

Evaluation of the price transmission in the commodity chain of milk and butter in the Czech Republic

Jana Lekešová¹ and Ivana Blažková²

¹Mendel University in Brno, Faculty of Business and Economics, Department of Business Economics, 61300 Brno, Czech Republic

²Mendel University in Brno, Faculty of Regional Development and International Studies, Department of Regional and Business Economics, 61300 Brno, Czech Republic

E-mails: xlekeso1@mendelu.cz; blazkova@mendelu.cz

Abstract

Lekešová, J. & Blažková, I. (2022). Evaluation of the price transmission in the commodity chain of milk and butter in the Czech Republic. *Bulg. J. Agric. Sci.*, 28(1), 42–48

The paper deals with the price transmission within the milk commodity chain in the Czech Republic. The aim of the paper is to assess the price transmission within the commodity vertical of the semi-skimmed long-life cow's milk (1.5% fat) as a product with low added value, and of butter as a higher added value product. The dataset consists of monthly prices on the sub-markets of the analysed commodity chain with the period of January 2002 to August 2020 that were retrieved from the Czech Statistical Office and the Ministry of Agriculture of the Czech Republic. Methodologically, the analysis is based on the elasticity of price transmission (EPT) coefficients used in both supply and demand direction, on the correlation of price differences, and on the evaluation of the time-lag changes in output prices in case of changes in input prices. The results show imperfections in the transmission of price changes between individual levels of the commodity chain. Time delays of price transmission are not obvious in the case of these commodities due to the perishability of these products. Finally, several suggestions for further research are given.

Keywords: agribusiness; milk; dairy product; price transmission; commodity chain

Introduction

Nowadays, agriculture is significantly affected by the situation on the downstream markets of the commodity chain, i.e. especially on markets finalizing and distributing processed food products (Blažková, 2010; Sexton & Xia, 2018). The growing concentration and consolidation of the food industry and retail (Hovhannisyan et al., 2019) and the processes of European market integration (Bekaert et al., 2013) raise the need to explore the link between farm and retail prices due to the concerns about the potential market power of intermediaries in commodity chains. The food commodity chain consists of three main sectors, i.e. agriculture, processing, and retailing, which are interconnected by

the price mechanism, therefore, research studies are needed to test whether prices at retail, wholesale or processor level respond differently to increases or decreases of prices on the farm level (Meyer & Cramon-Taubadel, 2004; Bakucs et al., 2014; Gizaw et al., 2021). The analysis of price changes within the commodity chains is regarded as a useful tool providing information on the distribution of market power within the commodity chain, on effects of specific market players on the market conditions and thus on the position, performance and development of the agricultural sector (Rezitis & Tsionas, 2019). As stated by Sarris & Hallam (2006), an important role in all models of global agricultural chains plays the price transmission mechanism, since the price transmission reflects the context of the development of price changes

on particular vertical market within the commodity chain. In empirical studies (Olipra, 2020; Newton, 2016; Čechura & Šobrová, 2008; Serra & Goodwin, 2003), the price transmission is usually expressed in terms of transmission elasticity, i.e. it measures how a one percent change in price on one market manifests in the change in another price on another market. The price transmission in commodity chains affects the income situation not only of all agricultural producers, but also of all companies in the downstream markets of the chain. Redlichová et al. (2015) document the shift of margins from the agricultural producer to the food processor, and especially to the retail organizations. Empirical research confirms the asymmetric price transmission especially in the case of a decline in input prices, when this decline in prices is only partially reflected in downstream prices, since the downstream subjects rather tend to increase their margins instead of reducing the prices of their products (Rezitis & Tsionas, 2019).

