 241–250

A situation, in which two firms compete, is in the economic theory described by duopoly models. Market equilibrium on the duopoly market is formed in a reciprocal adjustment process of market prices and materialized market opportunities. The goal of the analysis is to find out whether the agricultural products market is significantly influenced by appearance of duopolies, what form they have and if they can fundamentally influence the price level of food. That food chain stores endeavour to mutually adapt food product prices is generally known; it is set especially by the inelastic demand for the mentioned goods on the side of consumers, i.e., by the need to demand basic food. Duopoly reactions to price competition in food chain stores are particularly strong in the case of commodities of milk and tomatoes, where the reactions and approximation of prices can be clearly seen. Based on statistical research it is obvious that the reactions are most reflected on sales of the food chain stores Billa and Albert. To identify specific reactions of price duopoly at retail chains the ANOVA statistical method was used. The firm's duopoly behaviour as such on the food market need not be a subject for applying punishment from the antimonopoly bureau, if it does not have the cartel agreement character. An example can be the identical potato prices inquiry in the supermarkets of food chain stores.

duopoly, price competition, chain stores, ANOVA, Bertrand model, Chamberlin model, Sweezy model

Oligopoly can be defined as a market model of imperfect competition, for which a small number of firms within a sector is characteristic, as well as their high level of mutual dependence when considering their decision making (about prices, quantities, quality etc.). Oligopoly competition thus assumes existence of only a few firms in the sector, out of which at least some have a significant market share and can influence the product price on the market. When behaving oligopolistically, a supplying company influences the market demand and supply of the entire sector and therefore, while deciding on the volume of supply on the market, it has to count – besides the demand – also with the reaction of its competitor to its decision; at the same time it itself reacts to the decisions by its competitors. They include the expected competitors' reaction in the expected demand function.

The goal of the following study is to find out whether the agricultural products market is significantly influenced by the appearance of duopolies, what form they have and whether they can fundamentally influence the price level of food and thus have an impact on the consumers' demand for food.

MATERIAL AND METHODS

The basic theoretic model of an oligopoly competition behaviour in the conditions of post-industrial society introduced by Samuelson and Nordhaus (2005) is a basis for firms oligopoly behaviour investigation for most of the mainstream economists. The development of this theory of oligopoly into concrete market sector conditions is determined especially by Varian's microeconomic

analysis of an oligopoly sector (VARIAN, 1992); it is particularly focused on the definition of a product group. Both the neoclassic (Lipsey and Crystal) and the neo-Keynesian economic theories (Schiller) note not only differently defined types of collusive oligopoly, oligopoly with a dominant firm or duopoly models, but they also underline the need of government control over the oligopoly's market behaviour, even if there are notable differences in the particular approaches.

Duopoly models

A situation, where there are two firms at the market competing with each other, is in the economic theory described through duopoly models. Now, the decision making process of one firm meeting exactly one competitor on a market will be investigated. The relationship of two firms at a market can have various appearances, to which the particular duopoly models are connected.

A considerable variety of the oligopoly behaviour allows us to present only some of the simple types of expected reactions of competitors here, expressed by means of reaction functions.

Setting the equilibrium at duopoly market

Each firm within an oligopoly has its own function of expected demand, which includes the expected reaction of the buyers to the firm's choice as well as the expected competitor's reaction on the market price change and the change of realized quantity of supply. The firms maximize profit according to the imperfect competition condition:

$$MR(q) = MC(q) \qquad (1)$$

while choosing the quantities of supply, respectively:

$$MR(P) = MC(q(P)) \qquad (2)$$

while choosing the market price.

The market equilibrium at the duopoly market is formed in a process of mutual adaptation of the market prices and materialized market possibilities. This adaptation is based on the firm's expectations compared (according to the expected demand functions and expected competitor's reactions) with reality. This confrontation of expectations and reality leads to the expectation adjustment (expected demand function). A mutual correction of the expected firm's demand curves proceeds successively until the expectations are equal to reality. As soon as the harmony between expectations and reality is reached, thanks to corrections, the firms will be willing – under the same conditions, that is with the given supply function – to maintain the position at the oligopoly market. This state of things can be expressed as equilibrium formation on the duopoly market, which will be seen as certain market price stability as well as the stability of supplied product quantities.

