Econometric Analysis of Milk Value Chain

K. Matulová, P. Bubáková, O. Škubna, T. Taussigová

Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Economics

Abstract

This article deals with the basic analysis of price transmission in the milk agri-food chain. The analysis is aimed at deriving the fundamental relationships between milk prices at the individual levels of the chosen vertical. The results are then validated with the use of statistical hypotheses testing. From the derived single equation models, it is clear that there is a strong difference in the leverage of individual factors influencing the price at different levels of the milk value chain. The results were elaborated within the research intention IVZ MSM 6046070906.

Key words

Agri-food Chain, Milk, Price Transmission, Statistical Test.

Anotace

Článek se zabývá základní analýzou cenové transmise v zemědělsko-potravinářské vertikále mléka. Analýza se zaměřuje především na odvození základních vztahů mezi cenami mléka na jednotlivých úrovních vybrané vertikály. Výsledky jsou ověřeny za využití statistických testů. Z dosažených výsledků jednotlivých jednorovnicových modelů plyne, že v rámci cenové tvorby na jednotlivých úrovních dané vertikály existují značné rozdíly co do činitelů ovlivňujících výslednou cenu. Poznatky prezentované v článku jsou výsledkem řešení IVZ MSM 6046070906.

Klíčová slova

Zemědělsko-potravinářská vertikála, mléko, cenová transmise, testovací statistika.

Introduction

A product chain analysis is a useful tool for monitoring the influence of individual market subjects on the overall development of the given industry. Individual product chains within the agri-food sector are very well monitored in the Czech Republic from a statistical point of view. This is mainly due to previous historical periods when agriculture was marked out by a relatively direct dependency of individual product chains in a rather confined area.

As a consequence of globalization processes, some of the fundamentals related to the product chains in general – and within agriculture especially – have already been disrupted. Nevertheless, primarily because of food security, it is reasonable to monitor not only the volume of basic foodstuffs but also the possible relationships between price creations at individual levels of the product chain.

In this context, the concept of price transmission is introduced in the economic theory. This term is used for analyzing the proportional changes of inputs and the transmission of these changes into the changes of outputs.

In many processing industries, it was found out following: the growth of input price is almost immediately projected to output price, whilst the fall of input price does not bring that marked fall in output price and usually there is also a time delay in between these two falls (Peltzman, 2000).

This may also be the case of the milk price studied in this article (see charts 1 and 2 bellow). Therefore, we may suggest that the transmission process of price in given vertical chain is rather asymmetric. This idea is supported by the results of dairy sector studies in other countries (e.g. Kinnucan et al., 1987; Frigon et al., 1999).

Although the product market may be fairly similar to the perfect competition market, the production itself goes through an imperfect market environment at other levels of the product chain. The imperfect market environment means that the.

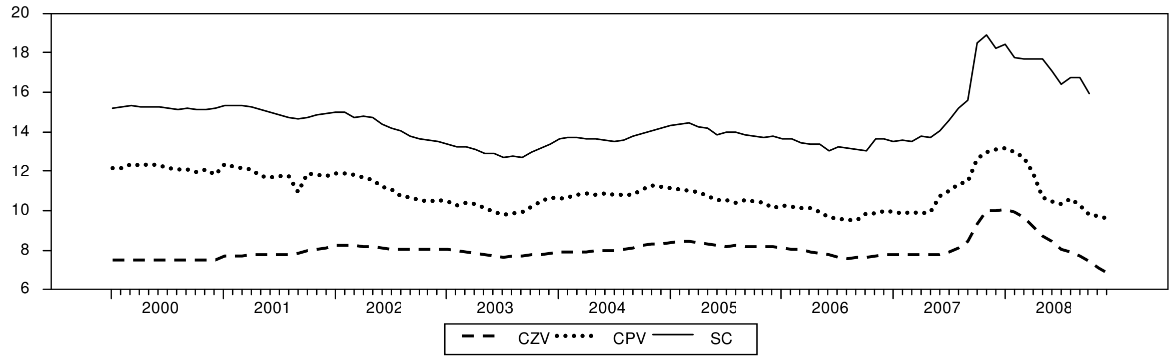

Chart 1: Agricultural Price, Producer Price, Consumer Price of Milk in CZK per litre.

