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PRICE FORMATION AND TRANSMISSION ALONG THE FOOD COMMODITY CHAIN

I. Blažková, P. Syrovátka

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Abstract

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The article is focused on analysis of price transmission along the wheat commodity chain in the Czech Republic, with the distinction on wheat products with low value added (wheat flour), respectively high value added (wheat rolls). The degree of vertical price transmission is measured to identify potential market failures, because asymmetric price transmission can be the result of existence of market power within the food commodity chain. The data basis is made up from monthly prices on partial markets of the analyzed commodity chain published by Czech Statistical Office and Ministry of Agriculture of the Czech Republic. The monitored time period is from January 2000 till October 2009. The analysis is based on calculation of the price transmission elasticity coefficient (evaluation of price transmission along the chain) and the intensity of dependency of positive and negative inter-market price differences (evaluation whether positive or negative price changes are better transmitted among particular vertical markets). Time lag is tested as well. The assessment of price transmission along the wheat commodity chain confirmed the existence of market power especially on the retail stage and low impact of price changes of farm prices on final consumer food prices.

wheat commodity chain, price transmission, elasticity of price transmission, market power

Analysis of price relations along commodity chains and evaluation by means of price transmission became frequently used methods for assessment of functioning, competition level and market power on agro-food markets. Prices drive resource allocation and output decisions of economic actors. Economists who study market process are therefore interested in price transmission process because price transmission is an indicator of how markets are integrated and interconnected – both vertically and horizontally. Economists are usually interested in asymmetric process of price transmission – transmission differs according to whether prices are increasing or decreasing (*Meyer, J and von Cramon-Taubadel, S., 2004; Peltzman, 2000*).

The question of price changes transmission along the commodity chain is of increasing importance with the context of market structures changes, increasing concentration of processing and retail companies and existence of market power within the commodity verticals. Measuring the degree of vertical price transmission can help to identify potential market failures and is often used as an indicator of the effectiveness and efficiency of the chain as well as of the degree of competition in food processing and distribution (*Commission of the European Communities, 2009*).

The assessment of price transmission typically aims at addressing the following issues (*Commission of the European Communities, 2009*):

a) the magnitude of the price adjustment – how much of the price change at one stage of the chain is transmitted to the downwards stage;
b) the speed of the price adjustment – the pace at which changes in prices at one level of the chain are transmitted to the other levels;
c) the asymmetry of the price adjustment – to what extent price increases and decreases are transmitted differently in terms of magnitude and speed.

The aim of the paper is to analyze the price transmission process along the wheat commodity

chain in the Czech Republic, with the distinction on wheat products with low value added (wheat flour), respectively high value added (wheat rolls). The research evaluates whether the results of analysis confirm the existence of market power at particular markets of the commodity chain.

MATERIALS AND METHODS

The data basis is made up from monthly prices on partial markets of the analyzed commodity chain published by Czech Statistical Office (CSO) and Ministry of Agriculture of the Czech Republic (MA CR) (*Situační a výhledová zpráva Obiloviny, 2009*). The monitored time period is from January 2000 till October 2009. The structure of price levels comprises the farm-gate prices (FP), the processors prices (PP) and the consumer prices (CP).

Intensity of price transmission among particular market levels (level *i* and *j*) within the chain is evaluated with using of elasticity price coefficient (EPT_{ij}) (*Mc Corriston, 2002; Lechanová, Bečvářová, 2006*):

$$EPT_{ij} = \frac{\frac{\delta p_j}{p_j}}{\frac{\delta p_i}{p_i}} = \frac{\delta p_j}{\delta p_i} \times \frac{p_i}{p_j},$$

where p_i represents the price on the market *i* and p_j represents the price on the market *j*. Generally the EPT coefficient represents the price change on the market *j* due to unit change in the price on the market *i*.

Regression linear models are constructed to quantify the price transmission between particular markets of the chain, parameters in regression models are computed through the use of least-squares method. The intensity of dependency of positive and negative inter-market price differences is found out by means of correlation coefficient (*r*) and it is judged whether positive or negative price changes are better transmitted among particular vertical markets. Created regression models are verified through the use of squared multiple determination coefficient and F-test (*Hušek, 2007*).