In the case of duopoly, the newly established market equilibrium will be relatively stable according to the sector entering restrictions (in contradiction to the monopolistic competition). If, in the long run, any new firms yet enter the sector in an limited number, it will cause the firm's market prices to get closer to the firm's average costs, without complete reduction of economic profits ($P > AC$), because the accession of the firms will be restricted by a necessary capital requirement.

The main methods used for scientific investigation are the economic-mathematical modelling method (used for modelling of the maximum profit of individual duopoly models), the method of description (description of the duopoly behaviour of firms), further the historical method, the method of analysis and synthesis and partially other methods.

While elaborating the study, the source was published data from the ÚOHS about the most significant detected and fined oligopoly agreements in the years 1990–2008 in the food production sector (Agriculture Information Bulletin, 2008). For the theoretical part elaboration, the publications of noted American economists, dealing with the issues of oligopoly market structures and market risk were used.

RESULTS AND DISCUSSION

Price competition models in the agricultural products sector

While analyzing the duopoly behaviour of agricultural firms on the market in sales competition (Cournot and Stackelberg models) we presume that duopoly firms choose the volume of agricultural production (output). The volume of production q then sets the level of market price (P) by using the inverse demand functions knowledge. On the oligopoly markets of agricultural production, the firms can often decide even for a different behaviour. The duopoly firms set some flexible price as a basis from which they derive how much of the agricultural products can be presented on the market. The choice of the basic variable can be considered the main presumption of the agricultural firm's behaviour analysis on the duopoly market.

In the following text about price competition on the duopoly agricultural markets it is assumed that, agricultural firms set the price and their reactions on a competitor's market price change are investigated. As an example of agricultural production we chose a duopoly competition, where there are two trade cooperatives supplying raw cow milk (homogenous agricultural product) on livestock products market. The largest share on the raw cow milk market holds the Mlecoop trade cooperative, which is a trade association of nine trade cooperatives. The second strongest trade cooperative on the raw cow milk market is the "Mlékařské a hospodářské družstvo Jih" cooperative, associating individual

milk producers from south and west Bohemia and Moravia. As a similar example from the field of plant production we can present a potato market in the Czech Republic, where there are also two considerable trade cooperatives producing vegetables – CZ Fruit and Litozel.

Bertrand (Edgeworth) model

The Bertrand model is based on an assumption that in a certain sector (in our case the agricultural production) only two firms exist (duopoly). Both of the two firms supply a homogenous animal product of raw cow milk and compete with each other on the market; they are equally strong, what is expressed by the same total costs curves (TC). A firm in the Bertrand model plans the market price P_1 with the expected volume of output q_1. It expects that the competitor will not react by the market price P_2 on a change of its market price P_1. The same behaviour occurs even in its reaction on the competitor's market price change (VARIAN, 1992).

The expected reactions of the firms can be described by the functions:

a) $P_2 = P_2(P_1) = $ a constant with zero first derivative

$$\frac{\partial P_2}{\partial P_1} = 0 \tag{3}$$

(P_2 does not change with a change of P_1)

b) $P_1 = P_1(P_2)$, where $P_1 = $ a constant with zero first derivative

$$\frac{\partial P_1}{\partial P_2} = 0 \tag{4}$$

(P_1 does not change with a change of P_2).

The demand for milk supply from the agricultural firms in Bertrand model can be generally expressed by the function:

$$q_i = f(P_1, P_2) \qquad \text{for } i = 1, 2. \tag{5}$$

Then the expected demand function, while choosing the price P_1 by the first firm and the competitor's price will be:

$$q_1 = q_1(P_1, P_2). \tag{6}$$

Profit maximizing in Bertrand model

In the Bertrand model the agricultural firms are of the same strength; that is set by the same total costs functions TC:

$$TC_i = c \times q_i \qquad \text{for } i = 1, 2, \tag{7}$$

where c represents the marginal costs, q_i is the volume of milk production of the i-th firm.