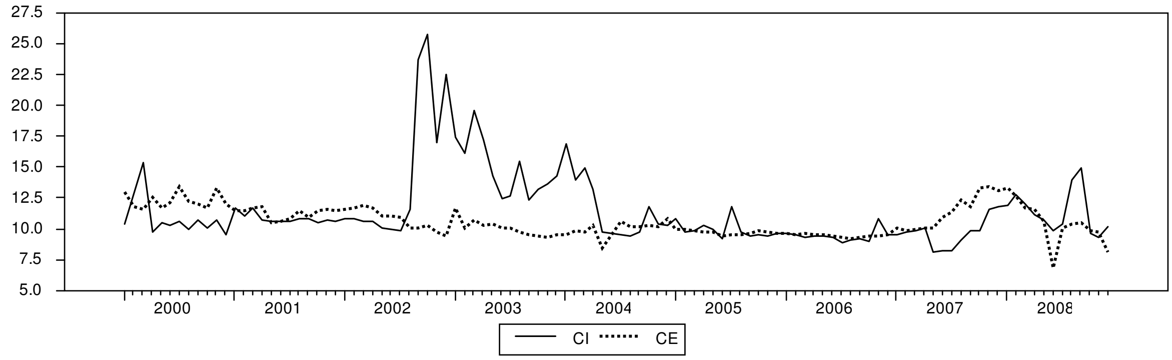

Chart 2: Import Price, Export Price of Milk in CZK per litre.

economic forces in the product chain are not evenly transmitted within the subject at separate levels.

Econometric methods are one of the useful tools that can be used to cover a wide range of market impacts within the price transmission. These methods are able – with different levels of success – to explain the impact of individual variablesSpecifically, the asymmetry of price transmission at the different levels of the milk product chain and the possibilities of its modelling with the use of econometric tools are the main interest of this article, which deals with the fundamental relations for price transmission in the dairy market in the Czech Republic.

The following charts (1 and 2) show the time development of individual types of price analyzed in this paper.

There is evidence of significant change in the price development of analyzed values from the end of the year 2007. The rapid increase in agricultural price began in October 2007 – during this time, the price reached its highest value for the last 11 years. The price continued to grow until January 2008, when it reached its maximum and then started to decline. Also, producer price and consumer price demonstrated the same development during the period under discussion.

This shock was primarily caused due to increased demand in Europe and Asia. In Europe, Czech, German and Italian producers led the increase in demand. In the development of export and import price, the influence of abnormal demand can be seen as well. All these facts contributed to an increase not only in milk itself but also in milk products – i.e. products with added value.

The data set is gathered from the Czech Statistical Office and from papers of the Ministry of Agriculture of the Czech Republic, and covers the period from January 2000 to December 2008 (hence, the total number of observations is 108). The analysis of the milk vertical chain uses the time series of agricultural, producer, consumer, export, and import price of milk. The data set of the first three mentioned is gathered in Czech Crown per litre, while both export and import price is obtained by dividing the total price and the total amount.

$$CZV_t = fce\ (CZV_{t-\tau}, CPV_t, CPV_{t-\tau}, SC_t, SC_{t-\tau}, CE_t, CI_t) \quad (1)$$

$$CPV_t = fce\ (CZV_t, CZV_{t-\tau}, CPV_{t-\tau}, SC_t, SC_{t-\tau}, CE_t, CI_t) \quad (2)$$

$$SC_t = fce\ (CZV_t, CZV_{t-\tau}, CPV_t, CPV_{t-\tau}, SC_{t-\tau}, CE_t, CI_t) \quad (3)$$

RATS software version 6.0 is used to estimate and to test individual models. Ordinary least squares method (OLS) is employed. The variables – agricultural price, producer price, and consumer price – are simulated with the use of single equation econometric models.

Firstly, the general economic models are set up:

Where:

CZV…agricultural price (1l of unrefined milk)

CPV…producer price (1l of processed milk)

SC…...consumer price (1l of processed milk)

CE…..export price (processed milk in the package up to 2l)

CI……import price (processed milk in the package up to 2l)

t……..time period

τ……..lag

In the general models, all above mentioned variables are covered. Then, the variables derived from estimated models are examined – variables' significance is analysed.

Several fundamental hypotheses can be postulated, which are divided into three examined groups - agricultural price, producer price and consumer price.

Agricultural Price Single Equation Model

Agricultural price hypotheses:

- Lag values and producer price influence the agricultural price.
- Consumer price together with export and import price do not contribute to the development of the given endogenous variable.

