THE ANALYSIS OF PRICE TRANSMISSION IN THE CHOSEN PRODUCTION CHAIN*

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The relationship between prices of products at various stages of the production chain determines both the character on one hand and the functionality of the price transmission mechanism on the other hand. Quantifying the price transmission relationship in the paper is based on the assumption of simultaneous relationships between the price of wheat producers and the prices of processors of feedstuff mixtures for chicken (broilers), pigs being fattened, and cattle (dairy cows). The selected methodological tool for the analysis of price transmission mechanism is the Vector Autoregressive Model (VAR) or Vector Error Correction Model (VECM), and also Impulse-Response (I-R) analysis.

wheat; feedstuff mixtures; price of agricultural producers; price of processors of feedstuff mixtures; VECM; I-R analysis

INTRODUCTION

Wheat is one of the most important crops grown in the Czech Republic. Due to its diversified use wheat is among other things an important component of animal feedstuff mixtures. Of the total production volume, on average 60% of the total domestic consumption is used on animal feed alone.

The share of wheat in the composition of feedstuff mixtures is different according to the category of farm animals so that it would correspond together with other components not only with requirements put on animal nutrition but also minimizing the costs of feeding the animals kept.

From the view-point of production costs and price calculation of feedstuff mixtures it is obvious that the price of raw-material inputs will influence the price of the final product and thereby also determine the expected profit margin. Regarding the time disproportion between production and consumption, this is mainly given by the length of the production cycle, and other factors connected with the possible asymmetry of information flows and market structure imperfections – there could be deviations which cause a malfunction or disturbance of the price transmission mechanism.

MATERIAL AND METHODS

The aim of the paper is to analyze the price transmission in the chosen production chain. The model of price transmission is based on the assumption of simultaneous relationships between the price of wheat (CZVP), and the prices of processors of feedstuff mixtures (CPVKS) for broilers (CPVKSB), for pigs being fattened (CPVKSV), and dairy cows (CPVKSH).

The chosen methodological tool for the analysis of the price transmission mechanism is the Vector Autoregressive Model (VAR) or Vector Error Correction Model (VECM). The defined model results from a hypothesis which supposes a simultaneous relationship in price transmission with an excess of demand power over supply power (oligopsony market structure). The simultaneous character of the analyzed model consists, according to Hušek (1999), in that the endogenous variables in particular equations of the model play a simultaneous role, i.e. concurrently as a function of explained and also explanatory variables.

Simultaneous relationships between particular variables (CZVP, CPVKSH, CPVKSV a CPVKSB) can be classified in the following way:

1. price of wheat determines the prices of feedstuff mixtures and vice versa;
2. there are links among particular prices of feedstuff mixtures for various categories of animals.

If there is the assumption of simultaneous relationships (see point 1), it is possible to stem from the relationship of the agricultural and processing market (supply and demand side). Let us assume the rational behavior of entrepreneurial subjects who struggle to obtain profit maximization under the conditions of perfect competition. Then marginal cost is equal to marginal revenue (or price), or MC = MR (or = P). Further let us assume that the price of wheat is the result of the interaction of supply and demand, i.e. the result of the relationship between the supplied quantity of wheat on one hand and the demanded quantity on the other hand.[1] On the basis of the above relationship and the assumption of a functioning price transmission,

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[1] Similarly the price of industrial products (the processor price of feedstuff mixtures) can be considered as the result of mutual interaction between supply and demand when industrial producers represent the supply side and the producers of meat are the demand side.

a hypothesis can be formulated that the increase of CZVP leads to an increase of CPVKS because the price of input raw materials for the production of feedstuff mixtures rise. This growth of CZVP and CPVKS determines the increase of the price of meat (CZVM).[2] Assuming a functioning price transmission in the vertical production chain, the growth of CZVM causes the increase of quantity (of meat) supplied, and also the increase of demanded quantity of feedstuff mixtures, which leads to an increase of wheat price. However, it is important to point out that any imperfection of the market structure (e. g. a deviation from perfect competition) can lead to an asymmetry of the price transmission in the production chain, or to an asymmetric transfer of information. This can deform the power of mutual interaction between different stages of the production chain. The asymmetric transfer of information can also cause changes, which will happen on one stage of the production chain and will have a considerable impact on other stages of the production chain. However, it does not have to apply in reverse and so it is possible to identify weak and strong relationships between particular stages of the production chain.[3]

If there is the assumption of simultaneous relations ad 2, then it is possible to stem from the assumption that trade policy of feedstuff producers (processors) and their long-run production portfolio of feedstuff is steady in the long term. Let us assume perfect competition and rational behavior of market subjects (profit maximization). If feedstuff producers keep a constant long-run production ratio, it means the percentage share of particular mixtures in their portfolio does not change, however, there can be some short-term deviations, which will lead to the increase in the production of one type of mixture at the expense of a mixture for other animals, thereby there is "a disturbance" of the production ratio.

