# Price transmission in Serbian milk commodity chain

*Rade Popovic*[1] *– Boris Radovanov*[2]

*Focus in the paper is on price transmission at Serbian dairy market. It analyzes milk price transmission for three products: pasteurized milk, white yoghurt and cheese. Those three products types participated in formal milk market with 65% of processed row milk. Monthly data are collected from three levels of milk chain: farm level, processors and retailers. Three step approach based on: intensity, asymmetry and time lags in price transmission was applied. Distinction of two market levels was made, first between farmers and processors and second among processors and retailers. Additionally price transmission from world to nationally market was examined.*

*Keywords: price transmission, milk and milk products, milk supply chain, market structure*

## 1. Introduction

Milk production is one of the most important agriculture branches, with 11% gross agriculture output share. Traditionally it is based on over 200.000 mainly small family farms. Family farms produced 91.3% of milk intended for human use in 2008, while rest was supplied by non-family farms. Total milk production was stable in last 10 years. Milk market is separated on formal, where dairy plants process milk, and informal, where milk is used for consumption on dairy farms and for direct sale. Formal milk market is developing in recent years. The most responsible for that positive trend is dairy processing sector. Successful privatization and huge investments in reconstruction and new capacities enable faster development of formal market. In 2008 it reached 53.8% of total milk production intended for human use. Now in Serbia operate 193 dairy processing firms, from which the biggest one Danube Food Group control 43% of formal milk market. Four biggest

[1] Rade Popovic, University of Novi Sad, the Faculty of Economics Subotica (Serbia)

[2] *Boris Radovanov,* University of Novi Sad, the Faculty of Economics Subotica (Serbia)

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dairy companies have 61% of market share. Process of concentration in dairy processing industry is ongoing.

Main group of dairy products in structure of formal milk market (Popovic 2009), measured in milk equivalents, was fermented milk products with 35% share in 2008. On second place was liquid milk with 34% share, from which UHT milk count 17% and pasteurized milk another 17%. Other products like: cheese, butter, cream, milk powder, cheese spreads etc. participated together with 31%.

Retail sector is composed from several big domestic and foreign retail chains and small retail shops. Process of concentration in retail sector is started earlier than in dairy processing industry. Until now, retail sector still didn't take strategic steps in this sector to ensure stability and competitive milk prices through own labels. In recent period, retailers practiced market power with pushing dairy processors to ensure longer credit period (90 and more days). That situation caused negative boomerang effect on other levels of dairy supply chain (farmers and processing industry) in few months period during 2009.

Trend of decreasing farmers' share in consumer expenditure is result of faster increase of productivity in agriculture production than in processors or retailer level. Such trend becomes obvious also in Serbian dairy market over previous period. But, in some cases it could be result of abuse of market power by processing or distribution trades (Bunte 2004). Downstream industries may practice market power by achieving lower purchase prices or higher margins, or both. If processors or retailers are able to practice market power they tend to increase difference between consumer and farmer price and reduce farmers' share in consumer expenditure. In recent years market power in dairy sector was one of the major policy concerns of Ministry of agriculture forestry and water management of Republic Serbia.

Price transmission is one of often discussed issues in agriculture economics. Between all agricultural products, in empirical studies, price transmission analyses of milk are the most often (Cotterill R., McCorriston S., Conforti P., Lechanova I., Novak P., etc.). Price transmission means, the way how prices at one level of product chain react to the price changes at another level. Market power may explain that price changes at one level are not transmitted to other levels (Bunte 2004). Except market power imperfections in price transmission can be caused by adjustment costs, profit maximizing inventory management, non-linearities in supply and demand. Between all two main causes are dominating in literature: non-competitive markets and adjustment costs (Meyer-Cramon 2002). McCorriston in his paper from 2002 urges that empirical studies with highly disaggregated data are becoming the main approach for gauging the impact of competition in multi-products industries with oligopolistic structure.