Duopoly firms then maximize the profits from milk production according to the function:

$$\pi_i = P_i \times q_i(P_1, P_2) - c \times q_i(P_1, P_2) \qquad \text{for } i = 1,2. \tag{8}$$

The firm's competition in Bertrand model proceeds as follows; both of the two agricultural firms set together their milk production prices. If the price by the first firm is lower than the second firm's price, the first firm will occupy the whole milk market. Were it to the contrary, the whole market would be occupied by the second firm. If both of the two duopoly firms decide for a common milk price, each of them gets the exact half of the market demand for milk. This conclusion accrues from the assumption of the same total costs functions in the case of both firms. The firms reach a stable equilibrium only when they both set the milk price at the level of marginal costs. Because both of the firms have the same total costs functions, only one milk market price occurs, and it is equal to the marginal costs. With this milk price, the firms reach zero economic profit. The Bertrand model equilibrium can be expressed by the Fig. 1.
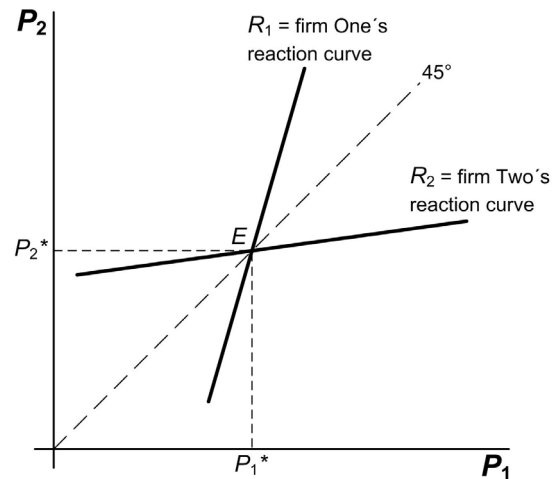
1: *Bertrand equilibrium*
Source: VARIAN, 1992

The reaction curves set the combinations of milk prices P_1 and P_2, which bring the given firm maximum profit; they have an appearance of a straight line with a positive angle coefficient. With the assumption of equal profit curves and reaction curves knowledge of both of the two agricultural firms, it is possible to find out an optimal price level (the price equilibrium of the model).

It is obvious from the graph that, both of the two agricultural firms sell their milk production for the same price. One of the assumptions of the model is the homogeneity of production and it is not possible to sell the same production on the same market for different prices. That is why the point E lies on the straight line, which starts from the point of beginning of the axes at an angle of 45°.

Duopoly price models with expected reactions from competitors

While analyzing the Bertrand duopoly model we set a simplifying assumption that the agricultural firm, while deciding, did not presume its competitor to react anyhow to its production price change (P).

In the following text this assumption is abandoned and it is assumed that, the agricultural firm plans to ask market price P_1 while expecting to supply quantity q_1. It expects the competitor to react to the potato price change. Its reaction to the market price of potatoes will be the same.

The expected reaction of both the two duopoly firms can be expressed by the functions:

a) $P_2^e = P_2(P_1)$ with the first derivative, not equal to zero

$$\frac{\partial P_2}{\partial P_1} \neq 0 \qquad (9)$$

(P_2 changes with the change of P_1)

b) $P_1^e = P_1(P_2)$ with the first derivative, not equal to zero

$$\frac{\partial P_1}{\partial P_2} \neq 0 \qquad (10)$$

(P_1 also changes with the change of P_2).

The expected demand function can have the form of:

$$q_1 = q_1(P_1, P_2(P_1)) \qquad (11)$$

with a revenue function:

$$TR_1 = P_1 \times q_1(P_1, P_2(P_1)). \qquad (12)$$

In principle we recognize three cases of possible price reactions of firms:
a) the price change of the second firm (P_2) can be the same as the price change of the first firm (P_1)
b) Chamberlin model
c) Sweezy model (also a model with a kinked demand curve).

The price change of the second firm (P_2) can be the same as the price change of the first firm (P_1)

The second duopoly firm reacts to a potato price growth (decline) P_1 by a growth (decline) of the potato price P_2.

Then the first firm is going to react the same way.