The linear form of the model is used. The general model of the dependent variable CZV – agricultural price – involves all reflected variables. The dummy variable is put into the model for price shock interception (October 2007 – March 2008), which is discussed in previous chapter (within the discussion concerning the development of individual types of prices). The lagged variables are included in the model as dynamising factors. Generally, information criteria are useful tools for setting the maximum number of lags. The Schwarz information criterion (SIC) indicates a maximum of only two lags, while in contrast the Akaike information criterion (AIC) indicates thirteen lags. For estimation purposes, it is useful to use SIC as it indicates a lower number of maximum lags.

In the following process, the estimated model is modified so it includes only significant variables. Therefore, in the model, the CZV variable is dependent on the CZV{1 to 2}, and CPV{0 to 1} variables (note: CZV{1} = CZVt-1). But this model is rejected, because it does not fulfil the fundamental assumptions of the econometric model – i.e. in this case, heteroskedasticity is detected, and a robust estimation cannot be made.

The given model (1) needs to be linearized as the previously mentioned problems during the modelling indicate that the model is not linear in its parameters. Linearizing the model is based on logarithmic transformation (e.g. CZV* = lnCZV). In this model, the explanatory variables remain the same – i.e. CZV*{1 to 2}, CPV*{0 to 1}. The hypothesis of homoskedasticity existence is not valid in this case, but the use of robust estimation helps to resolve the problem. Nevertheless, this model is rejected because the other statistical hypotheses are disturbed (i.e. stability, functional form, and normal distribution of random variable).

Finally, the model is estimated with the use of the differences of data set available (e.g. dCZVt = CZVt – CZVt-1). A maximum lag of one is selected on the basis of the SIC computation. The anomaly in differences is simulated with the use of a dummy variable, but the model then does not fulfil statistical hypotheses. Therefore in the final model, the dummy variable is not used. The final results of the single equation model of the CZV variable are shown in the following Table 1.

Linear Regression - Estimation by Least Squares
Dependent Variable DCZV
Monthly Data 03/2000 - 12/2008

Usable Observations	106	Degrees of Freedom	104
Centered R**2	0.703400	R Bar **2	0.700548
Uncentered R**2	0.703904	T x R**2	74.614
Mean of Dependent Variable	-0.006603774		
Std Error of Dependent Variable	0.160871950		
Standard Error of Estimate	0.088032644		
Sum of Squared Residuals	0.8059736245		
Log Likelihood	108.18711		
Durbin-Watson Statistic	1.907853		

Variable	Coeff	Std Error	T-Stat	Signif
1. dCZV{1}	0.620073	0.061612	10.06413	0.000000
2. dCPV	0.202389	0.034464	5.87249	0.00000005

Table 1 – Results of the Econometric Model CZV

Specification tests		**T-Stat.**	**P-value**
Test for Autocorrelation	Breusch-Godfrey SC Test	0.27862	0.59761
	Durbin h test	0.10139	0.91924
Test for Heteroscedasticity	Breusch-Pagan test	5.40702	0.14431
Structural Stability Test	Chow test	5.15323	0.00234
Functional Form Test	RESET test with quadratic	0.11340	0.73643
	RESET test with quadratic and cubic	0.08756	0.91623
Test for Normality	Jarque-Bera test	376.3686	0.00000

Table 2: Results of the Econometric Model CZV – Specification Tests.

From the total number of 108 observations, only 106 values are actually usable because of the differences and final lag of one in the model. In regard to the number of variables included in the model, the total number of degrees of freedom is 104. Centered R2 reaches the value of 0.703, i.e. the explained variable dCZV is interpreted by the given predetermined variables from 70.3 %. The Durbin-Watson Statistic shows the result is close to value of 2, i.e. first-order autocorrelation is not present in the model. The evidence of a lagged endogenous variable on the right side of the given model may cause the value of the discussed variable to be misleading, and therefore other suitable random variables autocorrelation tests must be used to confirm the absence of autocorrelation here. A correlation matrix is used to test multicollinearity among explanatory variables, and its presence is negated. According to the T-test, all of the estimated parameters are statistically significant at a high level of significance. Statistical hypotheses of the given model are proved by the specification tests (see Table 2). The significance level is 0.05. Because of the existence of a lagged endogenous variable in the model the random variables autocorrelation is tested with the use of a Durbin h test and a Breusch-Godfrey SC test, the null hypothesis is accepted, i.e. autocorrelation is not present in the model. The Breusch-Pagan test is used to test homoskedasticity, again, the null hypothesis is accepted, i.e. heteroskedasticity is not present in the model. The results of the Reset test show the proper selection of the model's functional form. Due to the significant value of the Chow test, the alternative hypothesis about instability of estimated parameters is accepted. On the basis of a

Jarque-Bera test, the null hypothesis about normal distribution of the random variable is rejected. Infringement of the parameters' stability estimate, and also of the normal distribution of the random variable results in the fact that the statistical tests do not have to have the required distribution.