As confirmed by previous studies (Aramyan & Kuiper, 2009; Verreth et al., 2015; Rezitis & Tsionas, 2019), the agro-food markets are characterized by imperfect competition, which leads to the asymmetry of price transmission between individual markets of the commodity chain. This arises, for example, due to the use of government support, abuse of market power of some market subjects, increased marketing costs or due to the inventory management. Price fluctuations on particular markets may be caused by the influence of various EU regulations and measures, changes in supply and demand, in the political situation, in the situation on foreign markets, by animal diseases or adverse weather conditions (Gouel, 2012; Borawski et al., 2020). As confirmed also by McCorrison et al. (2001), the distribution of market forces in the case of imperfect competition depends not only on the behaviour of the company, but also on the existence of economies of scale and elasticity of supply/demand (McCorrison et al., 2001). Storability also plays a role, as prices in industries with storable inputs or outputs change more slowly and with a longer time lag, while the sectors with perishable stocks shows more price volatility (Lechanová & Bečvářová, 2006). In the case of imperfect transmission of price changes, the consumer is not able to take full advantage of the declining agricultural price, profits are withheld and the problem of consumer welfare redistribution arises (Bečvářová, 2005).

Within agro-food markets, the price transmission can generally be considered asymmetric, which is in contrast to the general economic theory, which assumes a symmetrical price transmission (Pelzman, 2000). Goowin (2003) also draws attention to the state interventions as the cause of asymmetries in price transmission within the agro-food

commodity chain, such as support of agricultural producer prices or the implementation of production quotas. Meyer von Cramon-Taubadel (2004) considers transaction costs to be the main cause of price transmission asymmetry.

Although analyses of price relations and contexts have been solved for a long time by a number of authors, they are still matters of considerable interest due to their applicability in designing of agricultural and economic policies. Analysis of price relations is a particularly important tool in commodity chains, where farmers are particularly vulnerable to market distortions. As generally known and acknowledged by the authors of previous studies (Rudinskaya & Boskova, 2021; Bórawski et al., 2021; Weldeesenbet, 2013), such a commodity chain is considered to be a milk production chain. The above reasons motivate many researchers to address price aspects in commodity milk chains; however, the results differ not only depending on the methodology used, but especially across countries due to different structural market conditions. Although some studies on price aspects in the Czech milk commodity chain have already been published (Dudová & Bečvářová, 2015; Rudinskaya & Boskova, 2021), the uniqueness of our study lies in the timeliness and long time series of monthly data used (time period 24 years). To the best of our knowledge, such a study has not yet been published, and therefore its findings could be of benefit to both the research community and economic policy makers. The aim of the paper is to analyse and evaluate the price transmission within the milk commodity chain in the Czech Republic during the period 2002-2020. The paper focuses on the relationship between farm prices (FP), processor prices (PP), and consumer (i.e. retail) prices (CP) of two commodities – semi-skimmed long-life cow's milk (1.5% fat) as a product with low value added, and butter as a product with higher value added. Methodologically, the analysis is based on the elasticity of price transmission (EPT) coefficients used in both supply and demand direction, on the correlation of price differences, and on the evaluation of the time-lag changes in output prices in case of changes in input prices.

The paper is structured conventionally – the next section introduces the empirical approach and collected data, in the third section empirical results are presented, which is followed by discussion in the fourth section. Finally, the concluding section summarizes, gives final remarks and recommendations, as well as suggestions for further research.

Data and Methods

The dataset consists of time series of monthly prices at the farm, processor and consumer level for two products that have a cow's milk as a common basic raw material, are

analysed in this study, i.e. semi-skimmed long-life cow's milk and butter. The reference period is from January 2002 to August 2020. The data were obtained from the Czech Statistical Office (2020) and the Ministry of Agriculture of the Czech Republic (2020). The structure of price levels used in the analysis is as follows – prices of agricultural producers (FP), industrial producer prices (PP) and consumer prices (CP).

The analysis of price transmission is carried out in three steps, as previously done by Blažková & Syrovátka (2012) or Meyer & Cramon-Taubadel (2004). The chosen methodological approach, based on examining the intensity and asymmetry of the price transmission changes within the given commodity vertical, reflects the changes resulting from the formation of agribusiness in the last decades (Lechanová & Bečvářová, 2006).