Chamberlin model

The Chamberlin model assumes that the competing firms will copy the competitor's potato market prices and place them into their own expected demand functions. One of them can be the price leader and the second firm will only passively adapt its potato price choice to the price of the price leader. Then we presume that:

$$\frac{\partial P_2}{\partial P_1} = \frac{\partial P_1}{\partial P_2} = 1. \qquad (13)$$

We consider the first firm to be in the position of price leader, to have an information advantage and to know the second firm's potato supply curve. The first firm maximizes its profit and takes into account a possible reaction of the second firm (the follower). The second firm copies the potato price, set by the price leader, as given and adapts to it passively.
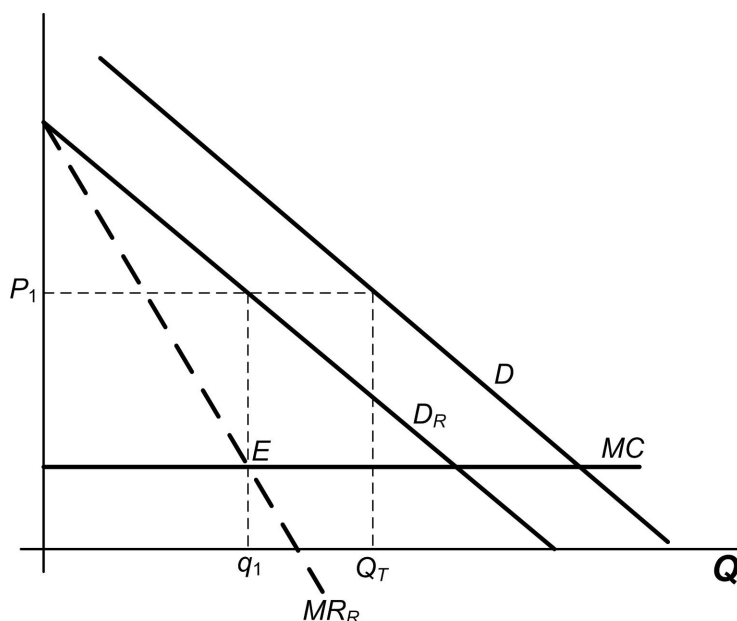
2: *Equilibrium in the price leader model*
Source: VARIAN, 1992

On the graph we can see the market demand D and the marginal costs of the second firm MC, which also show its potato supply curve. The leader (first firm) subtracts the marginal costs (supply from the market demand of the second firm and thus gets a reduced demand after its own potato production (D_R). The first firm maximizes its profits on the basis of marginal revenues equalization, derived from the reduced demand (D_R), with marginal costs (MC).

Since it is assumed the firms have the same cost functions, the course of the marginal costs of the first firm corresponds to the course of the competitor's (second firm) marginal costs. Optimum of the price leader appears in the point E, therefore the first firm will supply the production quantity q_1 on the market. The potato price will be derived from the reduced demand: an optimal volume of output thus matches the price P_1.

The second firm (follower) accepts the potato market price set by the leader. With this price, the total of Q_T units of production will be sold on the market. Inasmuch as the first firm supplies the market with q_1 units of output, the second firm gets a market share of:

$$q_2 = Q_T - q_1. \tag{14}$$

The price of the production on sale is higher than the firm's marginal costs, for which both of the two oligopoly firms reach (with an assumption of non-existent fixed costs) an economic profit. According to the larger market share the price leader reaches higher profits than the second firm in the passive role of follower.

Examples of firm's duopoly behaviour in food sector in the Czech Republic

By itself the firm's duopoly behaviour at the food market need not be subject to fines by the antimonopoly bureau, given it does not have cartel agreement character. The identical potato prices inquiry in the supermarkets of food chain stores can serve an example.

On December 8th, 2003, ÚOHS (the Office) started an administrative procedure with the companies AHOLD Czech Republic, BILLA, Carrefour ČR, DELVITA, Globus ČR, JULIUS MEINL, Kaufland ČR, PLUS – DISCOUNT, SPAR Czech trading company and Tesco Stores ČR. Possible breach of the law on protection of economic competition was seen by the Office in an agreement or action in common accord of participants of the procedure when setting the level of selling prices of potatoes for final consumers. When checking the levels of selling prices, the Office – among other facts – also found out that the selling price of the 2 kgs package of potatoes generally ranged between 29.50 CZK and 32 up to 34 CZK, while in the premises of seven participants of the procedure, the same level of selling prices – 29.90 CZK per 2 kgs package of potatoes was discovered. After the assessment of all facts and evidence gained during the course of

the administrative procedure, it was not proven by ÚOHS that the setting of selling prices of potatoes by the participants of the conduct and their level were a consequence of breach of the law.