The final econometric model can be written in following linear form of model (4).

The facts resulting from the character of buyer-supplier relationships in the dairy sector, i.e. in this case, the relationship between farmers and dairies can be summarized with following statements:

- Contracts are concluded for a minimum period of six months.
- As a result of minimum response to the situation in the market, purchasing price arranged in advance may fluctuate within a certain range during the given contracted period.

The agricultural price cannot respond to the market situation with significant price change as it is dependent on the value from the previous time period. Owing to this fact, significant price changes are powdered in other levels of the given food vertical. Therefore, the dependence of the endogenous variable dCZV at only its first lagged value – not the other lags – is reasonable.

The influence of the exogenous variable dCPV is driven mainly by the relationship between the dairies and the distributors of processed dairy products (wholesalers). This relationship also changes according to the market situation. The development of the market situation strongly influences the distributors and, nowadays, because of their growing economic power they are able to transfer the impacts of market changes to the dairies. Due to the structure of the dairies' market (oligopsonistic structure) in relation to the farmers, dairies mainly transfer the negative price changes to the farmers.

Real values (dCZV) together with theoretical values (TeodCZV) of endogenous variable calculated on the basis of the given linear single equation model are shown in Chart 3.

There is no need to compute elasticity to find out which of the predetermined variables have the significant influence on the given endogenous variable as all variables used in the model are expressed in identical units of measurement, and therefore their values can be mutually compared. The influence of dCZV{1} is stronger than the influence of dCPV.

Monthly changes in the consumer price are not statistically significant, i.e. consumer price does not influence the agricultural price (confirmation can be seen at the beginning of the year 2008, when the fall in agricultural price was followed by a moderate increase in consumer price). This fact follows from economic theory – in many processing industries it was discovered that whilst an increase in input price is almost immediately projected to output price, a drop in input price is followed by a delayed and only partial drop in output price (Peltzman, 2000). This phenomenon can be explained by two possible causes. In the first case, the basis can be found in inventory management, i.e. the changes in inventory price are not shown until the moment when the inventories are removed from the storage, and long-term character of buyer-supplier relations. The second explanation comes out of the existence of market strengths, i.e. the existence of imperfect competition – subjects on the market are strong enough to maximize their profit – amongst the other ways – by their ability to delay and by influencing the volume of the given product to restrict the input price drop influence to the output price (Lechanová et al., 2006).

$$dCZV_t = 0{,}620073*dCZV_{t-1} + 0{,}202389*dCPV_t + u_t$$

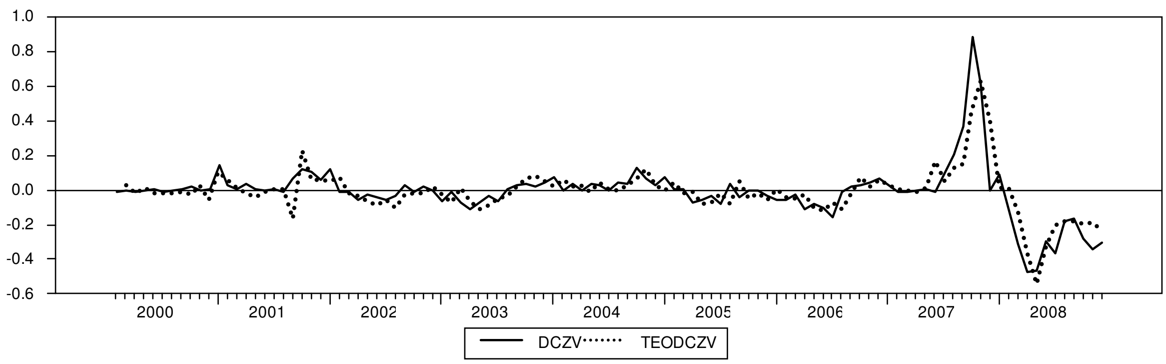

Chart 3: Real and Theoretical Estimated Values – dCZV.

Owing to the industry character of milk and dairy products production, the influence of export price and import price (note: price of processed milk in package) are not statistically significant within the EU market as proved by the final model (4). One of the reasons may be the minor volume of total import and export compared with the production and long-term buyer-supplier relations between the farmers and the dairies.

Producer Price Single Equation Model

Producer price hypotheses:

- Producer price is influenced by the agricultural price for the identical time period, and by the consumer price.
- Export and import price do contribute to the development of producer price.

