THE NATURE OF PRICE TRANSMISSIONS IN THE PORK AGRI-FOOD CHAIN*

L. Čechura, L. Šobrová

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

The paper deals with an analysis of price transmissions in a selected part of the pork agri-food chain in the Czech Republic. The analysis is focused on both, the vertical price transmission between agricultural and processing markets and the horizontal price transmission in the agricultural and processing markets in the Czech Republic and its individual regions. The analysis is based on a time series of bi-weekly data within the period of 2004–2007 and it employs the VECM (Vector Error Correction Model) to model the price transmissions. The results show that significant differences exist among the regional price transmissions and also at the aggregate level. The analysis suggests that there is no market power abuse at the aggregate level but this might not be the case on the regional markets. The same differences are also found in an evaluation of the long-term relationship and simultaneity. Thus, the analysis suggests that the derived conclusions from the model representing the whole price transmission might be too general due to the significant differences between regional markets. Finally, the horizontal price transmission shows there are significant interconnections between regional markets, however, the farm-gate price is not among all of them.

farm-gate price; processing price; price transmission; pork meat; agri-food chain; VECM

INTRODUCTION

All segments of every agri-food market might be connected – vertically and/or horizontally. The nature of the transmission of market signals from one market to another market in the value chain (i.e. vertical approach) is determined by market structure. In other words, the market structure of each market in agri-food chain and characteristics of enterprises operating on these markets determine the nature of the whole (price) transmission and thus its Pareto efficiency or inefficiency. If only one partial market of this transmission is asymmetric, the efficiency is decreased. From the horizontal point of view the law of one price should hold.

The paper analyzes the nature of price transmission in the pork agri-food chain, one of the most important agricultural sectors in the Czech Republic. By using both vertical and horizontal approach it attempts to verify the existence of both simultaneous and long-run relationship between agricultural and processing markets, to determine the market structure in this part of the chain and to show the nature of the horizontal price transmission.

The first studies of price transmission were carried out for the U.S. agri-food market (see e.g. Heien, 1980; Boyd, Brorsen, 1988; Kinucan, Forker, 1987). Nowadays, price transmission is also analyzed within the agri-food chains in Europe because only the consideration of the whole value chain can provide significant results and identify factors determining the successes and failures of the growth which has important political and entrepreneurial implications. However, the price transmission is not only analyzed vertically but also horizontally. The spatial approach provides information about the connection of the regional agricultural markets. In Europe the following studies were recently carried out. Vertical price transmission was analyzed by e.g. Jensen, Møller (2007), Bakucs, Fertö (2005) and Bojnec (2002). Horizontal price transmission was analyzed by e.g. Hockmann, Vöneki (2007), Goodwin, Harper (2000) or Bakucs, Fertö (2007).

Bojnec (2002) analyzed vertical transmission in the Slovenian beef and pork markets during the transition using co-integration analysis based on the multivariate approach (VECM). The analysis indicates that a long-run relationship (equilibrium) in the vertical price transmission between the farm-gate and retail prices of both, beef and pork exists. Jensen and Møller (2007) analyzed the vertical price transmission in six selected Danish agri-food chains. The research deployed univariate time series analysis and cointegration analysis (VECM). The results showed that for most commodities the price transmission tends to be upward asymmetric, i.e. a stronger impact of upward rather than downward price changes. Bakucs and Fertö (2005) analyzed price transmission between Hungarian agricultural and retail pork meat market. They also used cointegration analysis based on the VECM model. Among others, they found that retail prices entering the cointegration space were weakly exogenous variables. Hockmann and Vöneki (2007) analyzed horizontal price transmission in the Hungarian milk chain using cointegration analysis based on the VECM model. The results showed that a joint Hungarian market does exist and the oligopsony power is significant in the raw milk market but at a very low level. Goodwin and

* Knowledge presented in this paper is the result of grant solution MSM 6046070906 "Economics of Czech agriculture resources and their efficient usage within the framework of multifunctional agri-food systems".