These deviations are caused by price variability when a change of agricultural producer price of a certain type of meat (e.g. increase in CZVM of pork) leads to a growth of demand for feedstuff mixtures for the given type of animal (pigs being fattened) and so it will invoke an increase of CPVKS. If there is an increase of price of feedstuff mixture of one type, then this growth regarding wheat consumption in the production of feedstuff mixture will lead to a shift of this production factor (a raw material) on behalf the feedstuff mixture with the higher price. Regarding the fact that a functioning price transmission is considered, after a certain time there will be an increase of prices of other feedstuff mixtures and thereby the production ratio among the particular feedstuff mixtures will stabilize.

For an analysis of the defined model VAR analysis is used. The reason for using VAR analysis is its robustness in the analysis of model structure dynamics or the influence of shocks on the given system. The VAR analysis stems from the idea that all variables used for the analysis of a chosen dependency are random and simultaneously dependent. This means that the model structure contains only endogenous variables, whereas the maximum lag was the same. Construction of VAR models generally falls into the following steps:[4] transformation of data to stationary time series (tests of unit roots); a choice of variables for the model, a choice of maximum lag; a simplification of the model by reduction of maximal lag, and the orthogonalization of residues. The procedure is modified in the case of inclusion of a long term relationship.

The VECM can be expressed in the form (i):

$$\text{(i)} \quad X_t = \eta + \Pi X_{t-1} + \sum_{s=1}^{p} C_s X_{t-s} + U_t \,,$$

where $C_s = 0$ for $s > p$, X_t is $k \times 1$ vector of variables, which are integrated of order 1, i.e. I(1), u_1, …, u_t are nid $(0, \Sigma)$ and Π is a matrix of long-run relationship. If the variables are not cointegrated, the VECM reduces to VAR (p) model, which can be expressed in the form (ii)[5], whereas it is assumed that $C_S = 0$ for $s > p$:

$$\text{(ii)} \quad X_t = \eta + \sum_{s=1}^{p} C_s X_{t-s} + U_t$$ [6]

A necessary condition for a strict stationary of the VAR(p) model is that the error process U_t is strictly stationary and lag polynominal (iii):

$$\text{(iii)} \quad C(L) = I_k - C_1 L - \ldots - C_p L^p$$

This process is stationary, if all the roots $I_k - C_1 L - \ldots - C_p L^p = 0$ are located outside the unit circle. Then it is possible to write[7]:

$$\text{(iv)} \quad X_t = \left[C(L)\right]^{-1} U_t = \sum_{s=0}^{\infty} \psi_s U_{t-s} \,,$$

where $\sum_{s=0}^{\infty} \psi_{ij,s}^2 < \infty$ for $i = 1, 2, \ldots, k$ and $j = 1, 2, \ldots, k$.

The data set used from January 1995, with monthly periodicity, (in CZK per tonne) was obtained from the database of the Czech Statistical Office.

The first step in the price transmission analysis according to Hušek (1998) was testing the seasonability of the data set. Regarding the fact that it dealt with a short-run time series (i.e. a time series with monthly periodicity), empirical values of this time series can be affected by seasonal influences. This fact stems from the assumption that every time series can contain four components: a trend, a seasonal component, a cyclical component, and an irregular (random) component (Seger, 1988).

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[2] Direct link between CZVP and CZVM is not analyzed in the framework of the model regarding the fact that an overwhelming majority of feedstuff is processed outside the enterprise (farm).

[3] Strong relationships suppose the symmetric information flow or price transmission mechanism; weak relationships suppose an asymmetric information flow or price transmission in the production chain.

[4] See Hušek (1998).

[5] See Bierens (2007), Banerjee (2003) and others.

[6] In case that $E(X_t) = \eta = 0$ the VAR (p) model simplifies in a form

$$X_t = \eta + \sum_{s=1}^{p} C_s X_{t-s} + U_t$$

[7] Providing $E(X_t) = \eta = 0$, i.e. we consider for illustration a simpler form of a model structure.

The test for seasonability was carried out by the calculation of seasonal indexes – seasonal factors (with the help of the software, STATISTICA) from which it is possible to presume the development of a seasonal component of the analyzed time series, and the character of the seasonability. If seasonability was proved, then it was necessary to cleanup the data by using dummy (DUM) or seasonal (SIN2Π2) variables. The seasonal variable and the variable describing the length of the production cycle were defined with the use of a harmonious function in the form (v):

$$\text{(v)} \quad f: \quad y = A\sin(\omega t + \varphi_0),$$

where A, ω, φ_0 are real constants and t is time. The constant A, i.e. amplitude of the function is estimated as a parameter of variable $(\sin(\omega t + \varphi_0))^2$ of the defined econometric model; $(\omega t + \varphi_0)$ phase (φ_0 starting phase), or a period of the function was determined according to expectations about the character of seasonability in the agricultural sector. It means the seasonal variable is expressed according to the relation (vi).

$$\text{(vi)} \quad \left(\sin\left(\frac{\pi}{12}t - \frac{\pi}{12}\right)\right)^2.$$

After the test of seasonability, the unit root test – a stationarity test was employed. The stationarity of time series was tested by employing the ADF (Augmented Dickey-Fuller) test with maximum lag equal to 12 ($p = 12$). A null hypothesis H_0 assumes non-stationary data. This null hypothesis is rejected, if the ADF test statistics is higher than the critical value for the ADF statistics (5% significance level) and the time series are integrated of order 0, I(0).