As an opposite example of collusive oligopoly formation in case of two firms on the market a trade chains price cartel can be presented. The companies BILLA and Omega Retail (earlier JULIUS MEINL), which together coordinated and adjusted their purchase prices of goods and trading conditions towards their suppliers in years 2001 and 2002, were fined to pay 23.80 mil. CZK and 19.55 mil. CZK, respectively. These companies committed a price cartel when they were exchanged information about their purchase prices and bonus and discount systems. They compared this information and from their suppliers, they demanded levelling of their up-to-date financial conditions for purchase of goods to the level of another participant of the conduct (if he had them more convenient), moreover they also demanded financial compensations to balance incurred differences (Zemědělství, 2008).

By implemented agreements between themselves, cartel participants can exclude the risk of competition on market when an individual competitor does not have the information about an intended behaviour of his rival. Nevertheless, it is completely natural for competition on the market that competitors are forced to accept even inconvenient offers, if they want to further act on the market. Neither a continuing inexpedience of participation in economic competition on market does rehabilitate anti-competitive behaviour of subjects that are in the positions of mutual competitors. Such behaviour cannot even be rehabilitated by circumstances that influence agro production (for example Avian flu, increasing prices of energy) and production costs connected with that or by behaviour of other participants of competition on the market. Such common action of mutual competitors must be assessed as anti-competitive, because each participant in the competition on a market is supposed to act on his own and to carry the risks arising from it.

Of course there is a certain risk of being detected, but we can say "that the risk expresses a situation when the subject decides on the basis of information about the probability distribution of possible outcomes available" (ŠRÉDL, 2010).

Sweezy model (also the model with a kinked demand curve)

While analyzing models of duopolies described so far on examples of agricultureal production, most of the time we started from the assumption that the oligopoly firms supply a homogenous production, which they offer for an identical market price.

In the Sweezy model we presume that both of the two firms produce a specified product, for example bread (bakery, butter, cheese, etc.) and each firm expects that the competitor will not react on its market price increase, but it will react on its lowering by lowering his own price, as well. In the
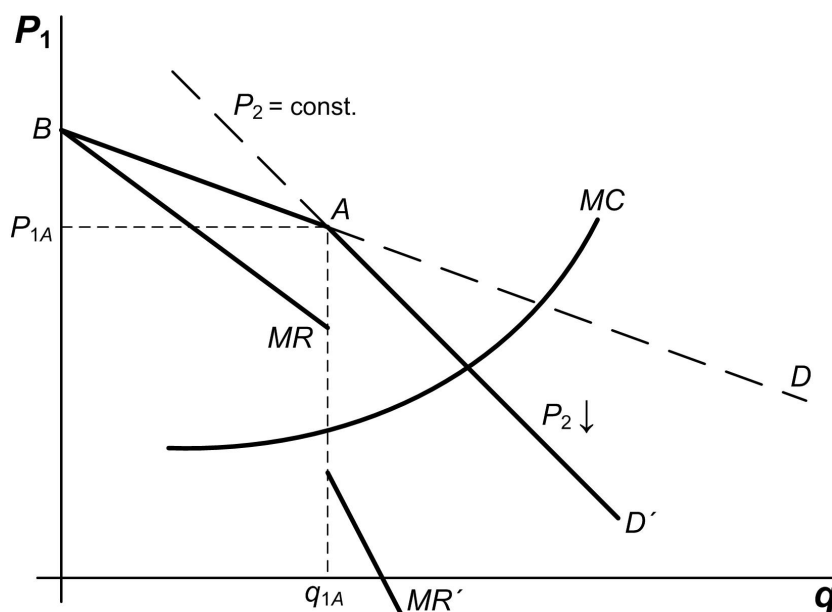
3: *Sweezy model*
Source: SWEEZY AND BARAN, 1966

Czech Republic an example of duopoly behaviour can be the competition of two bakery companies: United Bakeries and Penam.

We can see two demand curves D and D' on the graph. The first demand curve (D) comes out of the assumption that the competitor will not follow the price change (P) made by the first duopoly firm. The second demand curve (D') is based on the assumption that the competing firm will follow the price change made by the first firm (KAUSHIK, CASEY, 1982).

If the existing bread market price level of the first firm is P_{1A}, then while $P_1 > P_{1A}$ the function of expected demand will have lower slope (higher price elasticity of demand) with the competitors price P_2 = const., because even a little increase of P_1 causes a larger decrease in demanded quantity q_1 because of larger efflux of buyers.