The first part of the analysis evaluates the development of price levels and their mutual relations within the commodity chain with the use of elasticity of price transmission (EPT) coefficients, which represents the basic indicator for quantifying and assessing the price transmission intensity (Rumánková, 2014). This coefficient reflects the change in the downstream price if the upstream price has changed. If particular markets are denoted as i and j , the EPT_{ij} coefficient can be expressed as follows (McCorrison et al., 2001):

$$EPT_{ij} = \frac{\frac{\partial p_j}{p_j}}{\frac{\partial p_i}{p_i}} = \frac{\partial p_i}{\partial p_j} \cdot \frac{p_i}{p_j}, \quad (1)$$

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 . The EPT_{ij} coefficient indicates by what percentage the price was changed on the market j , if there was a change of 1% on the market i . The possibilities of the results of the price elasticity coefficient are an absolutely inelastic price transmission ($EPT = 0$), inelastic price transmission ($0 < EPT < 1$), unit elasticity of price transmission ($EPT = 1$), elastic price transmission ($EPT > 1$), and perfectly elastic price transmission ($EPT \rightarrow \infty$). The calculations were made for all market levels and then sorted into the matrix of EPT_{ij} coefficients according to Table 1.

Table 1. Elasticity of Price Transmission Matrix

	FP	PP	CP
FFP	X	EPT_{12}	EPT_{13}
PP	EPT_{21}	X	EPT_{23}
CP	EPT_{31}	EPT_{32}	X

Source: author's elaboration

Price transmission based on inter-market price transmission was performed in the supply and demand direction. In the supply direction (see EPT_{ij} above the diagonal in Table 1), it informs about how the price of the product in the previous vertical market is transferred to the subsequent vertical market. The demand direction (see EPT_{ij} below the diagonal in Table 1) provides information on how the price of outputs is transferred to the price of inputs.

In order to quantify the price transmission between particular vertical markets of the commodity chain, linear regression models are constructed (Lechanová & Bečvářová, 2006; Blažková & Syrovátka, 2012):

$$p_j^m = A^m + B^m \cdot p_i^m, \quad (2)$$

where p_j^m represents the price of a commodity m on the market j , p_i^m represents the price of a commodity m on the market i , A^m and B^m are regression parameters estimated with the use of the Method of Ordinary Least Squares (OLS) in these regression models (Hušek, 2007). Using Pearson's correlation coefficient, it is possible to determine the strength between two variables and quantify the relation strength. However, the use of Pearson's correlation coefficient assumes a linear relationship between the investigated variables, since the violation of this assumption can lead to misleading results (Hušek, 2007). Therefore, the value of 95% was used for the approximate assessment of the two-dimensional normality of the data set.

The second part of the analysis examines the positive and negative inter-market price differences, i.e. on the basis of these price differences it can be assessed whether price increases or price decreases are better transmitted between particular vertical stages of the commodity chain. According to Peltzman (2000), the price increase is usually reflected in the entry price, which is not the case when prices fall. The intensity of these dependencies was tested based on the correlation coefficient. Formally, the analysis of inter-market price differences can be expressed as follows (Hušek, 2007).

$$\Delta P_{jt} = A^+ + \sum_{l=1}^k B_l^+ \cdot \Delta P_{lt}^+, \text{ resp. } \Delta P_{jt} = A^- + \sum_{l=1}^k B_l^- \cdot \Delta P_{lt}^-, \quad (3)$$

where ΔP_{jt} is the price change on the j -th stage of the vertical in time t , which may be positive, i.e. $\Delta P_{jt} = A^+ + \sum_{l=1}^k B_l^+ \cdot \Delta P_{lt}^+$, or negative, i.e. $\Delta P_{jt} = A^- + \sum_{l=1}^k B_l^- \cdot \Delta P_{lt}^-$. A and B are parameters of particular regression functions.

The third part of the analysis focuses on the impact of the time lag on price transmission between particular vertical markets. The time lag is tested by means of the highest

value of correlation coefficient. A maximum time lag of two months is considered due to the perishable nature and character of food products.