If the data was not stationary, it is possible to come to the VECM construction by testing the long-run relationship between variables. If there is a long-run relationship between the variables, then there is a cointegrating vector defining this relationship. If the existence of a long-run relationship between variables (the cointegrating vector) is proved by the cointegration test based on maximal Eigenvalue (significance level – 5%) thereby it is confirmed that H_A: $r = 1$ against H_0: $r = 0$ (where r = a number of cointegrating vectors). Similarly it is possible to carry out the testing for the hypothesis H_A. $r = 2$ against H_0: $r \leq 1$.

RESULTS AND DISCUSSION

VECM

The data set in the form of time series of CZVP, CPVKSB, CPVKSV and CPVKSH was analyzed by the seasonal indexes. This test determinates whether the time series include a seasonal component. In line with this fact, dummy or seasonal variables were added to the model (DUM1, DUM2, SIN2Π2).

The unit root test – ADF test of a model with an intercept and no trend determine that the data are non-stationary, integrated of order I(1). Regarding the results of AIC (Akaike Information Criterion) or SBC (Schwarz Bayesian Criterion), the lag 2 was chosen as the most suitable.

Considering the fact that the variables are integrated of order I(1), on the basis of a methodological procedure an analysis of a mutual relationship between variables was come to by means of cointegration analysis.

The cointegration test with a restricted intercept and no trend in the VAR (Table 1a) shows that there is a long-run relationship between variables because a null hypothesis is rejected at the significance level of 5% (H_0 = variables are not cointegrated, the number of cointegrating vectors (r) is equal to zero) against an alternative hypothesis when $r = 1$ (i.e. one cointegrating vector). This means that the variables are cointegrated with one cointegrating vector and tend to equilibrium (at least some of them – see further), i.e. there is a long-run relationship between them.

The parameters of the VECM model (with restricted intercept and no trend in the VAR) were estimated by the method of least (cointegrated) squares. Statistical characteristics of the price transmission model show that parameter estimations seem to be indifferent and consistent (Tables 2, 3, 4, 5).

Various dependence tightness rate between the analyzed variables result from R-squared. It is possible to state that changes of the dependent variable in the 1st equation are from 25.92% explained by changes of independent variables and it is dealt with the lowest value R^2. In the 2nd equation, the change of the dependent variable (CPVKSH) is explained by 48.71%. More than 50% of the changes of the dependent variables (CPVKSV a CPVKSB) are described in the 3rd and 4th equation. In the case of the CPVKS for feedstuff mixtures for pigs being fattened this dependence is the highest and reaches 62%. Except in the first equation, all other equations of the model can be characterized by a medium dependency tightness rate, which regarding the characteristic of the examined relationships can be considered as a satisfactory result.

The results of the diagnostic statistical tests show other characteristics of the model and estimated parameters. A residual serial correlation was rejected in the 2nd and 4th equation of the model. The test of functional form shows positive results. An assumption of normality was fulfilled in the 2nd equation when the normal distribution hypothesis was confirmed. The results in the 3rd equation show heteroscedasticity – the assumption of a final and a constant variance of random (error) components (residues) was not fulfilled. According to the diagnostic tests, the best results were achieved in the 2nd (CPVKSH), and eventually in the 4th (CPVKSB) equation.

A normalized cointegrating vector (CZVP CPVKSH CPVKSV CPVKSB Constant) determines the long term equilibrium among variables (Table 1b). The cointegrating vector shows that CPVKSV and CPVKSB determine CZVP positively and from the view-point of the sign they correspond to the above defined assumptions. This means that a unit change in CZVP (increase of CZVP by a unit) will lead to increase of CPVKSV (by 1.067) and CPVKSB (by 0.024). However, in the framework of the cointegrat-

Table 1a. Cointegration LR test based on maximal eigenvalue of the stochastic matrix

Cointegration with restricted intercepts and no trends in the VAR

Order of VAR = 2

List of variables included in the cointegrating vector:

CZVP CPVKSH CPVKSV CPVKSB Intercept

List of I(0) variables included in the VAR:

DUM1 DUM2 SIN2π2

List of eigenvalues in descending order:

0.40313 0.15764 0.067259 0.010258 0.0000

Null	Alternative	Statistic	95% Critical Value
$r = 0$	$r = 1$	60.8953	28.2700
$r <= 1$	$r = 2$	20.2427	22.0400
$r <= 2$	$r = 3$	8.2160	15.8700
$r <= 3$	$r = 4$	1.2167	9.1600