On the contrary, while lowering the price $P_1 < P_{1A}$ the demand function for bread will have steeper slope (lower price elasticity), because the competitor will lower price P_2 as a reaction on the lower P_1, thus the influx of the buyers will be lower than their efflux as in case of P_1 growth. The relation holds:

$$\frac{\partial P_2}{\partial P_1} = 0 \qquad \text{for} \quad P_1 > P_{1A} \tag{15}$$

$$\frac{\partial P_2}{\partial P_1} > 0 \qquad \text{for} \quad P_1 < P_{1A}. \tag{16}$$

The result of this competing firms behaviour is the kinked demand curve compounded out of two parts: one of its parts (the less elastic one) expresses the competitors reaction on the bread

price decline made by the first firm, the second part (the more elastic one) expresses the absence of the competitor's reaction on the bread price increase of the first firm.

The demand curve kink *BAD'* lies at the point *A*. With regard to an unusual shape of the demand curve the marginal revenue curve (*MR*, *MR'*) is not continuous. Further, we will be interested in what quantity of bread production q the firm maximizes its profit. If we introduce the marginal costs curve *MC* into the graph, we find out that the equality of marginal revenue (*MR*) and marginal costs (*MC*) will never appear no matter what is the bread production quantity (*q*).

Therefore we consider the output q_1 as an optimal bread production quantity (*q*); if the firm supplied larger bread production than q_1, the firm's revenue growth would be lower than its costs growth and vice versa.

The Sweezy duopoly model with kinked demand curve was developed as a consequence of the need to explain the tendencies for sticky (rigid) prices appearance, which occurred at some oligopoly markets, for example the food chain stores, but it does not explain how the prices as such are formed.

Considering the unreal price growth in this oligopoly competition model the food chain stores broaden the supply of agriculture sector products, including the already mentioned bread, which they sell under their own brand.

They expect the demand after private products, which are cheaper than branded products, to increase. For example the Ahold Company already placed into its Albert shops more than 1 000 of new products sold under the private brand Euro

I: *Confidence interval 95% for average price on January to June 2010 (in CZK per unit)*

Food	Albert Palác Flora	Billa Korunní	Tesco Express I.P.Pavlova	Kaufland Chodovská
Bread 1 200 g	(19.15;20.97)	(20.16;21.95)	(16.56;18.35)	(17.43;19.25)
Milk 1 l	(11.52;12.84)	(11.33;12.62)	(12.54;13.82)	(10.51;11.82)
Butter 250 g	(23.58;25,66)	(23.81;25,84)	(20.80;22,83)	(21.02;23.09)
Sausage Vysočina 100 g	(11.93;13.87)	(12.70;14.52)	(18.30;20.12)	(10.76;12.59)
Cheese Eidam 30% 100 g	(14.30;15.36)	(14.25;15.32)	(11.60;12.67)	(10.23;11.32)
Apple red 1 kg	(13.63;16.81)	(17.64;20.75)	(16.27;19.38)	(9.60;12.78)
Tomato 1 kg	(36.28;43.77)	(39.19;46.53)	(33.90;41.24)	(29.19;36.69)

Source: price investigation

Shopper and Albert Quality. In the Tesco stores ČR the private brands take a share of almost 25% of the total food assortment and the number increases of about one third annually.

Just in the recent economic situation an increased demand for private brands can be observed, because they are a good quality-to-price-ratio alternative compared to the branded products. According to the producers the largest demand is for commodity food, thus after milk, oil, rice and flour. The largest share of the private brand assortment is in the category of meat, where it reaches 80% of total assortment.

The food chain stores' private goods, according to last year survey, are regularly purchased by more than one half of Czech population; but it is still less than e.g., in Hungary or Slovakia.

Duopoly price model solution on example of food chain stores' commodities

The firms duopoly behaviour on the agricultural products market is still a more frequent phenomenon with regard to the desirable production and distribution concentration of plant or animal production in agriculture. The agricultural producers face (by clustering their firms into big trade cooperatives) a split between frequent fragmentation of production (also given by landscape sustainable development) and the oligopoly power of supranational food chain stores, which take over a notable part of their production.

The firms duopoly behaviour as such, at the agricultural products markets, is not a cause for being subject to fines by the ÚOHS, if it does not demonstrably have a character of cartel agreement. On the contrary, of course the firm's duopoly behaviour attracts attention of the antimonopoly bureau and frequently leads to a start of inquiry, whether the particular duopoly situation does not have any features of illegal cartel (an example can be the inquiry of almost identical potato prices in food chain store supermarkets).