Dairy market is one of the most regulated food markets in vast countries. Recent changes in world milk prices had similar trends in Serbian market and affected mostly farmers and consumers. The additional aim of the article is to

analyses transmission of dairy world market price to Serbian market in farm gate prices using appropriate methodology.

## 2. Methodology

Applied methodology in the paper is aimed to research phenomena of price transmission in milk commodity chain in Serbia, distinguishing product with low value added (pasteurized milk) and product with high value added (yoghurt and cheese). Developed markets food commodity chains are usually consisted from five levels: farmers, wholesales, processors, distributors and retailers. Milk commodity chain in Serbia consist only three levels: farmers, processors and retailers. Processors are the most responsible for vertical coordination in chain. They collect and transport milk from farmers, process and distribute milk products to retailers. Therefore monthly data used in analysis are collected from three levels in period January 2007 – December 2009.

Price transmission is conducted subsequently between farmers and processors level and between processors and retailers level for chosen milk products. Analysis of price transmission is based on three step approach proposed by Lechanova in 2005.

In first step were analyzed coefficients of price transmission elasticity (EPT) as the basic measure of price transmission intensity. If two partial markets of dairy supply chain are denoted as *i* and *j* coefficient of price transmission can be defined as:

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

Sequence of parameters *i* and *j* determines direction of assessed process of price transmission. Coefficient of $EPT_{ij}$ explains by how much price of $j^{th}$ level will change if the price at $i^{th}$ level changes by 1%. With assumption of fixed proportion of technology, and if for example, row milk participated with 50% in total costs of processing one milk product, than transmission should be 0.5 (McCorriston 2002).

In second step, with focus on subsequent market level price differences, asymmetry of price changes were tested on basis of regression models (multiple regressions). With distinction of positive and negative price changes models has following forms:

$$\Delta P_{jt} = A^{+} + \sum_{l=1}^{k} B_l^{+} \cdot \Delta P_{it}^{+} \qquad \Delta P_{jt} = A^{-} + \sum_{l=1}^{k} B_l^{-} \cdot \Delta P_{it}^{-}$$

where:

$\Delta P_{jt}$ is downstream price changes,

$\Delta P_{it}^{+} = P_{it} - P_{it-1} > 0$ is positive price change at $i^{th}$ level of commodity chain and

$\Delta P_{it}^{-} = P_{it} - P_{it-1} < 0$ is negative price change at $i^{th}$ level of commodity chain.

The correlation intensity of positive respectively negative price differences can be evaluated by correlation coefficient.

In third step are analyzed the impact of time delay on the transmission of price changes between subsequent market levels. Monthly price differences, for chosen dairy products, at all market levels are used as data for analysis. Time delay is tested for 1, 2, 3 and 4 month period by determination coefficients.

As result of simplification some impediments in research data are unavoidable. They could be found in use of monthly prices instead of daily or weekly prices, excluding value added tax (VAT) from analysis, non accessible contract elements between processors and retailers (period of payment, confidential rebates), etc.