Harper (2000) analyzed the price transmission, threshold behaviour and asymmetric adjustment in the U.S. pork sector. They found that minor asymmetries are present in the response of farm prices to shocks in farm and wholesale prices in an earlier period, but are no longer as apparent in the later period. Bakucs and Fertö (2007) employed a cointegration analysis based on the Johansen approach to VECM model to study regional market integration in the Hungarian milk sector. The authors suggested that TVECM (Threshold VECM) models were more appropriate for spatial integration research than VECM models.

MATERIAL AND METHODS

The aim of this paper is to analyze the nature of the price transmission in the selected part of Czech pork agri-food chain (i.e. in the case of vertical price transmission between agricultural and processing markets and in the case of horizontal price transmission in the agricultural and processing market within the Czech Republic and its individual regions). The objective of the analysis is to verify or reject the following five hypotheses:

(i) A long-run relationship between agricultural prices and processing prices exists, i.e. the prices converge to the equilibrium in the long-run.
(ii) The relationship between agricultural and processing prices is simultaneous.
(iii) The processing companies abuse their market power, i.e. there is a non-competitive market structure in the agri-food chain.
(iv) The nature of regional price transmission in pork agri-food chain is homogenous.
(v) The regional agricultural and processing markets are interconnected. That is, there exits a significantly close relationships among regional markets in terms that a price shock in one regional market is transmitted to other regional markets.

The first and second hypothesis stem from the fact that the agricultural and processing markets are vertically related and thus market signals should be transmitted in both directions. The third hypothesis follows from the fact that the number of processing companies is much smaller than the number of agricultural companies. That is, the processing companies might dispose of market power. The forth and fifth hypotheses are based on the assumption that there are no significant differences between regional markets and that they transmit market signals amongst each other.

THEORETICAL FRAMEWORK

The theoretical framework is defined to give structure to the following econometric model (especially for the purposes of structural analysis) and to be able to verify the third hypothesis, i.e. to identify if the processing companies abuse their market power. The theoretical framework follows Lloyd et al. (2004).

The following model stems from the assumption that the economic agents behave rationally. That is, the *i*-th processing company solves the classical optimisation problem, i.e. it maximises the profit function $\pi_i(P_P, P_A)$

$$\pi_i = P_P(Q_P)\cdot Q_{Pi} - P_A(Q_A)\cdot Q_{Ai} - C_i, \quad (1)$$

where P_P is processing price, P_A the prices of agricultural raw material, $Q_{Pi} = \frac{Q_{Ai}}{k}$, k is the input-output coefficient, Q_{Pi} is the output of *i*-th processing firm, Q_{Ai} is the quantity of agricultural raw material used by *i*-th processing firm and C_i are other costs of the *i*-th firm.

The first order condition for profit maximization of the *i*-th firm can be then written as (for further model details see Čechura, Šobrová (2008):

$$\frac{\partial \pi_i(P_P, P_A)}{\partial Q_{Pi}} = 0, \text{ i.e.}$$

$$P_p + Q_{Pi}\cdot\frac{\partial P_p}{\partial Q_P}\cdot\frac{\partial Q_P}{\partial Q_{Pi}} - kP_A - kQ_{Ai}\cdot\frac{\partial P_A}{\partial Q_A}\cdot\frac{\partial Q_A}{\partial Q_{Ai}} = 0, \quad (2)$$

For better orientation below, it is useful to express relationship (2) in elasticity notation:

$$P_p\cdot\left(1+\frac{\chi_i}{e_{PP}}\right) = kP_A\cdot\left(1+\frac{\delta_i}{e_{PA}}\right), \quad (3)$$

where χ_i is the conjectural elasticity (i.e. $\chi_i = \frac{\partial Q_P}{\partial Q_{Pi}}\frac{Q_{Pi}}{Q_P}$) of the *i*-th firm in the processing market, e_{PP} is the price elasticity of demand for the processing market of a given product, δ_i is the conjectural elasticity of the *i*-th firm in the agricultural market (i.e. $\delta_i = \frac{\partial Q_A}{\partial Q_{Ai}}\frac{Q_{Ai}}{Q_A}$) and e_{PA} is the price elasticity of the agricultural product's supply.