The food chain stores endeavour to mutually adapt food product prices is generally known; it is set especially by the inelastic demand for the mentioned goods from the consumers, i.e., by the need to demand basic food. An interesting illustration of the mentioned assimilations (duopoly reactions) can be a table expressing the proximity of firms supply and equilibrium prices.

As it is seen on the Tab. I, in case of homogenous products (e.g. milk) supplied by the Czech trade cooperatives, the duopoly price competition appears and the market price gets very close to equilibrium price. On the contrary we can present an example (tomatoes) of heterogeneous product, of which the price was influenced by the oligopoly space model, where these agricultural products are bought by particular food chain stores in different countries and thereby we can observe different price levels. This can lead to considerable differences in the shopping basket prices for the consumers.

A cluster of weekly prices of selected kinds of food from 4 representatives of the chain stores was analyzed using the ANOVA method. After verification and satisfaction of this method's conditions, the F-test values were found as well as the p-value (probability) for hypothesis testing of the average price of food between the food chains. Tab. II shows the test results.

II: *Criterion F in ANOVA and significant probability values*

Food	F-criterium	Probability value p
Bread 1 200 g	12.932	0.00000
Milk 1 l	9.7602	0.00001
Butter 250 g	6.4493	0.00050
Sausage Vysočina 100 g	55.128	0.00000
Cheese Eidam 30% 100 g	55.411	0.00000
Apple red 1 kg	19.658	0.00000
Tomato 1 kg	5.040	0.00278

Source: price investigation

In all the cases a significant statistical difference was found between the sellers. The question is, between which sellers. The Scheffé test was used and evaluated at a 5% significance level in order to form homogeneous groups of sellers, that are shown in Tab. III.

Duopoly reactions to price competition in food chain stores are particularly strong in the case of

III: *Homogeneous groups of markets*

Bread 1 200 g Average price		1	2	3
Tesco	17.48	****		
Kaufland	18.34	****	****	
Albert	20.06		****	****
Billa	21.06			****
Milk 1 l Average price		**1**	**2**	
Kaufland	11.16	****		
Billa	11.98	****	****	
Albert	12.18	****	****	
Tesco	13.18		****	
Butter 250 g Average price		**1**	**2**	
Tesco	21.82	****		
Kaufland	22.06	****		
Albert	24.62		****	
Billa	24.82		****	
Sausage Vysočina 100 g Average price		**1**	**2**	**3**
Kaufland	11.68	****		
Albert	12.90	****	****	
Billa	13.61		****	
Tesco	19.21			****
Cheese Eidam 30% 100 g Average price		**1**	**2**	**3**
Kaufland	10.78		****	
Tesco	12.14			****
Billa	14.78	****		
Albert	14.83	****		
Apple red 1 kg Average price		**1**	**2**	**3**
Kaufland	11.19			****
Albert	15.22	****		
Tesco	17.83	****	****	
Billa	19.19		****	
Tomato 1 kg Average price		**1**	**2**	
Kaufland	32.94	****		
Tesco	37.57	****	****	
Albert	40.03	****	****	
Billa	42.86		****	

Source: price investigation

the commodities of milk and tomatoes, where the reactions and approximation of prices can be clearly seen in Table III. Based on statistical research it is obvious that the reactions are most reflected in the sales of food chain stores Billa and Albert.

CONCLUSION

The effort to sell the agro-products and maximize profit even in the hard food chain store competition conditions leads to formation of Sweezy duopoly model in case of heterogeneous agro-production (bread, bakery, cheese etc.) and input costs increase. Here, the private brands have the crucial role of agro-production, which can grant higher production sales with lower sale prices and constant quality.

In the agro-production practice we meet more often the price competition models than the sales competition models and most of the cases of firm's duopoly behaviour has a character of competitor's expected reaction model. It is set by the persistent struggle for survival under the conditions of tough competition environment, which is proved by many firms leaving the market as well. Hence, we can see also the impact of nature (crop failure), healthy life style efforts (bio products), small scale and farmer market preferences (fresh and quality production) and other factors, which modify the firms oligopoly behaviour in the agricultural production sector. Consumption is viewed also as a social behaviour. Psychological aspects of the consumer subjects' behaviour are also important (ŠRÉDL, SOUKUP, 2011).