Results and Discussion

The results of the price transmission analysis for the cow's milk commodity chain, i.e. the EPT_{ij} coefficients, are presented in Table 2; the results of the price transmission analysis for the butter milk commodity chain are in Table 3. The coefficients above the diagonal in the matrix represent elasticity of price transmission in the supply direction; the coefficients below the diagonal represent the elasticity of price transmission in the demand direction.

Table 2. EPT matrix for milk

EPT cow milk	FP cow milk p_1	PP cow milk 1.5% fat p_2	CP cow milk 1.5% fat p_3
FP cow milk p_1	X	0.30	0.41
PP cow milk 1.5% fat p_2	0.46	X	1.00
CP cow milk 1.5% fat p_3	0.23	0.36	X

Source: Ministry of Agricultural of the Czech Republic (2020), author's elaboration

Table 3. EPT matrix for butter

EPT butter	FP cow milk p_1	PP butter p_2	CP butter p_3
FP cow milk p_1	X	1.02	1.13
PP butter p_2	0.30	X	1.22
CP butter p_3	0.20	0.71	X

Source: Ministry of Agricultural of the Czech Republic (2020), author's elaboration

As seen in Table 2, an inelastic price transmission was observed between the farm and processor level in the supply direction in the case of the cow's milk commodity chain ($EPT_{12} = 0.30$), which is in line with studies conducted by e.g. Lass et al. (2001) or Acosta & Valdés (2014). On the contrary, the price transmission for butter (see Table 3) can be regarded as elastic ($EPT_{12} = 1.02$). In the demand direction, the price transmission is inelastic between processor and farm level for both commodity chains, i.e. cow's milk and butter ($EPT_{21} = 0.46$ for cow's milk commodity chain and 0.30 for butter commodity chain). Regarding the price relations between the processor and consumer market, an elastic price transmission was found out in the supply direction in both cases, i.e. cow's milk ($EPT_{23} = 1.00$) and butter ($EPT_{23} = 1.22$). However, in the demand direction there was

an inelastic price transmission between these two markets for both commodities ($EPT_{32} = 0.36$ and 0.71).

If we look at the price transmission in the supply direction between the farm and consumer/retail market, we can observe an inelastic price transmission for the cow's milk commodity chain in Table 2 ($EPT_{13} = 0.41$), while within the butter commodity chain there was an elastic price transmission in the observed period ($EPT_{12} = 1.13$), as seen in Table 3. In the demand direction, inelastic price transmission between consumer/retail and farm price was found for both commodity chains ($EPT_{31} = 0.23$ for cow's milk commodity chain and $EPT_{31} = 0.20$ for butter commodity chain).

The results show an asymmetric price transmission within the milk commodity chain, which has been observed previously in number of studies. In the fluid milk market, similar price relations were confirmed e.g. by Weldesenbet (2013) in Slovakia, by Falkowski (2010) in Poland, Fernández-Amador et al. (2010) in Austria or by Reziti (2014) in Greece. Studies dealing with butter markets confirm the price asymmetry as well, especially asymmetric retail price responses are often highlighted, e.g. Chavas & Mehta (2004), by Tifaoui & Von Cramon-Taubadel (2017) or Loy et al. (2012).

Asymmetry of price changes within the commodity chain may occur due to imperfect competitive market structure (Falkowski, 2010), i.e. in the case of input price decline, the price decrease is only partially reflected in the output price and at the same time margins increase. This is evident especially due to the growing concentration and integration across subsequent stages of the downstream agro-food chain (Sexton & Xia, 2018). Other causes of asymmetric price transmission often discussed and confirmed in the literature are e.g. the inventory management (Dudová & Bečvářová, 2015), transaction costs (Meyer von Cramon-Taubadel, 2004), or public price support (Kinnucan & Forker, 1987), which cause additional price inelasticity, i.e. dampen the effects of possible fluctuations in input prices.

The second part of the price transmission analysis assessed whether price increases or price decreases are better transmitted between particular vertical stages of the commodity chain. There is a presumption of better price transmission to the downstream market when prices rise than when prices fall (Bečvářová, 2005; Pelzman, 2000). As seen in Table 4, at the first level of the cow's milk commodity chain, i.e. between farm and processor price, the assumption was confirmed – the correlation coefficient is higher in the case of price increase than in the case of price decrease. In the butter commodity chain, the dependency is higher in the case of price decrease. At the second level of the commodity chain, the assumption of better price transmission in case of price increase was confirmed for both commodities.