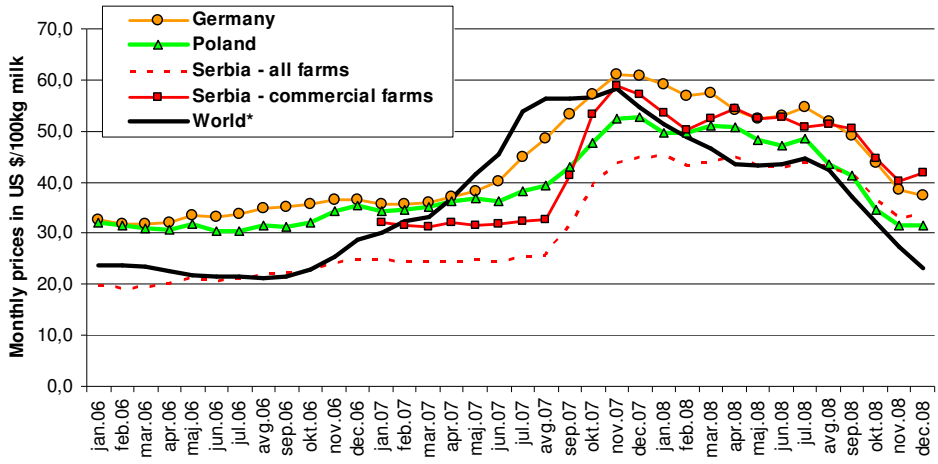
## 3. Results

World milk market experienced the highest milk price volatility in period end of 2006 to 2009 that are unrecorded in last three decades. Trend of world farm gate milk prices was followed by certain degree of national prices. Every country was affected by the milk price increase in period of 2007 and price decrease in 2008 year. The difference between them is the time lag and the force with which the national price responded to the world market price signals (Hemme et al. 2009).

In case of Serbia (Figure 1) world milk price variations were followed with time lag of 9 months for all farms, and 6 months for group of commercial farms[3]. At same period in Germany and Poland national farm gate milk prices reacted faster on world trend, one and four months respectively. Some possible reasons for big time lag on Serbian market could be: Serbian milk market is not well integrated in world market, and farmers in Serbia have lower market power than in other two countries. In case of commercial farms first reason is not possible because eventually when milk prices starts to rise they reach level and remain on higher level of world milk prices. Second reason is more acceptable, since there no dairy cooperatives.

[3] Commercial farms include family and non family farms with 10 and more cows in herd.

*Figure 1.* Farm gate milk prices in Serbia, Poland, Germany and World in period 2006-2008




*Source:* IFCN and own research

In Figure 2 is depicted price development for pasteurized milk, yoghurt and cheese respectively in three year period from January 2007 to December 2009. For yoghurt and cheese conversion rates are applied to provide data comparability. Conversion rate for yoghurt is 1.2 liter of raw cow milk. For feta type cheese conversion rate is 5 liters of cow milk, but because in analysis were included cheese packaging of 500 g, allotted amount of cow milk is 2.5 liters.

From visual insight in price developments from three milk products it's possible to make some conclusions for first and second market level. Prices between farmers and processors have partially similar variation only in case of pasteurized milk. For yoghurt and cheese processors' prices followed farmers prices only in 2007, after that they became rigid and insensitive for pattern of farmers' prices. Milk as main input for those products, which dominate in their total cost, should have the main impact of processors' prices. In analyzed period energy costs in terms of fuel for vehicles had similar variations, but share of this cost usually don't exceed 5% in milk products cost.