This model of the dependant variable CPV – producer price – involves all reflected explanatory variables. Again, the dummy variable is put into the model for the same price shock interception. The model is estimated with the use of linear form – its usability will be tested. The information criterion is used to set up the maximum number of lags for the following delayed variables – CZV, CPV, and SC – the results of AIC indicate eight lags, the results of SIC indicate only four lags in maximum, therefore the SIC results are used in the model. In the next stage, the estimated model is modified to a version where it includes three significant variables. The results of the single equation model estimation are given in Table 3.

From the total number of 108 observations, only 107 values are usable due to a lag of one in the final model. In regard to the number of variables in the model, the total number of degrees of freedom is 102. Centered R2 reaches the value of 0.955, i.e. the endogenous variable CPV is explained by given the predetermined variable from 95.5 %. The Durbin-Watson Statistic shows the result is higher than the value of 2, i.e. first-order autocorrelation is not present in the model. Again, because of the evidence of a lagged endogenous variable in the model, random variables autocorrelation tests must be used to confirm the absence of autocorrelation here.

The results obtained by the correlation matrix show that multicollinearity is proved only between the explanatory variables CZV and CZV{1}. This may affect the interpretation of the influence of the discussed explanatory variables for the given endogenous variable. There is also a strong association between the endogenous variable CPV and its lagged value together with export price. According to the T-test, all of the estimated parameters are statistically significant to a high level of significance. Statistical hypotheses of the given model are proved by the specification tests (see Table 4).

Linear Regression - Estimation by Least Squares
Dependent Variable CPV
Monthly Data 02/2000 – 12/2008

Usable Observations	107	Degrees of Freedom	102
Centered R**2	0.954508	R Bar **2	0.952724
Uncentered R**2	0.999680	T x R**2	106.966
Mean of Dependent Variable	11.004392523		
Std Error of Dependent Variable	0.930721142		
Standard Error of Estimate	0.202367797		
Sum of Squared Residuals	4.1771779862		
Regression F(4,102)	535.0343		
Significance Level of F	0.00000000		
Log Likelihood	21.68440		
Durbin-Watson Statistic	2.274183		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	0.813589	0.320539	2.53819	0.012655
2. CZV	1.038382	0.136714	7.59528	0.000000
3. CZV{1}	-1.044132	0.139376	-7.49147	0.000000
4. CPV{1}	0.857891	0.038639	22.20265	0.000000
5. CE	0.073801	0.029425	2.50809	0.013715

Table 3: Results of the Econometric Model CPV.

Specification tests		**T-Stat.**	**P-value**
Test for Autocorrelation	Breusch-Godfrey SC Test	2.30037	0.12934
	Durbin h test	0.00000	1.00000
Test for Heteroscedasticity	Breusch-Pagan test	1.50607	0.68087
Structural Stability Tests	Chow test	2.57249	0.05850
Functional Form Tests	RESET test with quadratic	1.01565	0.31596
	RESET test with quadratic and cubic	0.51461	0.59931
Tests for Normality	Jarque-Bera test	71.51081	0.00000

Table 4: Results of the Econometric Model CPV – Specification Tests.

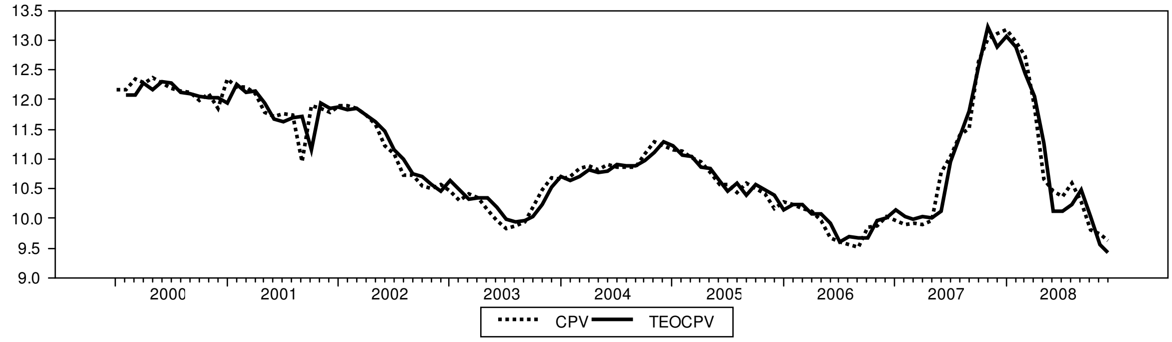

Chart 4: Real and Theoretical Testimated Values – CPV.