Table 4. Analysis of positive and negative inter-market price differences

		First level of commodity chain FP-PP	Second level of commodity chain PP-CP
Cow milk	Price increase	29.69%	7.21%
	Price decrease	21.48%	3.42%
Butter	Price increase	3.56%	7.84%
	Price decrease	22.25%	2.51%

Source: Ministry of Agricultural of the Czech Republic (2020), author's elaboration

In Table 5 the results of the time lag analysis are reported. Since both milk and butter are perishable products, the time lag of 2 months can be considered as maximum. In the case of milk commodity chain, the highest correlation coefficient can be seen for the price transmission without time lag, which is valid for both farm-processor relationship and processor-consumer relationship. Comparable results can be found e.g. in Popovic & Radovanov (2010), who also investigated time delays in dairy commodity chain. In terms of the fluid milk commodity chain, higher correlation coefficient was observed in the case of time lag of 2 months. At the second level of the chain, the coefficients reach high values both without time lag and with time lag of 1-2 months. This is due to the possibility of storage at this level of the commodity chain, since the expiration date of butter can be up to three months.

Table 5. Value of determination coefficient for various lengths of time delay

Lengths of time delay	no time delay	1 month	2 months
First level of commodity chain of milk FP-PP	37%	32%	25%
Second level of commodity chain of milk PP-CP	60%	60%	59%
First level of commodity chain of butter FP-PP	55%	60%	63%
Second level of commodity chain of butter PP-CP	93%	92%	89%

Source: Ministry of Agricultural of the Czech Republic (2020), author's elaboration

Conclusions

The results obtained by the analysis made it possible to specify imperfections in the transmission of price changes between individual levels of the commodity chain and thus drew attention to the impact of market failures in the form of market power or other interventions affecting market devel-

opments. The existence of market power especially on the retail stage was confirmed, which corresponds to the previous analysis of this commodity chain (Dudová & Bečvářová, 2015). Low impact of farm price change on price changes in successive stages of the chain, i.e. processing and distribution level, points to the fact that consumer/retail prices depend more on other costs such as labour costs, costs of energy or marketing, and thus the price of raw agricultural commodity makes up only a small share on the final consumer price.

Our findings confirmed the asymmetric transmission pointing to the uneven distribution of market power in the commodity chain. Dairy farmers are in a worse bargaining position vis-à-vis their customers, so they are trying to merge into cooperatives and consolidate their milk sales to realize more favourable prices. Through the CAP, sectoral assistance could be newly introduced to motivate and encourage greater cooperation between farmers. Furthermore, policy-makers should be aware of the seriousness of the existence of market power and look for ways to mitigate the negative effects on the dairy sector. Perishable products do not allow farmers to store, nor do they have enough time to find more suitable customers and markets for their products if they are under pressure on the local market to lower prices by economically strong processors. Therefore, policies should be designed to promote competition, i.e. to reduce uncompetitive behaviour by eliminating barrier of market entry, which could lower concentration.

As the presented analysis is focused only on milk and butter sector in the Czech Republic, there are several challenges for the further examination. First, it would be useful to investigate other food chains and sectors to find out, whether such findings hold also for other commodities. Second, there are more methodological approaches to the price analyses that have been developed and applied to date (see e.g. Meyer & Von Cramon-Taubadel, 2004), therefore it would be appropriate to verify the results using different empirical approaches. And third, the analysis could also be extended to more countries in order to provide an international comparison. There is no doubt that the findings from robust analyses of price dynamics and transmission within various commodity chains and across countries could have potential implications for policy makers as they may serve for the further direction of economic policies.

Acknowledgements

Supported by the Internal Grant Agency of Faculty of Business and Management, Mendel University in Brno (PEF_DP_2020017), and by Internal Grant Agency of

Faculty of Regional Development and International Studies, Mendel University in Brno (IGA_FRRMS_2020/003).

