

Some approaches to the analysis of market structure's impact in milk commodity chain

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ABSTRACT

The nowadays development in agribusiness can be characterised as shifting of power to the finalising levels and distribution in food commodity chains, which influence as well as form competitive environment of farm and also food-processing companies. The dependence of producers (farmers) on finalising stage is increasing, as well as the risk is transferred and the marked power is enforced in food commodity chains. Those factors are changing proportions, conditions of approach and share of individual stages of commodity chain on value added launched in final product. Possible approach to the identification of market power within food commodity chains is the approach based on price transmission analysis; inelastic price transmission (especially in case of price growth) can imply the existence of market power at certain market level of the commodity chain. This approach - with the distinction of dairy products with low or high value added - is applied on dairy commodity chain in conditions of the Czech Republic.

Key words: commodity chain, market structure, milk and milk products, price transmission, value added

1. INTRODUCTION

The issue of price transmission - the proportion of an input price change that is passed on to the output prices - has always been frequently discussed in agricultural economics. It is particularly important in the analysis of welfare effects of changes in agricultural policies, like elimination of farm price support programs or introduction of alternative support mechanisms, and in the analysis of economic effects of new technologies. In many industries, it has been observed that, while increases in input prices are almost instantaneously reflected in the output prices, input price decreases are usually followed only by delayed and partial drops in the output prices [Peltzman, 2000].

In economic theory, this phenomenon has been explained in terms of two major influences [Revoredo, Nadolnyak, Fletcher, 2004]:¹

- *Existence of market power of manufacturers (imperfect competition).* The logic of the market power argument is simply that firms in a tacitly collusive industry earning abnormal profits tend to simultaneously increase their margins in response to a drop in the input costs thereby passing only a small fraction of the decrease on to the output prices. At the same time, collusive behaviour facilitates passing (almost) all of the input price increase to the output price. The magnitude of such transmission asymmetry depends not only on the firm behaviour but also on the economies of scale and demand and supply elasticity [McCorriston, Morgan, and Rayner, 2001].
- *Profit maximizing inventory management.* The inventory management argument is that the presence of inventories introduces additional price rigidity, which is consistent with maximizing behaviour: because of the "cushioning" effect of inventories, prices tend to move sluggishly in industries whose outputs (inputs) are storable, as price responses are substituted by quantity responses. Thus, sectors with perishable inventories are more likely to exhibit more price flexibility than those with easily storable stocks.

2. GOAL OF THE PAPER AND METHODOLOGY

Based on the results of the price transmission analysis the paper aims to assess the impact of market structure on price transmission process within commodity chain of milk in the Czech

¹ Apart from the market power and inventory management arguments, asymmetric price transmission has also been attributed to cost adjustment rigidities, like menu costs or sticky wages.

Republic, with the distinction on milk products with low (milk) or high (yoghurt, cheese) value added. The database is represented by monthly prices at individual stages of the selected commodity chain in the period of January 1998 – March 2006, while at the second and the third stage of price transmission analysis the differences of monthly prices are used within selected period of time.

The analysis of price transmission within milk commodity chain is carried out in three consequential stages as suggested in Lechanová [2005]:

- At the 1st stage of the analysis the process of price transmission at all market levels of the chain is assessed by means of complex and systematic approach. For enumerating of the intensity of the price transmissions, the coefficient of price transmission elasticity (EPT) is used as the basic measure.

If we suppose two levels of the partial markets within the selected commodity chain and we denote them i and j, the coefficient of the price transmission elasticity (EPT) between these two market levels can be defined by entirely common way [McCorriston 2002]:

$$EPT_{ij} = \frac{\frac{\partial p_j}{\partial p_i} \cdot p_i}{p_j}$$

The sequence of parameters i and j is decisive for the direction of assessed process of price transmission.
So defined EPT_{ij} coefficient expresses, by how much will change the price at jth market level if the price at ith level changes by 1%.