The final econometric model is written in its linear form (5):

$$CPV_t = 0{,}8136 + 1{,}0384*CZV_t - 1{,}0441*CZV_{t-1} + 0{,}8579*CPV_{t-1} + 0{,}0738*CE_t + u_t \quad (5)$$

The level of significance is 0.05. The existence of autocorrelation is tested by the Durbin h test, and the absence of autocorrelation is proved. On the basis of the Breusch-Pagan test, the null hypothesis is accepted, i.e. heteroskedasticity is not present in given model. The Chow test proves the stability of parameters estimated but at its frontier value. The suitable functional form of the model is proved with

the Reset test. Due to the results of the Jarque-Bera test, the null hypothesis about normal distribution of the random variable is rejected, therefore the statistical tests do not have to have the required distribution.

The real (CPV) and the theoretical (TeoCPV) values of the given endogenous variable calculated on the basis of the linear single equation model are shown in Chart4.

First the lagged production price has the strongest influence at producer price CPV. As has already been discussed in a previous section of this chapter, when dealing with the processed material the dairies are tied to the buyer-supplier contracts. Equally, they conclude contracts with the wholesalers and retail chains for a certain period of time. The price is given in advance in the contract and it is mainly dependent on the development during the previous period (see 4.1 above – the impact of inventories). The price oscillations are limited by precautions of wholesalers or retail chains (e.g. lowering the producer price in dependence on special offers in retail chains). The raw milk is sold only in the case of the dairies' oversupply, and the price is haggled over according to the current situation at the market.

The export price variable is significant (note: export price of processed milk). Recently, the volume of

Czech export is growing, namely to Slovakia and Germany, and also to Hungary.

Both lagged and present values of the CZV variable are included in the final model as they are individually statistically significant. While the present agricultural price has a positive influence on the endogenous variable, its one period lagged variable is the opposite. The price in general is determined by the interaction of supply and demand on the market. The difference in the direction of impact of these two discussed explanatory variables (CZV, CZV{1}) is typical as it comes from economic price cyclic behaviour in the agri-food market as demonstrated by the Cobweb theorem (7):

$$P_t = P_0 * (-1)^t * r^t \qquad (7)$$

Where: Pt ….Price in time t

P0 …Price in time t = 0

r…...Ratio of the gradient between supply and demand curves in absolute values

t…... time period

Because the present value of the CZV variable is positive and its first lagged value is negative, the final influence of the agricultural price is not significant. Another fact that supports this assumption is the high level of multicolinearity between these variables – 96 % (i.e. variables have a very similar development).

The producer price model (5) consists of more explanatory variables than the agricultural price model (4). Therefore, for better evaluation of the influence of predetermined variables on the endogenous variable, the elasticity computation on the basis of average values is put to use. The results confirm that the lagged endogenous variable CPV{1} has the strongest influence – 1% change of this variable influences the given endogenous variable from 0.86 %. The same change of export price affects CPV from 0.07 %. 1 % growth in the present agricultural price results in 0.758 % growth of the given endogenous variable, while the same growth of CZV{1} leads to a 0.764 % decrease in CPV. From the given results of the elasticity computation, it is clear that dairies are strongly influenced by their own prices from the previous period, while agricultural producers are not strong enough to be able to influence producer price – i.e. they are under the conditions of imperfect competition.

The parameters of import price, consumer price, and dummy variable are not statistically significant. According to the dairy products' structure together with the structure of retail chains (or wholesalers), the influences can be shown in irregular time periods of various length. Therefore, it is not possible to model it. A high level of dairy products' substitution can cause a low influence of consumer price to the producer price. Another reason not to use the consumer price as an explanatory variable may be the character of the data set – producer price data has a similar development to the data for the agricultural price (see Chart 1). As for the import price, this is probably also caused by the character of the data set. The dummy variable used for the price shock interception is not statistically significant, as the price shock has been already modeled with the use of lagged variables CZV and CPV.

Consumer Price Single Equation Model

Consumer price hypotheses:

- Consumer price is influenced by agricultural price and producer price.
- There is evidence of export price influence, while import price is not significant for the development of consumer price.

This model of the dependant variable SC – consumer price – involves all reflected explanatory variables. The dummy variable is put into the model for the same price shock interception. The model is estimated with the use of linear form and its suitability will be tested. The information criterion is used to set up the maximum number of lags of the following delayed variables – CZV, CPV, and SC – the results of AIC indicate eight lags, the results of SIC indicate only five lags maximum, therefore the SIC results are used in the computation. The estimated model is then modified to a version where it includes four significant variables. The results of the single equation model estimation are given in Table 5.