Source: own calculations

Table 1b. Cointegration analyses

Estimates of restricted cointegrating relations (SE's in brackets) converged after 2 iterations

118 observations from 1995M3 to 2004M12. Order of VAR = 2 chosen r =1

List of variables included in the cointegrating vector:

CZVP CPVKSH CPVKSV CPVKSB Intercept

List of I(0) variables included in the VAR:

DUM1 DUM2 SIN2π2

List of imposed restriction(s) on cointegrating vectors:

A1 = 1

	Vector 1
CZVP	1.0000
	(*NONE*)
CPVKSH	0.47715
	(0.14691)
CPVKSV	–1.0670
	(0.079275)
CPVKSB	–0.024242
	(0.15769)
Intercept	–114.6209
	(287.9413)

Estimates of restricted cointegrating relations converged after 22 iterations

List of imposed restriction(s) on cointegrating vectors:

A1 = 1; A2 = 0; A4 = 0

	Vector 1
CZVP	1.0000
	(*NONE*)
CPVKSH	0.0000
	(*NONE*)
CPVKSV	–0.62636
	(0.043115)
CPVKSB	0.0000
	(*NONE*)
Intercept	83.1679
	(315.6628)

Source: own calculation

ing vector it cannot be accepted that the unit CZVP negatively influences the change of CPVKSH (it will cause a decrease in CPVKSH by –0.477).

In the framework of the cointegration analysis, testing the structural hypotheses was carried out (a test over-identifying restrictions on CV's), where the best restriction seem to be the restriction A2 = 0 and A4 = 0. Results of the normalized cointegrating vector are as follows: (1.0000; 0.0000; –0.6264; 0.0000; 83.1679). The unit price CZVP will cause a change in CPVKSV by 0.626 (Table 1b).

From the resulting cointegrating vector, a long-run relation between CZVP and CPVKSV is obvious (a change of CZVP will cause a change in CPVKSV with the same sign but a different intensity). Prices of other feedstuff mixtures (CPVKSB a CPVKSH) are not cointegrated with CZVP. A reason for the non-existence of a long-run relationship could be mainly the fact that the development processor's price is determined by another more important indicator than CZVP. Long-run relationship among CPVKSB, CPVKSH and CZVP could be determined by the volume of feedstuff production because data on the production of animal feedstuff mixtures are influenced by the fact that almost 45% of the total volume of produced feedstuff mixtures for farm animals is on a feedstuff mixture (FM) for pigs, and the remaining share then on FM for cattle and poultry. Despite the fact that consumption of wheat for feeding purposes in different years is varying, in the context of cereals it is just wheat which reaches the highest share in consumption of feedstuff mixtures (31–54% in analyzed period).

Prices of feedstuff mixtures do not influence each other in the long term. It can indicate imperfections of the market structure which blend together with the way of management on the production chain (the excess of demand power), systems of backward takings and production of feedstuff mixtures just "made-to measure" according to requirements of a customer (an agricultural enterprise with a mixed program, i.e. production of cereals and fattening of animals). For this reason it is useful to analyze in more detail particular direct and indirect relationships in the context of the vertical production chain which can help to a more detailed explanation of the functioning mechanism of relationships in the production chain.

The statistical significance of particular parameters of the model can be judged by the p-value ([Prob]). The results of the statistic significance of a long-run relationship (ecm1) suggest that particular equations show that a statistically significant long-term relationship is obvious only in the 1^{st} and the 3^{rd} equations. In the other variable the relationship is not statistically significant.

Impulse-Response Analysis

An analysis of price transmission was carried out on the basis of Impulse-response analysis. Thus, it illustrates the dynamics of the system and informs about the speed and the way of establishing equilibrium. If the variables

Table 2. VECM – 1st equation

ECM for variable CZVP estimated by OLS based on cointegrating VAR(2)			
Dependent variable is dCZVP			
118 observations used for estimation			
Regressor	Coefficient	Standard error	T-ratio[Prob]
dCZVP1	0.42688	0.096623	4.4180[0.000]
dCPVKSH1	0.037907	0.14548	0.26057[0.795]
dCPVKSV1	0.31419	0.15541	2.0216[0.046]
dCPVKSB1	0.032741	0.12846	0.25487[0.799]
ecm1(–1)	–0.20088	0.058457	–3.4363[0.001]
DUM1	15.7595	52.5100	0.30012[0.765]
DUM2	92.4371	48.0217	1.9249[0.057]
SIN2π2	22.1183	19.3770	1.1415[0.256]
List of additional temporary variables created:			
dCZVP = CZVP – CZVP (–1)			
dCZVP1 = CZVP (–1) – CZVP (–2)			
dCPVKSH1 = CPVKSH (–1) – CPVKSH (–2)			
dCPVKSV1 = CPVKSV (–1) – CPVKSV (–2)			
dCPVKSB1 = CPVKSB (–1) – CPVKSB (–2)			
ecm1 = 1.0000 * CZVP + 0.0000 * CPVKSH – 0.62636*CPVKSV + 0.0000 * CPVKSB + 83.1679			
R-squared	0.25919	R-Bar-squared	0.21205
S.E. of regression	114.1488	F-stat. F(7,110)	5.4980[0.000]
Mean of dependent variable	1.6780	S.D. of dependent variable	128.5942
Residual sum of squares	1433293	Equation Log-likelihood	–722.3180
Akaike Info. Criterion	–730.3180	Schwarz Bayesian Criterion	–741.4007
DW-statistic	1.9621	System Log-likelihood	–2728.3
Diagnostic tests			
* Test statistics	* LM version	* F-version	
* A: Serial correlation	* CHSQ (12) = 22.7780[0.030]	* F(12,98) = 1.9535[0.037]	
* B: Functional form	* CHSQ (1) = 1.1380[0.286]	* F(1,109) = 1.0615[0.305]	
* C: Normality	* CHSQ (2) = 200.9291[0.000]	* Not applicable	
* D: Heteroscedasticity	* CHSQ (1) = 2.0539[0.152]	* F(1,116) = 2.0548[0.154]	