Expressing (3) for the whole market, i.e., summing all firms on the market by using firms' market shares as weights, results in (4):

$$P_p\cdot\left(1+\frac{\chi}{e_{PP}}\right) = kP_A\cdot\left(1+\frac{\delta}{e_{PA}}\right). \quad (4)$$

In equation (4), χ and δ stand for industry level market parameters.

According to the values of χ and δ we may distinguish four situations:

(i) $\chi = \delta = 0$: if both χ and δ are equal to zero then the market structure is competitive.
(ii) $\chi > 0$ and $\delta = 0$: there is oligopoly power and no oligopsony power in the market.
(iii) $\chi = 0$ and $\delta > 0$: there is oligopsony power and no oligopoly power in the market.
(iv) $\chi > 0$ and $\delta > 0$: oligopoly and oligopsony power can be found in the market.

The market structure is competitive if and only if the price transmission elasticity (i.e. $e_{pA} = \frac{dP_A}{dP_P}\frac{P_P}{P_A}$ and/or $e_{P_P} = \frac{dP_P}{dP_A}\frac{P_A}{P_P}$) is equal to 1. If the market structure is not competitive the price transmission elasticity differs sig-

nificantly from 1 (to determine the nature of market structure the model must be further specified (see Lloyd et al., 2004)), however, for our purposes the exposition is sufficient).

ESTIMATION STRATEGY

The analysis was carried out at two levels – vertical price transmission and horizontal price transmission. The vertical price transmission investigates the relationship between the agricultural and the processing market based on the reduced model of price transmission that has the structural alternative defined in the theoretical framework (see above). Moreover, the theoretical framework enables to verify the third hypothesis based on the estimated valued of the price transmission elasticity in the VECM. The horizontal price transmission analyzes the connections among regional markets in both agricultural and processing market. That is, the relationships between the farm-gate price(s) (in CZK/kg of carcass) and/or weighted processing price(s) were analyzed (weighted prices were calculated based on the prices of roast pork, pork leg without bones and pork shoulder without bones and weights were determined by weight yield, i.e. in this case 33.21%, 42.77% and 24.03% for mentioned parts).

Since the subject of the analysis is the vertical and horizontal price transmission in pork agri-food chain in the Czech Republic and in separate regions of the Czech Republic we use farm-gate prices and processing prices for the Czech Republic and its regions, specifically Stredni Cechy (SC), Severovychod (SV), Severozapad (SZ), Jihozapad (JZ), Jihovychod (JV) and Moravsko-slezsko (MS). The region Stredni Morava was not analyzed because of the lack of data. The set of data was provided by The State Agricultural Intervention Fund (SZIF), the time series contain biweekly data from June 2002 till July 2007. Within these time series several values were missing, hence, they were omitted for the analysis.

The VECM (Vector Error Correction Model, (see e.g. Banerjee et al., 2003; Čechura, 2006) was employed to analyze relationship between farm-gate price(s) and/or weighted processing price(s) of pork meat. The analysis consists of several consecutive steps.

First of all, the integration of each time series is investigated. For this purposes, the LR test was employed (see e.g. Juselius, 2006). The LR test is in our case employed within the modeling by VECM (in CATS procedure).

The VECM model for the analysis of vertical price transmission was used in the following form:

$$\Delta X_t = \eta + \Pi X_{t-1} + \sum_{s=1}^{p} C_s \Delta X_{t-s} + u_t \,, \qquad (5)$$

where $C_s = 0$ for $s > p$, X_t is k x 1 vector of variables (i.e. in this case farm-gate price and processing price), which are supposed to be integrated of order 1, (I(1)), u_1, …, u_t are nid (0,$\sum$) and $\prod$ is a matrix of the long-run relationships (in our case between farm-gate price and processing price). For further reference the part $\sum_{s=1}^{p} C_s \Delta X_{t-s}$ including intercept is called the VAR space of VECM. If the variables are not co-integrated, the VECM reduces to VAR model (see e.g. Banerjee et al., 2003; Čechura, 2006), as following:

$$\Delta X_t = \eta + \sum_{s=1}^{p} C_s \Delta X_{t-s} + u_t \,. \qquad (6)$$

Then, a test for *weak exogeneity* (see e.g. Juselius, 2006) was employed. That is, we tested the hypothesis that a variable has influenced the long-run stochastic path of the other variables of the system, while at the same time has not been influenced by them, is called the hypothesis of 'no levels feedback' or long-run weak exogeneity. Results of this test may recommend rethinking the analyzed relationships, possibly to rebuild the model describing simultaneous relationships.