References

- Acosta, A. & Valdés, A.** (2014). Vertical price transmission of milk prices: are small dairy producers efficiently integrated into markets? *Agribusiness*, 30(1), 56-63.
- Aramyan, L. H. & Kuiper, M.** (2009). Analyzing price transmission in agri-food supply chains: an overview. *Measuring Business Excellence*, 13(3), 3-12.
- Bakucs, Z., Falkowski, J. & Fertő, I.** (2014). Does market structure influence price transmission in the agro-food sector? A meta-analysis perspective. *Journal of Agricultural Economics*, 65(1), 1-25.
- Bečvářová, V.** (2005). Podstata a ekonomické souvislosti formování agrobiznisu. 1st Ed. Brno: MZLU v Brně. ISBN 80-86633-70-5.
- Bekaert, G., Harvey, C. R., Lundblad, C. T. & Siegel, S.** (2013). The European Union, the Euro, and equity market integration. *Journal of Financial Economics*, 109(3), 583-603.
- Blažková, I.** (2010). Economic performance differentiation of the processing stage within the commodity chain. *Agricultural Economics*, 56(1), 16-24.
- Blažková, I. & Syrovátka, P.** (2012). Price formation and transmission along the food commodity chain. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 60(4), 31-36.
- Bórawski, P., Guth, M., Parzonko, A., Rokicki, T., Perkowska, A. & Dunn, J. W.** (2021). Price volatility of milk and dairy products in Poland after accession to the EU. *Agricultural Economics*, 67(3), 111-119.
- Borawski, P., Guth, M., Truszkowski, W., Zuzek, D., Beldycka-Borawska, A., Mickiewicz, B. & Dunn, J. W.** (2020). Milk price changes in Poland in the context of the Common Agricultural Policy. *Agricultural Economics*, 66(1), 19-26.
- Čechura, L. & Šobrová, L.** (2008). The price transmission in pork meat agri-food chain. *Agricultural Economics – Czech*, 54(2), 77-84.
- Chavas, J. P. & Mehta, A.** (2004). Price dynamics in a vertical sector: the case of butter. *American Journal of Agricultural Economics*, 86(4), 1078-1093.
- Czech Statistical Office** (2020). Prices of producers – time series. https://www.czso.cz/csu/czso/ipc_ts (Access: 15.10.2020).
- Dudová, B. & Bečvářová, V.** (2015). The character of price transmission within milk commodity chain in the Czech Republic. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 63(3), 887-892.
- Falkowski, J.** (2010). Price transmission and market power in a transition context: evidence from the Polish fluid milk sector. *Post-communist Economies*, 22(4), 513-529.
- Fernández-Amador, O., Baumgartner, J. & Crespo-Cuaresma, J.** (2010). Milking the prices: the role of asymmetries in the price transmission mechanism for milk products in Austria. *Working Papers in Economics and Statistics*, No. 2010-21, University of Innsbruck, Department of Public Finance, Innsbruck.
- Gizaw, D., Myrland, Ø. & Xie, J.** (2021). Asymmetric price transmission in a changing food supply chain. *Aquaculture Economics & Management*, 25(1), 89-105.
- Gouel, C.** (2012). Agricultural price instability: a survey of competing explanations and remedies. *Journal of Economic Surveys*, 26(1), 129-156.
- Hovhannisyan, V., Cho, C. & Bozic, M.** (2019). The relationship between price and retail concentration: Evidence from the US food industry. *European Review of Agricultural Economics*, 46(2), 319-345.
- Hušek, R.** (2007). Econometric Analysis (Ekonometrická analýza), 1st Ed. Praha: Oeconomica, ISBN 978-80-245-1300-3 (Cz).
- Kinnucan, H. W. & Forker, O. D.** (1987). Asymmetry in farm-retail price transmission for major dairy products. *American Journal of Agricultural Economics*, 69, 285-292.
- Lass, D. A., Adanu, M. & Allen, P. G.** (2001). Impacts of the northeast dairy compact on New England retail prices. *Agricultural and Resource Economics Review*, 30, 83-92.
- Lechanová, V. & Bečvářová, V.** (2006). Possibilities of using price transmission analysis to assess the impact of market power in food verticals. Brno: Mendel University of Agriculture and Forestry in Brno. ISBN 80-86633-70-5.
- Loy, J. P., Holm, T. & Steinhagen, C.** (2012). Vertical price transmission in differentiated product markets. A disaggregated study for milk and butter. Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14, 2012., No 323-2016-11461.
- McCorriston, S., Morgan, C. W. & Rayner, A. J.** (2001). Price transmission: the interaction between market power and returns to scale. *European Review of Agricultural Economics*, 28(2), 143-159.
- Meyer, J. & Cramon-Taubadel, S.** (2004). Asymmetric price transmission: a survey. *Journal of Agricultural Economics*, 55(3), 581-611.
- Ministry of Agricultural of the Czech Republic** (2020). Statistics – milk (Statistika – mléko) (Cz). <http://eagri.cz/public/web/mze/zemedelstvi/publikace-a-dokumenty/statistika/mleko/> (Access: 01.12.2020)
- Newton, J.** (2016). Price transmission in global dairy markets. *International Food and Agribusiness Management Review*, 19, 57-71.
- Olipra, J.** (2020). Price transmission in (de) regulated agricultural markets. *Agrekon.*, 59(4), 412-425.
- Peltzman, S.** (2000). Prices rise faster than they fall. *Journal of Political Economy*, 108(3), 466-502.
- Popovic, R. & Radovanov, B.** (2010). Price transmission in Serbian dairy chain. *Economics of Agriculture*, 57(297-2016-3776), 543-554.
- Redlichová, R., Bečvářová, V. & Vinohradský, K.** (2015). Organic farming form the economic perspective – The impact of subsidy policy on the economic results. In: *Proceedings of the Conference “Determinants of the Economic Stability”*, Smižany, Czech Republic, 90-95, ISBN 978-80-552-1599-0.
- Reziti, I.** (2014). Price transmission analysis in the Greek milk market. *SPOUDAI-Journal of Economics and Business*, 64(4), 75-86.