Source: own calculation

are cointegrated in the short term, these variables can diverge (e.g. owing to shocks) from an equilibrium relationship, however, with the operation of economic factors in the long-term they turn back to the equilibrium relationship.

Fig. 1 illustrates the reaction of the price of wheat producers to innovations in CZVP. From the development of this reaction it is obvious that CZVP reacts positively to an innovation in CZVP in the entire analyzed time period, whereas a similar reaction is also obvious in all other variables (CPVKSH, CPVKSV, CPVKSB) reacting to this innovation. In the first three months all prices of feedstuff mixtures react according to the innovation in CZVP (however, in the 1st month the reaction is relatively low, an increase happens in the following months); in a longer period the intensity of reaction of these variables changes. In fact in the long term the lowest reaction intensity is obvious in CPVKSH, the highest in CPVKSV, which exceeds from the 4th month the reaction of CZVP.

Similarly also CPVKSH and CPVKSB exceed the intensity of the reaction of CZVP, then between the 4th and 5th month after the innovation in CZVP, in CPVKSB this super-elevation happens sooner than in CPVKSH. Between the 3rd and 4th month CZVP reaches a reaction maximum; subsequently it shows a decreasing trend, and from the 15th month it stagnates (the reaction is spent). CPVKSV reaches the maximum reaction to innovation in CZVP in the 7th month and this reaction lasts till the 11th month, in the other prices of feedstuff mixtures this maximum happens roughly one month earlier and lasts a shorter time (till the 9th–10th month).

From the reactions of all variables to the innovation in CZVP it is obvious that it weakens (it is spent) and the system tends to equilibrium relationship after 15 months.

The reaction of all variables to the innovation in CPVKSH (Fig. 2) is the same as in case of the innovation in CZVP and is positive through the whole analyzed period and is the highest of all the reactions.

The reaction of CZVP to the innovation in CPVKSH is the weakest. The behaviour of the CPVKSV reaction is the weakest of all the feed mixtures; it shows growth until the 10th month when it is spent. Similarly as CPVKSV, so CPVKSB reacts to the innovation in CPVKSH and CPVKSB, however, the intensity of the reaction is higher

Table 3. VECM – 2nd equation

ECM for variable CPVKSH estimated by OLS based on co-integrating VAR(2)			
Dependent variable is dCPVKSH			
118 observations used for estimation			
Regressor	Coefficient	Standard error	T-ratio[Prob]
dCZVP1	0.35256	0.065402	5.3907[0.000]
dCPVKSH1	0.096337	0.098473	0.97831[0.330]
dCPVKSV1	0.19675	0.10520	1.8703[0.064]
dCPVKSB1	0.084397	0.086952	0.97061[0.334]
ecm1(–1)	0.048352	0.039568	1.2220[0.224]
DUM1	–67.6021	35.5430	–1.9020[0.060]
DUM2	–52.5313	32.5049	–1.6161[0.109]
SIN2π2	13.0612	13.1159	0.99583[0.322]
List of additional temporary variables created:			
dCPVKSH = CPVKSH – CPVKSH (–1)			
dCZVP1 = CZVP (–1) – CZVP (–2)			
dCPVKSH1 = CPVKSH (–1) – CPVKSH (–2)			
dCPVKSV1 = CPVKSV (–1) – CPVKSV (–2)			
dCPVKSB1 = CPVKSB (–1) – CPVKSB (–2)			
ecm1 = 1.0000 * CZVP + 0.0000 * CPVKSH – 0.62636 * CPVKSV + 0.0000 * CPVKSB + 83.1679			
R-squared	0.48705	R-Bar-squared	0.45441
S.E. of regression	77.2651	F-stat. F(7,110)	14.9210[0.000]
Mean of dependent variable	10.4836	S.D. of dependent variable	104.6045
Residual sum of squares	656687.8	Equation Log-likelihood	–676.2672
Akaike Info. Criterion	–684.2672	Schwarz Bayesian Criterion	–695.3500
DW-statistic	2.1853	System Log-likelihood	–2728.3
Diagnostic tests			
* Test statistics	* LM version	* F-version	
* A: Serial correlation	* CHSQ (12) = 16.2549[0.180]	* F(12,98) = 1.3047[0.228]	
* B: Functional form	* CHSQ (1) = 0.019550[0.889]	* F(1,109) = 0.018062[0.893]	
* C: Normality	* CHSQ (2) = 1.7872[0.409]	* Not applicable	
* D: Heteroscedasticity	* CHSQ (1) = 0.73410[0.392]	* F(1,116) = 0.72618[0.396]	