Finally, *impulse-response analysis* (see e.g. Charemza, Deadman, 1993) was used to determine and describe the responses of each variable to unitary innovation (shock) of any variable. On the basis of this analysis, the long-term relationship among the variables can be examined and approaching the equilibrium after the innovation determined.

Subsequently, the horizontal price transmission was analyzed. Thus, the *VECM model* for farm-gate prices and VECM model for processing prices was defined, according to the assumptions already mentioned (in this case Π represents regional interrelationships).

All calculations were done with the help of econometric software RATS 6.35 and CATS 2.0.

DESCRIPTION OF THE PORK AGRI-FOOD CHAIN

The pork agri-food chain in the Czech Republic may be divided into four markets, namely the agricultural market, the processing market, the consumer market and the production factors (inputs like feeding stuff) market. The paper analyzes the relations between the agricultural market and processing market and the interrelationships among regional markets on both agricultural and processing stage. The agricultural market is given by the transactions between pig producers and pork meat processors. Pork meat processors may be defined on two levels – 1st level processors (slaughterhouse – cooling chamber) and 2nd level processors (meat – butcher products). And, processing market refers to the transactions between pork meat processors and retailers or wholesalers.

Table 1 shows the pork farm-gate price, pork processing price, margins and their main characteristics in selected regions of the Czech Republic, i.e. it contains the basic information about in the analysis employed time series.

The average farm-gate price was almost the same in all the analyzed regions, approximately 41 CZK/kg. The minimal price was found in JV region (40.98 CZK/kg) and the maximal in SZ region (41.56 CZK/kg). The average

Table 1. Statistical characteristics of pork farm-gate (CZK/kg) and processing prices (CZK/kg) (weighted prices) in analyzed period

	JV				JZ				MS			
	mean	std. error	*b*	R^2	mean	std. error	*b*	R^2	mean	std. error	*b*	R^2
FP	40.98	3.86	–0.0889	0.9946	41.35	3.79	–0.0914	0.9946	41.27	4.11	–0.1059	0.9939
PP	94.42	7.74	–0.2568	0.9977	92.26	5.30	–0.1375	0.9980	89.73	6.24	–0.1344	0.9964
Margin	52.59	5.73	–0.1579	0.9952	50.09	4.59	–0.0755	0.9935	48.47	4.73	–0.0305	0.9909
	SC				SV				SZ			
	mean	std. error	*b*	R^2	mean	std. error	*b*	R^2	mean	std. error	*b*	R^2
FP	41.44	3.78	–0.0877	0.9944	41.10	3.91	–0.0948	0.9942	41.56	3.63	–0.0799	0.9947
PP	92.08	5.21	–0.0399	0.9969	91.04	8.08	–0.2157	0.9955	99.38	5.51	–0.0326	0.9970
Margin	50.24	4.41	–0.0111	0.9925	49.43	6.92	–0.1125	0.9847	57.80	5.69	0.0443	0.9909
	SC											
	mean	std. error	*b*	R^2								
FP	41.26	3.79	–0.0892	0.9944								
PP	92.34	5.82	–0.1852	0.9984								
Margin	50.39	4.03	–0.1016	0.9968								

Source: SZIF and own calculations

farm-gate price of pork meat was 41.26 CZK/kg. The average processing price was higher than the level of farm-gate price, the minimal in MS region (89.73 CZK/kg) and the maximal in SZ region (99.38 CZK/kg). The average processing price of pork meat in the Czech Republic was 92.34 CZK/kg. The variation of processing price was higher than the variation in farm-gate price.