- Rezitis, A. N. & Tsionas, M.** (2019). Modeling asymmetric price transmission in the European food market. *Economic Modelling*, 76, 216-230.
- Rudinskaya, T. & Boskova, I.** (2021). Asymmetric price transmission and farmers' response in the Czech dairy chain. *Agricultural Economics*, 67(5), 163-172.
- Rumánková, L.** (2014). Asymmetry in price transmission of the Czech wheat agri-food chain. *AGRIS on-line Papers in Economics and Informatics*, 6(665-2016-45005), 63-71.
- Sarris, A. & Hallam, D.** (2006). Agricultural commodity markets and trade – New approaches to analyzing market structure and instability. Northampton: Edward Elgar Publishing, Inc., ISBN 92-5-105313-8.
- Serra, T. & Goodwin, B.** (2003). Price transmission and asymmetric adjustment in the Spanish dairy sector. *Applied Economics*, 35(18), 1889-1899.
- Sexton, R. J. & Xia, T.** (2018). Increasing concentration in the agricultural supply chain: Implications for market power and sector performance. *Annual Review of Resource Economics*, 10(1), 229-251.
- Tifaoui, S. & Von Cramon-Taubadel, S.** (2017). Temporary sales prices and asymmetric price transmission. *Agribusiness*, 33(1), 85-97.
- Verreth, D. M., Emvalomatis, G., Bunte, F., Kemp, R. & Oude Lansink, A. G.** (2015). Price transmission, international trade, and asymmetric relationships in the Dutch agri-food chain. *Agribusiness*, 31(4), 521-542.
- Weldesebet, T.** (2013). Asymmetric price transmission in the Slovak liquid milk market. *Agricultural Economics*, 59(11), 512-524.

Received: April 13, 2021; *Accepted:* June 28, 2021; *Published:* February, 2022