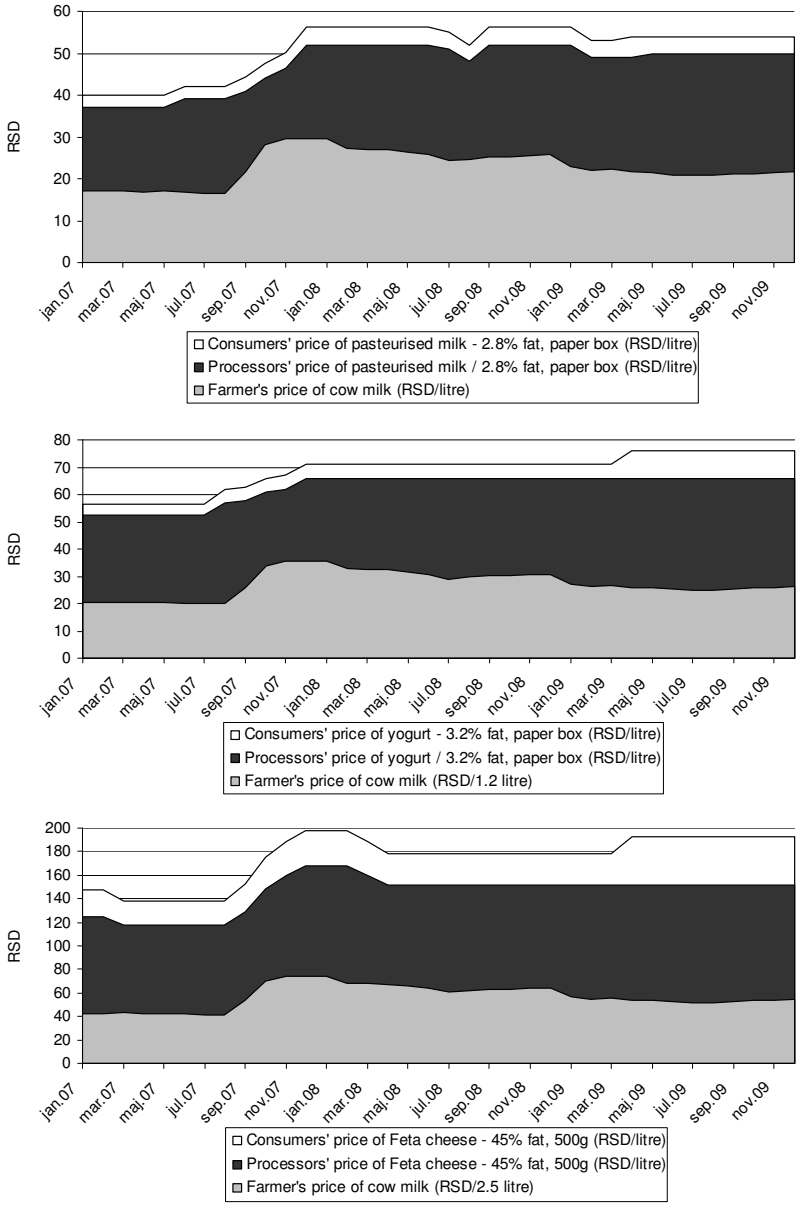
On the market level between processors and retailers it is obvious that retailers' prices well followed movement of processors' prices. Retailer prices do not absorb any processor price change and react immediately in same direction. Retailer share (or retailer margin) in consumer price is probably bigger than data in figure 2 presents. Difference lays is in confidential rebates, which are not visible out of processor – retailer contract. On this conclusion refers consumer price movement for yoghurt and cheese in May 2009. Contract relationships between processor and retailer changed at that time and probably rebates were decreased. On basis of new

contract retailer decide to increase their margin, which previously was substituted by bigger rebate.

Structures of consumer prices for three milk products can be analyzed by shares of supply chain participants. Average share of farmer in consumer price is highest in case of pasteurized milk 44.3% in three years period. In 2009 farmer share for this product reduced to 39.98%. In case of other two milk products with higher value added, average farmer share in consumer prices was 39.2 and 32.3% for yoghurt and cheese respectively. Similarly, as for pasteurized milk in 2009, farmer share reduced on 34.6 and 28.4% respectively.

According to presented data, average shares of processors in consumer prices for: pasteurized milk, yoghurt and cheese were 48.3, 51.7 and 50.8%. In practice those shares were certainly lower, because of rebates and credit period that processors allowed to retailers.

*Figure 2.* Price volatility in period 2007 – 2009 (farm gate, processor and consumer prices) in milk supply chain




*Source:* own research

First step of price transmission analysis, according to applied methodology, is calculating intensity of price transmission by EPT coefficients. Results are presented

in Figure 3. To understand correctly EPT coefficients it is necessary to define share of milk cost for each milk product. With assumption that processor price cover all economic costs of milk products, average shares of row milk cost are: 48% for pasteurized milk, 43% for yoghurt and 39% for cheese.

At market level between farmer and processor EPT coefficients indicates elastic (over-shifting) price transmission for pasteurized milk and cheese. In other words, 1% increases of row milk price results with 0.56% price increase of pasteurized milk and 0.66% for cheese, while full transmission should be 0.48 and 0.39% respectively. Some of explanation for over-shifted price transmission should be price increase of other inputs or market power. For yoghurt it's observed inelastic EPT coefficient.