- At the 2nd stage of the analysis the attention is focused on subsequent partial markets within analysed commodity chain, where the analysis of price differences is carried out in order to evaluate the difference in results in case of positive, respectively negative price differences. Price differences are enumerated from quarterly nominal prices, whereas price difference between two time periods (t and t+1) is assigned to the following time period (t + 1). The asymmetry of price transmission with the distinction on positive and negative price changes was tested on the basis of regression models (simple repeated regression) according to following relationships:

$$\Delta P_{jt} = A^+ + \sum_{l=1}^k B_l^+ \cdot \Delta P_{it}^+, \quad \text{resp.} \quad \Delta P_{jt} = A^- + \sum_{l=1}^k B_l^- \cdot \Delta P_{it}^-$$

The intensity of positive or negative price differences (distinguished according to the values of independent time series) are evaluated by means of determination coefficient.

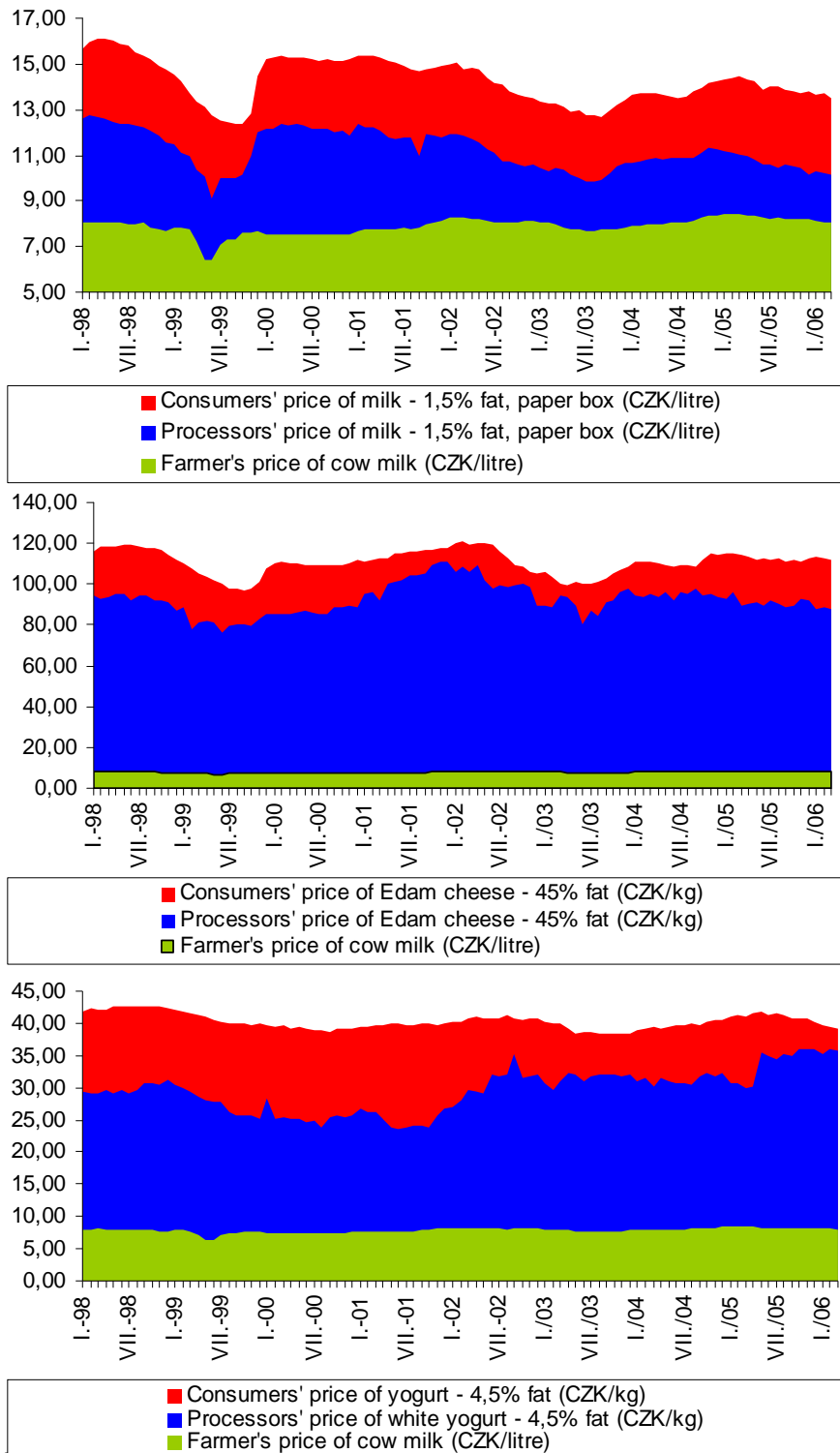
- The third stage of the analysis rests upon the analysis of the impact of time delay on the transmission of price changes between individual market levels. Monthly price differences at all market levels of analysed commodity chain are used as database for this stage of the analysis.