From the total number of 108 observations, only 105 values are usable due to a lag of one in the final model. In regard to the number of variables in the model, the total number of degrees of freedom is 101. Centered R2 reaches the value of 0.955, i.e. the endogenous variable SC is explained by the given predetermined variable from 95.5 %. The Durbin-Watson Statistic shows the result is close to the value of 2, i.e. first-order autocorrelation is not present in the model. Random variable autocorrelation tests must be used to confirm the absence of autocorrelation.

The results obtained by the correlation matrix show that multicollinearity between the predetermined variables is not present, but there is a strong association between the explained variable and its lagged value. This may affect the interpretation of the influence of discussed explanatory variables at the given endogenous variable. According to the T-test, all of the estimated parameters are statistically significant to a high level of significance. Statistical hypotheses of the given model are tested with the use of the specification tests (see Table 6).

Linear Regression - Estimation by Least Squares

With Heteroscedasticity-Consistent (Eicker-White) Standard Errors
Dependent Variable SC
Monthly Data From 02/2000 – 10/2008

Usable Observations	105	Degrees of Freedom	101
Centered R**2	0.954553	R Bar **2	0.953204
Uncentered R**2	0.999591	T x R**2	104.957
Mean of Dependent Variable	14.542380952		
Std Error of Dependent Variable	1.392258489		
Standard Error of Estimate	0.301180083		
Sum of Squared Residuals	9.1616536690		
Log Likelihood	-20.94453		
Durbin-Watson Statistic	1.723244		

Variable	Coeff	Std Error	T-Stat	Signif
1. CZV	-0.287359	0.096209	-2.98681	0.00281907
2. CPV	0.515262	0.155549	3.31255	0.00092451
3. SC{1}	0.725809	0.083989	8.64172	0.00000000
4. TIME	0.011702	0.003954	2.95967	0.00307971

Table 5: Results of the Econometric Model SC.

Specification test		**T-Stat.**	**P-value**
Test for Autocorrelation	Breusch-Godfrey SC Test	2.13405	0.14406
	Durbin h test	0.35701	0.72108
Test for Heteroscedasticity	Breusch-Pagan test	8.37664	0.03884
Structural Stability Tests	Chow test	2.18716	0.09446
Functional Form Tests	RESET test with quadratic	3.60154	0.06061
	RESET test with quadratic and cubic	4.54415	0.01294
Tests for Normality	Jarque-Bera test	529.8217	0.00000

Table 6: Results of the Econometric Model SC – Specification Tests.

5.

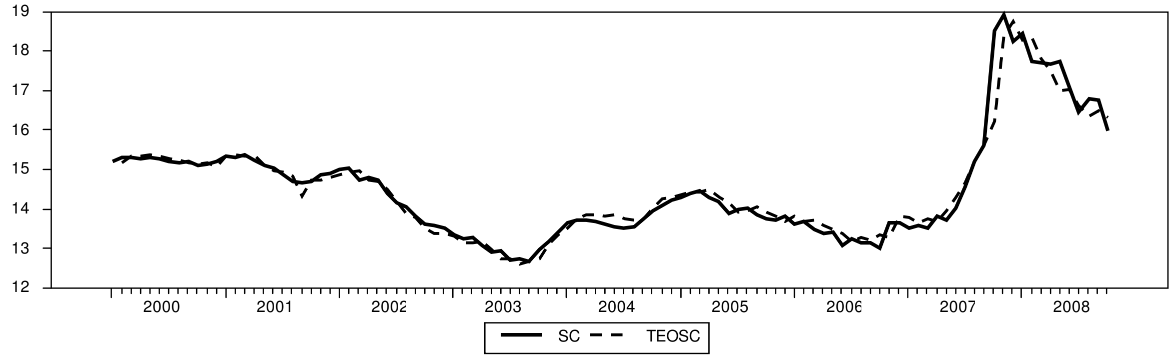

Chart 5: Real and Theoretical Estimated Values – SC.

The final econometric model can be written in the following linear form (6).

$$SC_t = -0,2874*CZV_t + 0,5153*CPV_t + 0,7258*SC_{t-1} + 0,0117*TIME_t + u_t \quad (6)$$

The real (SC) and theoretical (TeoSC) values of the given endogenous variable calculated on the basis of the linear single equation model are shown in Chart In the given econometric model of consumer price shown above, the following parameters are statistically significant – CZV, CPV, SC{1}, and Time.