On the basis of inter-market price differences it is evaluated, what kind of price changes are transmitted better among particular vertical stages – whether price increases or price decreases (intensity of time series dependency is evaluated through the use of correlation coefficient). Time lag is tested as well (according to the highest value of correlation coefficient).

RESULTS AND DISCUSSION

The results of price transmission analysis for wheat flour commodity chain and wheat rolls commodity chain are listed in Tab. I and II. Values of coefficients of price transmission elasticity (EPT_{ij}) predicate about elasticity of price transmission among particular vertical stages, values of squared multiple determination coefficient (r^2) show the dependency of simulated relations and values of F-test (*F-test*) probe statistical demonstrativeness of the model.

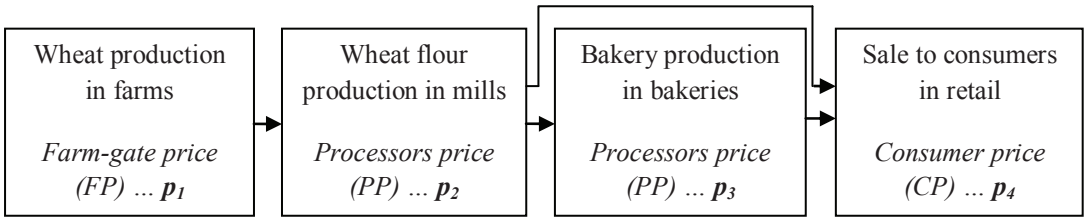
The Fig. 1 illustrates the particular stages of the wheat commodity chain and price structure along the chain used in the following text:

The results of price transmission along the commodity chain of wheat flour production:

The price transmission from farmer to processor and retail was observed to be non-elastic in case of wheat flour commodity chain – the values of price elasticity coefficients (*EPTij*) for the market level $i = 1$, $j = 2$ and 4 were 0.46 and 0.45. The price increase on the farm level is better transmitted to the processor level then the price decrease and the existence of time lag was observed between farm-gate price change and the subsequent processor price change in the duration of three months, that can be the a result of storage of basic agricultural commodity, as it was speculated in former research (*Blažková, Chmelíková, 2010*).

On the second stage of the commodity chain for the market level $i = 2$ ($j = 1, 4$) the price transmission was elastic – unit change of wheat flour processor price (p_2) caused change of wheat farm price (p_1) and wheat flour consumer price (p_4) greater than one unit (EPT_{ij} was 1.19 and 1.11). Between processors and retail stage the price decreases are better transmitted than price increases that can be the result of market power of subsequent vertical stage (retail) – due to market power of retail their input prices are maintained at low level and there is not possible to advance of processors prices at the level of processing stage (mills). This fact was observed pursuant to the commodity chain of wheat rolls production (*Blažková, Chmelíková, 2010*).

Changes of consumer price (p_4) are not fully transmitted in case of demand direction on the market level $i = 4$ (EPT_{41} was 0.91 and EPT_{42} was



1: *Wheat commodity chain*

I: *Results of price transmission analysis – wheat flour*

p_i	p_j	EPT_{ij}	r^2	F-test	
				F	α
FP – wheat (p_1)	PP – wheat flour (p_2)	0.46	0.5541	69.58	2.13×10^{-11}
FP – wheat (p_1)	CP – wheat flour (p_4)	0.45	0.4218	40.85	3.49×10^{-8}
PP – wheat flour (p_2)	CP – wheat flour (p_4)	1.11	0.9538	1155.68	4.47×10^{-39}
PP – wheat flour (p_2)	FP – wheat (p_1)	1.19	0.5541	69.58	2.13×10^{-11}
CP – wheat flour (p_4)	FP – wheat (p_1)	0.91	0.4218	40.85	3.49×10^{-8}
CP – wheat flour (p_4)	PP – wheat flour (p_2)	0.86	0.9538	1155.68	4.47×10^{-39}

Source: CSO, MA CR, calculations: authors

0.86). The retail price policy does not always reflect the price development on the previous vertical stage, because it can be issue of long-term strategy, e. g. low flour price (as a cheap common everyday consumption product) can attract customers to the retail store, where they consequently buy also other (more expensive) products. Imbalances in bargaining power within the chain can affect the degree and speed of price transmission, because enterprise with strong bargaining power in the chain has the opportunity to diminish or delay the transmission of price changes.