The intensity of interdependence of time-delayed time series is evaluated by means of determination coefficient. Time delay of 1, 2, 3, and 4 months is tested, whereas the exact length of time delay is determined according to the time delay with highest determination coefficient. Gradually the most probable length of time delay is determined for selected branch of the milk commodity chain.

3. RESULTS AND DISCUSSION

As a starting point of the research, price development for all analysed dairy products (milk, yoghurt, edam cheese) is assessed in time period I./1998-III./2006, which is depicted on following graphs (*Figure 1*):

Figure 1: Price development (farm, producers', consumer prices) in milk commodity chain



Based on visual assessment of price development in graphs on Figure 1 it is clear that:

- On the 1st level of analyzed commodity chain (i.e. between the farmer and the processor) the processors' price partially copies farm price development only at the milk commodity. From the price development of other dairy products with higher value added (yogurt, cheese) it is evident that the processors' price development is influenced besides the price of agrarian commodities (milk) also by other costs, what obviously causes fluctuating development of processors' prices.

- On the 2nd level of analyzed commodity chain (i.e. between processor and retailer) it is possible to claim that the consumer price levels of all analyzed products copy the development trend of processors' prices; in the case of consumer prices of products with higher value added (yogurt, cheese) strong fluctuations within processors' prices are absorbed in both directions; the similarity between processors' and consumer prices is at highest level in the case of milk.

If we focus on the share of individual links of the commodity chain (farmer, processor, retailer) on the final consumer price of analyzed commodities, we can conclude, that:

- Highest share on consumer price has the farmer in case of milk; the price of agrarian commodity represents in average 58% of consumer price. Since it is dairy product with low value added, the share of processor on final price represents in average only 20%.
- In the case of products with higher value added (for instance yogurt or cheese) the processor's share on final price is higher than farmer's; processor's share is around 50%, while farmer's share is only around 20% in case of yogurt.

Figure 2: EPT matrix (from the left: milk, yogurt, cheese)

EPT ^m cow milk	Farmers' price of cow milk	Processors' price of milk - 1,5% fat, paper box	Consumers' price of milk - 1,5% fat, paper box	EPT ^m white yogurth	Farmers' price of cow milk	Processors' price of white yogurt 4,5% fat	Consumers' price of white yogurt 4,5% fat	EPT ^m Edam cheese	Farmers' price of cow milk	Processors' price of Edam cheese - 45% fat	Consumers' price of Edam cheese - 45% fat
Farmers' price of cow milk	X	0,16	0,25	Farmers' price of cow milk	X	1,10	0,55	Farmers' price of cow milk	X	1,04	0,67
Processors' price of milk - 1,5% fat, paper box	0,06	X	0,84	Processors' price of white yogurt 4,5% fat	0,21	X	0,06	Processors' price of Edam cheese - 45% fat	0,31	X	0,45
Consumers' price of milk - 1,5% fat, paper box	0,11	1,08	X	Consumers' price of white yogurt 4,5% fat	0,38	0,82	X	Consumers' price of Edam cheese - 45% fat	0,47	1,03	X

Source: own calculation based on data of Commodity study Milk 12/2006

Results at the first stage of price transmission analysis, when the intensity of price transmission is expressed by the coefficient of price transmission elasticity (Figure 2), approved that:²

- On the 1st level of commodity chain (producer-processor relation) we can observe inelastic transmission of farm price changes into consequential stage (i.e. into the processors' price) only for milk – product with low value added and fast production cycle. Elastic transmission of price changes was noted in case of products with higher value added (cheese and yogurt), which can be caused by certain time delay in reaction of output price into input price change as a result of important role of storage along the production of this product or higher margin of processor.
- On the 2nd level of commodity chain (producer-consumer relation) inelastic transmission of price changes was noted for all analyzed dairy products.