Source: own calculation

than in CPVKSV. CZVP reacts less to the innovation in CPVSKH, the initial reaction is changed for achievement of the maximum, followed by a slight decrease, or stagnation into subsequent off-going of the reaction. The reaction intensity in all variables points to the fact that the system has again a tendency to tend the equilibrium (in 11 months).

The price of feedstuff mixtures for pigs being fattened (Fig. 3) reacts to the innovation in CPVKSV positively for the entire horizon; it shows the highest value of the reaction. From Fig. 3 it follows hat all prices of processors of feedstuff mixtures react to the innovation in CPVKSV positively through 10 months. The intensity of the reaction for CPVKSH is the lowest of all reactions. The 2nd lowest reaction can be characterized CZVP, which reaches its maximum in the 5th month (other variables between the 9th and the 10th month) and c. from the 8th month it stagnates, in fact, or, slightly, decreases. The system gets after the innovation in CPVKSV to equilibrium after 11–12 months.

The reaction of the price of processors – CPVKSB (Fig. 4) to innovations in CPVKSB is positive through the entire analyzed period and at the same time the highest of all the reactions to the innovation in CPVKSB. This reaction is in the 2 months positive, later it stagnates or insignificantly decreases.

Also CPVKSH reacts positively to the innovation in CPVKSB, however, this reaction is very low; with its course it copies the reaction of CPVKSB. In the entire time horizon the price of feedstuff mixtures for pigs for fattening reacts to the shock in CPVKSB and moves in the interval of negative figures. In the 1st month it reaches its minimum, in the next month the negative reaction is slightly reduced, and from the 2nd month is fading away. CZVP reacts positively in the two months to the shock in CPVKSB (in the 1st month it reaches its maximum), from the 2nd month it moves around zero, and subsequently in another 1 to 2 months into negative figures where the reaction is spent. In comparison with other shocks, in this case the system returns to equilibrium much earlier, c. after 6 months.

From a long-term point of view it is possible to state that the reaction of all prices to the innovations tends to equilibrium, or their reactions are gradually spent, where-

Table 4. VECM – 3rd equation

ECM for variable CPVKSV estimated by OLS based on cointegrating VAR(2)			
Dependent variable is dCPVKSV			
118 observations used for estimation			
Regressor	Coefficient	Standard error	T-ratio[Prob]
dCZVP1	0.35435	0.058002	6.1093[0.000]
dCPVKSH1	0.24748	0.087331	2.8338[0.005]
dCPVKSV1	0.17107	0.093292	1.8336[0.069]
dCPVKSB1	–0.092646	0.077113	–1.2014[0.232]
ecm1(–1)	0.13134	0.035091	3.7427[0.000]
DUM1	–39.6329	31.5212	–1.2573[0.211]
DUM2	–61.6584	28.8270	–2.1389[0.035]
SIN2π2	–10.7739	11.6318	–0.92624[0.356]
List of additional temporary variables created:			
dCPVKSV = CPVKSV – CPVKSV (–1)			
dCZVP1 = CZVP (–1) – CZVP (–2)			
dCPVKSH1 = CPVKSH (–1) – CPVKSH (–2)			
dCPVKSV1 = CPVKSV (–1) – CPVKSV (–2)			
dCPVKSB1 = CPVKSB (–1) – CPVKSB (–2)			
ecm1 = 1.0000 * CZVP + 0.0000 * CPVKSH – 0.62636 * CPVKSV + 0.0000 * CPVKSB + 83.1679			
R-squared	0.61484	R-Bar-squared	0.59033
S.E. of regression	68.5224	F-stat. F(7, 110)	25.0849[0.000]
Mean of dependent variable	7.8208	S.D. of dependent variable	107.0569
Residual sum of squares	516485.1	Equation Log-likelihood	–662.0977
Akaike Info. Criterion	–670.0977	Schwarz Bayesian Criterion	–681.1804
DW-statistic	2.3365	System Log-likelihood	–2728.3
Diagnostic tests			
* Test statistics	* LM version	* F-version	
* A: Serial correlation	* CHSQ (12) = 23.5969[0.023]	* F(12,98) = 2.0413[0.028]	
* B: Functional form	* CHSQ (1) = 5.1153[0.024]	* F(1,109) = 4.9392[0.028]	
* C: Normality	* CHSQ (2) = 45.2315[0.000]	* Not applicable	
* D:Heteroscedasticity	* CHSQ (1) = 8.0897[0.004]	* F(1,116) = 8.5379[0.004]	