The results of price transmission along the commodity chain of wheat rolls production:

On the first stage of the commodity chain for the market level $i = 1$ ($j = 2, 3, 4$) – i.e. price transmission from farmer to processor and retail – values of price elasticity coefficients (*EPTij*) are less than 1 (from 0.29 to 0.61). It means non-elastic price transmission and if there is a unit change of wheat farm price (p_1), the price change on the successive markets of the chain is less than one unit. The price increase on the farm level is better transmitted to the processor level than the price decrease, which corresponds to former research studies (*Pelzman, 2000; Lechanová, Bečvářová, 2006; Lechanová, Novák, 2006*). It results from the fact that agricultural sector, which is fragmented and unorganized with non-differentiated products, is often perceived as facing unbalanced bargaining power against the rest of the chain. The existence of time lag between farm-gate price change and the subsequent processor price change was proved in the duration of two months, that can be the a result of storage of basic agricultural commodity.

On the second stage of the commodity chain for the market level $i = 2$ ($j = 1, 3, 4$) the price transmission was more elastic, e.g. a unit change of baking wheat flour price (p_2) caused change of wheat farm price (p_1) and wheat rolls consumer price (p_4) greater than one unit (EPT_{ij} was 1.36 and 1.57). The price transmission between two stages of processing (mills and bakeries) was non-elastic. The price change was better transmitted between mills and bakeries in case of price decrease, that can be the result of market power of subsequent vertical stage (retail) as it is noted above in case of the commodity chain of wheat flour production – due to market power of retail their input prices are maintained at low level and there is not possible to advance of processor prices at the level of the second stage of processing (bakeries). There was proved the existence of time lag between the two processing stages in the duration of one month, which corresponds with flour storage.

Elastic price transmission was observed in case of supply direction on the market level $i = 3$ (EPT_{34}

II: *Results of price transmission analysis – wheat rolls*

p_i	p_j	EPT_{ij}	r^2	F-test	
				F	α
FP – wheat (p_1)	PP – baking wheat flour (p_2)	0.46	0.6285	196.28	1.05×10^{-26}
FP – wheat (p_1)	PP – wheat rolls (p_3)	0.29	0.2194	32.61	8.83×10^{-8}
FP – wheat (p_1)	CP – wheat rolls (p_4)	0,61	0.2868	46.64	4.15×10^{-10}
PP – baking wheat flour (p_2)	PP – wheat rolls (p_3)	0.85	0.6403	206.53	1.60×10^{-27}
PP – baking wheat flour (p_2)	CP – wheat rolls (p_4)	1.57	0.6246	193.00	1.95×10^{-26}
PP – wheat rolls (p_3)	CP – wheat rolls (p_4)	1.80	0.8973	1013.7	3.62×10^{-59}
PP – baking wheat flour (p_2)	FP – wheat (p_1)	1.36	0.6285	196.28	1.05×10^{-26}
PP – wheat rolls (p_3)	FP – wheat (p_1)	0.75	0.2194	32.61	8.83×10^{-8}
PP – wheat rolls (p_3)	PP – baking wheat flour (p_2)	0.75	0.6403	206.53	1.60×10^{-27}
CP – wheat rolls (p_4)	FP – wheat (p_1)	0.46	0.2868	46.64	4.15×10^{-10}
CP – wheat rolls (p_4)	PP – baking wheat flour (p_2)	0.40	0.6246	193.00	1.95×10^{-26}
CP – wheat rolls (p_4)	PP – wheat rolls (p_3)	0.50	0.8973	1013.7	3.62×10^{-59}

Source: CSO, MA CR, calculations: authors

was 1.80), which matches to the elastic reaction of wheat rolls consumer prices (p_4) on changes in wheat rolls processor prices (p_3). The price increase is better transmitted, which again acknowledge greater market power of retail. There is not time lag between the bakery and retail stage, which can be expected with regard to perishable nature and storage instability of the product (wheat rolls).