SUMMARY

Oligopoly competition assumes the existence of a few firms only in the sector, out of which at least some have a significant market share and can affect the product prices on the market. The market equilibrium on the duopoly market is formed in a process of mutual adaptation of the market prices and materialized market possibilities. This adaptation is based on the firms expectations compared (according to the expected demand functions and expected competitor's reactions) with reality. The duopoly firms set some flexible price as the basis from which they derive how much of the agricultural production can be presented on the market. The choice of the basis variable can be considered as the main presumption of the agricultural firm's behaviour analysis at the duopoly market. A duopoly competition can be chosen as an example, where there are two trade cooperatives producing raw cow milk (a homogenous agricultural product) on the livestock production market. In the Sweezy model we will presume that both of the two firms produce a specific product, for example bread (bakery, butter, cheese, etc.) and the firm expects that the competitor will not react on its market price increase, but it will react on its lowering by lowering his as well. In the Czech Republic an example of duopoly behaviour can be the competition of two bakery companies: United Bakeries and Penam. The Sweezy duopoly model with kinked demand curve was developed as a consequence of the need to explain the tendencies for sticky (rigid) prices appearance, which occurred on some oligopoly markets, for example the food chain stores, but it does not explain how the prices as such are formed. Considering the unreal price growth in this oligopoly competition model the food chain stores broaden the supply of agriculture sector products, including bread, which they sell under their own brand. The food chain stores endeavour to mutually adapt food production prices is generally known; it is set especially by the inelastic demand for the mentioned goods from the side of consumers, i.e. by the need to demand basic food. A cluster of weekly prices of chosen kinds of food from 4 representatives of the chain stores was analyzed using the ANOVA method. After verification and satisfaction of this method's conditions, the F-test values were found as well as the p-value (probability) for hypothesis testing of the average price of food among the food chains. Based on statistical research it is obvious that the reactions are most reflected on sales of food chain stores Billa and Albert.

REFERENCES

KAUSHIK, S. K., CASEY JR, W. L., 1982: The Kinked-Demand Model Of Oligopoly: Textbook Departures From The Original Sweezy Model. *American Economist*, Volume 26,2: 25–32. ISSN 0569-4345.

LIPSEY, R. G., CHRYSTAL, A. K., 2004: *Economics.* Oxford University Press: Corby. ISBN 978-18-527-8561-1.

PRÁŠILOVÁ, M., 2010: Statistický pohled do nákupního koše. *Sborník příspěvků z odborných seminářů "Statistica Didactica et Statistica Practica",* CULS: 54–57. ISBN 978-80-213-2142-7.

SAMUELSON, P. A., NORDHAUS, W. D., 2004: *Economics.* Columbus: McGraw Hill Higher Education. ISBN 978-80-205-0590-3.

SCHILLER, B. R., 2010: *The Micro Economy Today.* Columbus: McGraw-Hill, Inc. ISBN 978-00-772-4741-6.

ŠRÉDL, K., 2010: Behaviour of subjects in risk markets. *Agricultural Economics – Czech,* Volume 56: 224–230. ISSN 1211-3174.

ŠRÉDL, K., SOUKUP, A., 2011: Consumer's behaviour on food markets. *Agricultural Economics – Czech,* Volume 57: 140-144. ISSN 1211-3174.

SWEEZY, P. M., BARAN, P. A., 1966: *Monopoly Capital: An essay on the American economic and social order.* New York: Monthly Review Press. ISBN 978-08-534-5073-3.

VARIAN, H. R., 1992: *Microeconomic Analysis.* London: Norton. ISBN 80-85865-25-4.

Zemědělství, informační list (Agriculture, Information List) Volume 1/2008, Brno: ÚOHS.

Address

doc. Ing. Marie Prášilová, CSc., PhDr. Ing. Lucie Severová, Ph.D., Ing. Lenka Kopecká, Ing. Roman Svoboda, Katedra statistiky, Katedra ekonomických teorií, Česká zemědělská univerzita v Praze, Kamýcká 129, 165 21 Praha 6 – Suchdol, Česká republika, e-mail: prasilova@pef.czu.cz, severova@pef.czu.cz, kopeckal@pef.czu.cz, svobodar@pef.czu.cz