Established EPT coefficients on market level between processor and retailer indicates price transmission elasticity for all three products respecting shares of processors in consumer prices. Processor prices changes of milk products are well transmitted to retail level.

*Figure 3.* Matrixes of coefficients of price transmission elasticity for: pasteurized milk, yoghurt and cheese

| EPT milk | Farm price of cow milk | Processors` price of milk | Consumers` price of milk |
|---|---|---|---|
| Farm price of cow milk | 1 | 0.56 | 0.56 |
| Processors` price of milk | 1.06 | 1 | 1.00 |
| Consumers` price of milk | 1.06 | 0.99 | 1 |

| EPT white yogurt | Farm price of cow milk | Processors` price of white yogurt | Consumers` price of white yogurt |
|---|---|---|---|
| Farm price of cow milk | 1 | 0.39 | 0.29 |
| Processors` price of white yogurt | 1.18 | 1 | 0.88 |
| Consumers` price of white yogurt | 1.19 | 0.97 | 1 |

| EPT cheese | Farm price of cow milk | Processors` price of cheese | Consumers` price of cheese |
|---|---|---|---|
| Farm price of cow milk | 1 | 0.66 | 0.51 |
| Processors` price of cheese | 1.22 | 1 | 0.73 |
| Consumers` price of cheese | 1.96 | 1.38 | 1 |

*Source:* own research

The most of empirical studies focused on price changes transmission between subsequent market levels revealed that positive price changes are much faster and in bigger volume are transmitted on subsequent commodity chain than negative price changes. In table 1 are presented correlation coefficients for positive and negative price changes on two subsequent market levels.

On first market level, related to farmers and processors, positive price changes are positively correlated for all three milk products. Negative price changes are positively correlated for pasteurized milk and negatively for cheese, which means when farm milk price decrease price of cheese are increased. Correlation of negative price changes don't exist in case of yoghurt, because during three year period processor price of yoghurt just increased. Taking together positive price changes of row milk are transmitted in greater extend than negative price changes.

At second market level of dairy chain between processor and retailer both positive and negative price changes has high value of positive correlation coefficients. Price decrease of processors product are fully transmitted to consumers

and price increases are almost fully transmitted. In case of yoghurt and cheese price increase are in small extend absorbed with consumers prices, probably because of stocks in markets.

*Table 1.* Correlation of positive and negative price changes

| Article | First market level | Second market level |
|---|---|---|
| Pasteurized milk | | |
| Price increase | 43,56% | 98,60% |
| Price decrease | 9,27% | 100,00% |
| Yogurt | | |
| Price increase | 38,11% | 83,36% |
| Price decrease | 0,00% | 0,00% |
| Cheese | | |
| Price increase | 89,12% | 89,30% |
| Price decrease | -8,25% | 100,00% |

*Source:* own research

Third step of analysis is time delays in output prices reaction to changes in input prices. Time delays are confirmed on first market level for all three products in periods of 1 and 2 months. On second level time delay exists in one month period only in case of cheese. It is because of characteristics of product which can be used and kept in storage in longer period. For other two milk products it is not possible because of their short periods for use which are for pasteurized milk 3 days and for yoghurt 15 days. The highest coefficients of determination are on second market level for non delays.