Even though the model does fulfil the requirements of statistical tests, its economic verification shows the relationships among the variables used in the model are not correct. From an economic view, it can be assumed that individual variables influence the given endogenous variable, but the parameters may be distorted because of the following – absence of the constant variable (i.e. by not using the constant variable in the model, other estimated parameters take the possible distortion instead of the constant and the results then may be misleading), and the presence of the time variable. Hence, use of the given model is not possible, as the parameters do not have the required value in economic practice.

Conclusion

This article introduces the models of price transmission in the milk value chain. Three econometric models were composed – an agricultural price model, a producer price model, and a consumer price model. The statistical tests of the consumer price model together with its economic verification showed its inapplicability; therefore we did not further discuss this one.

Hypotheses concerning the agricultural price are fulfilled, i.e. the development of agricultural price is strongly influenced by its lag-1 variable and producer price. On the other hand, consumer price is not one of the factors influencing agricultural price. Export price and import price do not contribute to the development of the discussed endogenous variable.

The reason why agricultural price cannot respond immediately to the market change (and therefore why the significant price changes are powdered in other levels of given food vertical) is given by its dependency on its value from the previous time period. This dependency is based on two facts – milk purchasing price is usually arranged in advance and it may fluctuate only within a certain given range during the contracted period.

We suppose the influence of producer price on agricultural price is driven mainly by the relationship between the dairies and the wholesalers. Nowadays, the importance of the distributors of processed dairy products is growing (due to their economic power) – the wholesalers are therefore able to transfer (mainly the negative) impacts of market changes to the dairies, but due to the oligopsonistic dairies' market structure the dairies also transfer mainly the negative price changes to the lower level of this food vertical, i.e. to the farmers. Therefore we assume the asymmetric price transmission may be primarily caused by the existence of imperfect market competition within this sector.

The influence of export price and import price is not statistically significant (within the EU market). The minor volume of total export and import compared to the total production and long-term relations between the farmers and the dairies may be one of the reasons.

Producer price hypotheses are only partly confirmed – i.e. the agricultural price together with the export price contributes to the development of the given endogenous variable. The consumer price and import price are not relevant for an explanation of producer price creation.

From the results of producer price model it is clear, that dairies are strongly influenced by their own price from previous period, while the agricultural producers are not strong enough to be able to influence the producer price. These results also confirm that Czech dairy market can be characterized by imperfect market competition.

The final hypotheses concerning the consumer price are partly confirmed, but the model does not fulfil relevant economic verification, therefore – as the model is not usable – there is no need to discuss the significance of the model's explanatory variables.

The irrelevancy of consumer price in the computation of both agricultural price and the producer price model may mainly be caused by the existence of retail chains on the market. The power of these enterprises enables them to effectively suppress price transmission, particularly its direct displays at the individual levels of the given vertical. The reason why agricultural price is influenced by producer price can be expressed as the result of imperfect market competition at all levels of the milk value chain.

The given results should be considered an initial analysis of the milk value chain. For deeper examination of this sector – i.e. market structure, context of price transmission creation – further econometric analysis is needed (e.g. the use of VAR or VECM models).

The results were elaborated within the research intention IVZ MSM 6046070906.

Corresponding author:
Ing. Kateřina Matulová
Czech University of Life Science in Prague, Department of Economics
Kamýcká 129, Prague 6 - Suchdol, Czech Republic
Phone: +420224382088
email: matulova@pef.czu.cz

References

[1] FRIGON, M., DOYON, M., ROMAIN, R. Asymmetry in Farm-Retail Price Transmission in the Northeastern Fluid Milk Market. University of Connecticut, Food Marketing Policy Center, Research Report No. 45, 1999.

[2] KINNUCAN, H.W., FORKER, O.D. Asymmetry in Farm-Retail Price Transmission for Major Dairy Products. American Journal of Agricultural Economics. Vol. 69 (2), 1987.

[3] LECHANOVÁ, I., NOVÁK, P. Analýza vlivu tržní struktury v komoditní vertikále mléka v podmínkách ČR. International Scientific Days 2006. Nitra, 2006.

[4] PELTZMAN, S. Prices Rise Faster then They Fall. Journal of Political Economy, 108(3). 2000.

[5] Situační a výhledová zpráva – mléko. MZE ČR. 2008. http://www.mze.cz

[6] Zpráva o trhu s mlékem a mlékárenskými výrobky. SZIF. 12/2007, 2/2008, 4/2008. http://www.szif.cz