Source: own calculation

as the length of time to return to equilibrium for particular innovations differs. The longest reaction time is in the case of the innovation in CZVP when the system after the unit innovation returns to equilibrium after 15 months. Approximately the same length of return to equilibrium (11–12 months) is obvious in the case of innovations in CPVKSH and CPVKSV. The shortest time (6 months) to return to equilibrium is required by variables in the case of the innovation in CPVKSB. However, regarding the amount of innovations it is not possible to assume that the price of wheat producers or the prices of feedstuff mixtures reach the equilibrium price, but they only tend to this price.

CONCLUSIONS

The results from the analyzed econometric model (VECM) show that there is a simultaneous dependency among the chosen variables which was analyzed with the order $p = 2$. The cointegrating vector determined the existence of a long-run relationship between the price of wheat and the prices of feedstuff mixtures for a chosen category of animals. The above mentioned development can be partially compared with the course in a cobweb theorem, regarding the course of reaction of CZVP to the shock in CZVP. After a shock there is an increase of CZVP which according to the cobweb theorem will lead to the growth of the quantity supplied. The growth of the supplied quantity and the higher price of the supply will determine the demand price and thereby also the quantity of wheat demanded. Regarding the contradictory reaction of all CPVKS, it is possible to expect the interactions on the supply and demand side. Cobweb theorem patterns can be seen in the functional mechanism where after high price levels there is an increase of the quantity supplied which causes a fall of prices in the future period. However, regarding the content of variables in the analyzed VECM model it is necessary to point out that the analyzed model contains only variables – prices, not the quantity of production. For this reason the concept of the cobweb theorem cannot be proved, nevertheless, the existence of price transmission relationships can be considered. However,

Table 5. VECM – 4th equation

ECM for variable CPVKSB estimated by OLS based on cointegrating VAR(2)			
Dependent variable is dCPVKSB			
118 observations used for estimation			
Regressor	Coefficient	Standard error	T-ratio[Prob]
dCZVP1	0.28974	0.072818	3.9790[0.000]
dCPVKSH1	0.28353	0.10964	2.5861[0.011]
dCPVKSV1	0.29981	0.11712	2.5598[0.012]
dCPVKSB1	0.031794	0.096811	0.32842[0.743]
ecm1(–1)	0.041580	0.044055	0.94382[0.347]
DUM1	–75.6600	39.5729	–1.9119[0.058]
DUM2	–6.9213	36.1904	–0.19125[0.849]
SIN2π2	16.3800	14.6030	1.1217[0.264]
List of additional temporary variables created:			
dCPVKSB = CPVKSB – CPVKSB (–1)			
dCZVP1 = CZVP (–1) – CZVP (–2)			
dCPVKSH1 = CPVKSH (–1) – CPVKSH (–2)			
dCPVKSV1 = CPVKSV (–1) – CPVKSV (–2)			
dCPVKSB1 = CPVKSB (–1) – CPVKSB (–2)			
ecm1 = 1.0000 * CZVP + 0.0000 * CPVKSH – 0.62636 * CPVKSV + 0.0000 * CPVKSB + 83.1679			
R-squared	0.52528	R-Bar-squared	0.49507
S.E. of regression	86.0255	F-stat. F(7,110)	17.3876[0.000]
Mean of dependent variable	11.3911	S.D. of dependent variable	121.0625
Residual sum of squares	814043.1	Equation Log-likelihood	–688.9407
Akaike Info. Criterion	–696.9407	Schwarz Bayesian Criterion	–708.0234
DW-statistic	2.1586	System Log-likelihood	–2728.3
Diagnostic tests			
* Test statistics	* LM version	* F-version	
* A: Serial correlation	* CHSQ (12) = 8.0107[0.784]	* F(12,98) = 0.59479[0.842]	
* B: Functional form	* CHSQ (1) = 3.2998[0.069]	* F(1,109) = 3.1358[0.079]	
* C: Normality	* CHSQ (2) = 408.7101[0.000]	* Not applicable	
* D: Heteroscedasticity	* CHSQ (1) = 0.023527[0.878]	* F(1,116) = 0.023133[0.879]	

Source: own calculation

from the view-point of the relationship between supply and demand it is important to realize that price changes are determined by, besides climatic and agri-biological conditions, but also by the development of agrarian foreign trade, production, yield, as well as a farmers´ reaction to the expected price according to adaptive expectations.