*Table 2.* Determination coefficients for examined time delays

| Article | Time delay (in months) | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | No delay |
| Pasteurized milk | | | | | |
| First market level | 38,12% | 23,57% | 6,92% | 0,54% | 17,22% |
| Second market level | 2,50% | 1,42% | 1,36% | 0,01% | 98,06% |
| Yogurt | | | | | |
| First market level | 16,39% | 22,17% | 8,53% | 0,31% | 15,46% |
| Second market level | 2,66% | 14,79% | 0,10% | 4,84% | 69,48% |
| Cheese | | | | | |
| First market level | 53,10% | 21,05% | 1,14% | 0,65% | 51,67% |
| Second market level | 37,93% | 7,61% | 0,02% | 5,04% | 84,89 |

*Source:* own research

## 4. Conclusions

Dairy supply chain in Serbia is moving toward successive oligopsony (dairy processing and retail industry). Since 2004, when privatization of dairy processing firms started, Serbian dairy industry experienced dynamic development. Concentration rate in dairy industry was CR4 = 61% in 2008. The four biggest dairy processing companies are: Danube food group BV, Mlekara Sabac, Somboled and Mlekoprodukt. Concentration process in food retail industry, as the dominant channel for dairy food distribution, resulted with several domestic and foreign retail chains. While concentration rates are important in describing an industry, high concentration rate is not evidence that companies behave anti-competitively.

Empirical results of price transmission suggest that there is over-shifted elasticity, that's mean when farmer milk price increase for 1% processor and retailer prices increase more than 1%. Price asymmetry in dairy commodity chain in Serbia is also confirmed. Processor' and retailers' prices are more likely to increase if farmer price increase, than to decrease if farmer price decrease. Also time lag analysis revealed that on second market level wasn't time delay, and on first market level between farmers and processors time lags exists for 1 and 2 month periods. In other words positive price changes are much faster and in bigger volume are transmitted on first commodity level than negative price changes. Revealed results infer some signs of market power of processors. Practicing market power from participants at any level of commodity market chain leads to reduction of competitiveness and other performances of whole food chain.

*References*

Bunte, F. 2004: Pricing and performance in agri-food supply chains, In Proceedings of the Frontis workshop on quantifying of the agri-food supply chain. In ed. Onderstejin K. et al., Wageningen, Netherlands 22 – 24 October 2004.

Conforti, P. 2004: Price transmission in selected agricultural markets. FAO commodity and trade policy research working paper No. 7.

Cotterill, R. 2002: Who benefits from deregulated milk prices: the missing link in the marketing channel. Proceedings, University of Connecticut.

Hemme et al. 2009: IFCN Dairy Report 2009, International Farm Comparison Network, IFCN Dairy Research Center, Kiel, Germany.

Lechanova, I.-Novak P. 2006: Price transmission in Czech milk commodity chain, In: Annals of the Polish association of agricultural and agribusiness economists, Poznan, Poland, Vol. 8, No 6, 108-112. p.

McCorriston, S. 2002: Why should imperfect competition matter to agriculture economists? European Review of agriculture economics, Oxford University Press. Vol. 29, 349-371. p.

Meyer, J.-Von Cramon, T. S. 2002: Asymmetric price transmission: a survey: paper at the 10th EAAE conference in Zaragoza. [http://www.jochenmeyer.de/pdf/meyer-cramon.pdf].

Novak, P. 2007: Some approaches to the analysis of market structure's impact in milk commodity chain. 104th EAAE-IAAE Seminar Agricultural Economics and Transition, Corvinus University of Budapest, Hungary.

Peltzman, S. 2000: Prices rise faster than they fall. *Journal of political economy*, The University of Chicago Press. Vol.108, No 3, 466-502. p.

Popovic, R. 2007: Packaging types of milk and dairy products on Serbian market, *Food industry – Milk and dairy products*, Faculty of Technology Novi Sad, Serbia, Vol. 18, No. 1-2, 65-69. p.

Popovic, R. 2009: Structural changes on Serbian formal milk market, *Food industry – milk and dairy products*, Belgrade, Vol. 20, No. 1-2, 7-12. p.

Popovic, R. 2009a: Effects of market structure changes on dairy supply chain in Serbia, Paper presented at Agribusiness and Agro-industries development in Central and Eastern Europe, A joint FAO – IAMA Workshop at International food and agribusiness management association, 19th Annual World Forum & Symposium, page. 113-124, Budapest 20-21 Jun 2009.