At the second stage of the price transmission analysis correlation of positive, resp. negative price differences was assessed, expressed by determination coefficient (see Figure 3).

- On the 1st level of commodity chain the initial presumption (positive price changes are transmitted to a greater extend than negative price changes due to the market power of

² Only price transmission of inputs into outputs and not vice versa (i.e. part of EPT ratio matrix over the diagonal) was observed due to the lower conformity of EPT ratio values.

individual links within the commodity chain) was confirmed for all analyzed dairy products (milk, yogurt, cheese),

- On the 2nd level of commodity chain the initial presumption was confirmed only for dairy product milk and yogurt; it was not confirmed in the case of cheese and it is most likely that the storage plays important role here again.

Figure 3: Correlation of positive and negative price differences

		1 st level of commodity chain	2 nd level of commodity chain
Cow milk	Price increase	41%	48%
	Price decrease	26%	38%
Edam cheese 45% fat	Price increase	16%	1%
	Price decrease	9%	17%
White yogurt 4,5% fat	Price increase	6%	21%
	Price decrease	3%	7%

Source: own calculation based on data of Commodity study Milk 12/2006

Time delay of output prices reaction to changes in input prices was evaluated at the third stage of analysis. Due to the type of assessed dairy products the time delay was tested only for the final product Edam cheese, 45% fat. Results of this stage of analysis (*Figure 4*) approved that on the first as well as on the second level of this chain we can observe time delay in reaction of output prices to changes in input prices, namely in lengths of 1 or 2 months on the 1st or 2nd level of commodity chain, which proves relatively important function of storage in the cheese production process as well as in distribution process.

Figure 4: Values of determination coefficient for several lengths of time delay

Edam cheese 45% fat	Length of time delay				
	1 month	2 months	3 months	4 months	no time delay
1 st level of commodity chain	12%	5%	1%	8%	10%
2 nd level of commodity chain	18%	33%	23%	15%	14%

Source: own calculation based on data of Commodity study Milk 12/2006

4. CONCLUSIONS

Results of the first and the second stage of price transmission analysis proved increasing importance of market power on partial markets within analyzed commodity chain in condition of the Czech Republic, namely:

- On the level of processor (dairy industry entities),
- On the level of trade (retail) as well.

Dairy sector in the Czech republic experienced dynamic development since 1989; purely concentrated sector in 1989 turned into fragmented in the first half of the nineties and than again into concentrated sector in 2006. Situation in the sector in 2006 is characterized with values of concentration ratios: $CR_3 = 44,6\%$, $CR_5 = 54,6\%$, and $CR_{10} = 72,9\%$. Among the largest dairy works are MADETA, OLMA, Hlinsko Dairy, Dairy Kunín and others. Nowadays the concentration rate strengthens the intensity of competition among existing companies though (see *Figure 5*), but the concentration process and downfall or acquisition of unsuccessful companies continues (Černíková, 2003).

Figure 5: Development of concentration in Czech dairy sector

1989	1994	1999	2001	2006
7 state-owned concerns	90 entities (113 dairies)	65 entities (70 dairies)	62 entities	32 entities
cca 20 new entities			22 entities	

Source: Černíková (2003), own calculations

Since the second half of 90s strong concentration of retail sector has continued, which can be proved on revenue increase of top 10 companies on the market from 23 billions CZK (1993) to 219 billions CZK in 2005; according to Incoma Research market share of these companies was around 67% in 2005. This process is being stabilized and slowed down in last decade.

Increasing market power of dairy enterprises as well as retail chains in the commodity chain was proved based on results of the first or second stage of price transmission analysis, where incomplete price transmission ($EPT < 1$) was approved on this level of commodity chain; in the second stage the presumption, that the price decreases are transmitted in less extend than price increases as a result of processors' market power, was confirmed.

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