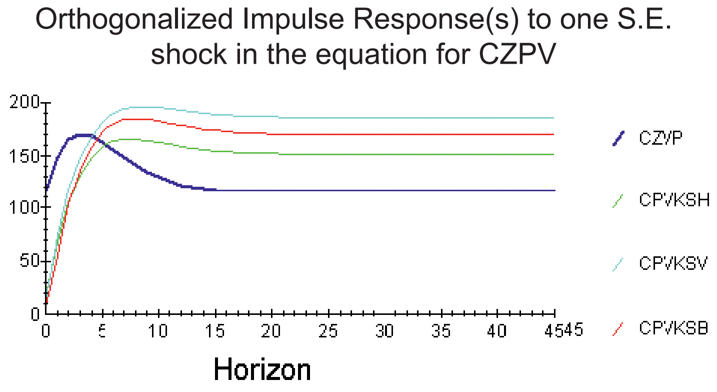

Fig. 1. I-R analysis of reaction to innovations of CZVP

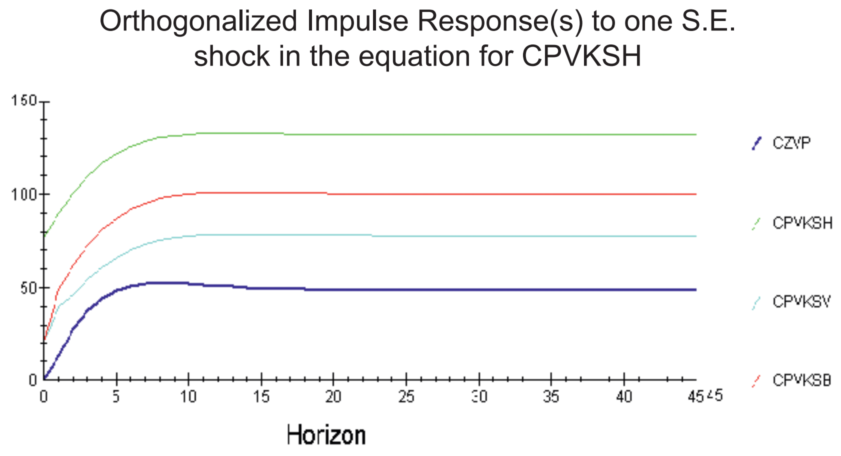

Fig. 2. I-R analysis of reaction to innovation of CPVKSH

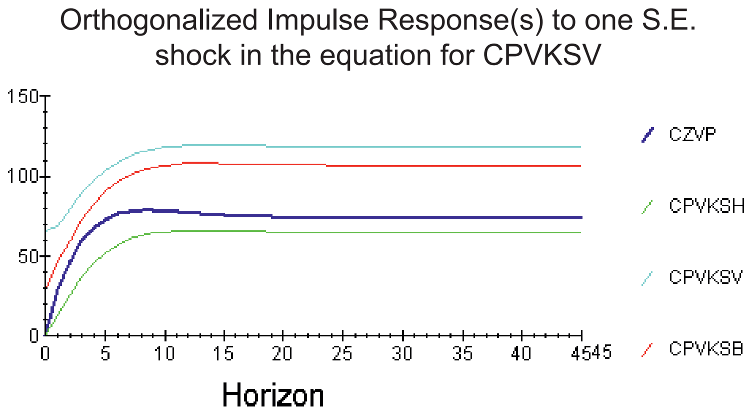

Fig. 3. I-R analysis of reaction to innovations of CPVKSV

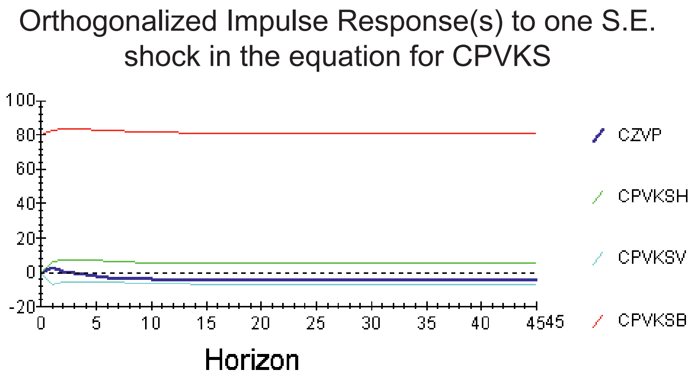

Fig. 4. I-R analysis of reaction to innovation of CPVKSB

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GALLOVÁ, L. (Česká zemědělská univerzita, Provozně ekonomická fakulta, Praha, Česká republika):

Analýza cenové transmise ve zvolené výrobkové vertikále.

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Vztahy mezi cenami na různých stupních výrobkové vertikály určují charakter a funkčnost cenové transmise. Kvantifikace vztahů cenové transmise je v přípěvku založena na předpokladu simultánních vztahů mezi cenou zemědělských výrobců pšenice a cenami průmyslových výrobců krmných směsí pro kuřata (brojlery), prasata ve výkrmu a skot. Vybraným metodickým nástrojem pro analýzu vztahů cenové transmise je Vector Autoregressive Model (VAR), resp. Vector Error Correction Model (VECM) a dále Impulse- Response (I-R) analýza.

pšenice; krmné směsi; cena zemědělských výrobců; cena průmyslových výrobců; VECM; I-R analýza

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