Changes of consumer price (p_4) are not fully transmitted on the previous vertical markets (the EPT_{ij} values were from 0.4 to 0.5).

The results of the price transmission analysis in the commodity chain of wheat rolls production confirm the existence of market power especially on the retail stage, which corresponds to former analyses of this commodity chain (*Blažková, 2008b*). Low influence of farm price change on price changes in successive stages of processing and distribution reflects the fact, that final consumer prices are influenced rather by costs of labour, energy and marketing than by costs of raw agricultural products. It is estimated that average over the whole food chain, the cost of the agricultural products only make up approximately 20% of the consumer prices (*European Commission, 2003*). In case of wheat rolls, the share of the raw agricultural commodity is even only 7% on consumer price, whereas share of retail stage is about 35% (*Blažková, 2008a*).

It is necessary to realize that although the existence of market power is generally considered to be the main cause of asymmetric price transmission, some authors emphasize, that the asymmetry of price transmission can be observed not only in oligopolistic market structure but also in competitive market structure. Asymmetry of price transmission among particular vertical stages along the chain can be caused also by e.g. policy interventions, asymmetric information or inventory management (*Meyer, von Cramon-Taubadel, 2004*).

It is important to emphasize the fact that systematic analysis of the magnitude, speed and degree of asymmetry requires relevant and reliable data. While prices for raw agricultural products are in general available and accurate, the situation is more problematic at the level of food processors and retailers. It is also not possible to distinguish between the effects of the wholesale and retail sector in price transmission analysis because of data non-availability.

SUMMARY

The aim of the article was to analyze the price transmission process along the wheat commodity chain in the Czech Republic. Two products of this commodity chain were evaluated – wheat flour and wheat rolls. The data basis was made up from monthly prices on partial markets of the analyzed commodity chain, the monitored time period was from January 2000 till October 2009. Intensity of price transmission among particular market levels within the chain was evaluated with using of elasticity price coefficient. Regression linear models were constructed to quantify the price transmission between particular markets of the chain, the intensity of dependency of positive and negative inter-market price differences was found out by means of correlation coefficient. On the basis of inter-market price differences it was evaluated, what kind of price changes are transmitted better among particular vertical stages – whether price increases or price decreases. Time lag was tested as well.

The price transmission from farmer to processor and retail within the commodity chain of wheat flour production was observed to be non-elastic. The prices were better transmitted in the case of price increases than price decreases and the existence of time lag was observed between farm-gate price change and the subsequent processor price change in the duration of three months. The price transmission between processors and retail was found out elastic, whereas the price decreases were better transmitted than price increases. Changes of consumer price were not fully transmitted to the previous market levels.

The price transmission along the commodity chain of wheat rolls production was observed asymmetric as well. The farm price changes were not fully transmitted to the successive vertical markets. It was found out better price transmission in case of price increase than price decrease from farm to processor stage of the commodity chain. The existence of time lag between farm-gate price change and the subsequent processor price change was proved in the duration of two months. It was proved an elastic reaction of wheat rolls consumer prices on changes in wheat rolls processor prices. There was not observed time lag between the bakery and retail stage due to perishable nature and storage instability of the product (wheat rolls).

The assessment of price transmission along the wheat commodity chain confirmed the existence of market power especially on the retail stage and low impact of price changes of farm prices on final consumer food prices. Final consumer prices are influenced especially by costs of labour, energy and marketing or are governed by price strategies of retail stores.

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Address

Ing. Ivana Blažková, Ph.D., Ústav regionální a podnikové ekonomiky, doc. Ing. Pavel Syrovátka, Ph.D., Ústav ekonomie, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: blazkova@mendelu.cz, pavels@mendelu.cz