Linear trend functions describing long-term development of the time series show that the time series of farm-gate price in all regions is decreasing slightly. Parameter *b*, which describes the slope of the trend function, equals approximately –0.08 in almost all the analyzed regions. The lowest slope was calculated for the SZ region (–0.0799) and the steepest for the MS region (–0.1059). All the calculated values of coefficient of determination equal more than 0.99, which represents good reliability of all calculated trend functions. Parameter *b* of the time series describing the development of pork farm-gate price in the Czech Republic equals –0.0892, the coefficient of determination equals 0.9944. Parameter *b* of the trend functions estimated for processing price is negative in all the analyzed regions, thus the long-term tendency of processing price in all analyzed regions is decreasing. The values of parameter *b* is between –0.2568 (JV region) and –0.0326 (SZ region). All the calculated coefficients of determination show the reliability of the estimated trend functions, the values are higher than 0.99 in all cases. Parameter *b* describing the slope of the pork processing price in the Czech Republic equals –0.1852, the coefficient of determination 0.9984.

The margin, as the difference between average processing price and average farm-gate price, was approximately 50 CZK/kg, however the difference between the maximum and minimum level was quite high (almost 10 CZK/kg, which means about 20% difference). The minimal value was achieved in the MS region (48.47 CZK/kg) and the maximal value in the SZ region (57.80 CZK/kg). The average margin in the Czech Republic was 50.39 CZK/kg. Standard error occurs between 4.41 (SC region) and 6.92 (SV region). Average standard error was 4.03 (the Czech Republic). The margin within the analyzed period slightly decreases in almost all regions, except the SC and SZ regions. Parameter *b* of the linear trend function occurs between –0.1579 (JV region) and 0.0443 (SZ region). The slope of the trend function of the average margin in the Czech Republic equals –0.1016. Values of determination coefficients show reliability of all estimated trend functions, the values occur around 0.99 (0.9847 in SV region and 0.9952 in JV region). The coefficient of determination for the Czech Republic margin equals 0.9968.

According to the development of the farm-gate price, processing price and margins might be deduced as the long-term development of farm-gate price and processing price is very similar in all analyzed regions. The long-term tendency of margins is similar in almost all regions, except the SC and SZ region. However, the SZ region was detected as the region which reached the highest level for all – farm-gate price, processing price and margin. Furthermore, the long-term decrease of both prices in this region is the lowest of the analyzed regions. Moreover, the long-term tendency of margin development is contrary to the other analyzed regions as it was increasing.

RESULTS AND DISCUSSION

VERTICAL PRICE TRANSMISSION

VECM

The estimated VECM can be described as follows. The model consists of two endogenous variables (i.e., LFP – logarithm of farm-gate price (FP = P_A), LPP – logarithm of processing price (PP = P_P); the logarithmic transformation of the time series was used to linearized the time series which is a common procedure) and unrestricted constant. The form with unrestricted constant was chosen based on the results of the exclusion test. The VECM was

first estimated full sample, i.e. from June 2002 till July 2007. However, the results of the estimation and the following CUSUM test showed that the time series had a different nature before and after EU accession. In other words, the time series contained two segments, which have different parametric values. To solve the problem we decided to model the price transmission in the second segment, i.e. on the data set, which represented the period after EU accession (from May 2004 till July 2007).

We again used the form of the VECM with unrestricted constant (according to the results of the exclusion test) and 8 lags in the VAR space. The length of lag was chosen based on SIC (Schwarz Information Criterion) and with a respective auto-correlation residuals structure. The non-stationarity of time series or integration of order 1, I(1), respectively, was confirmed by the LR test.

The Trace test suggests that the model contains one co-integrating vector at the 5% significance level (see Table 2). That is, the results of the estimation inform about the existence of an equilibrium relationship. The VECM has one co-integrating vector, thus the model contains unique information about the long run relationship between variables and can be used to characterize the market structure.

To obtain the demanded co-integrating vector, it is necessary to normalize the eigenvectors by the LFP coefficient. The resulting co-integrating vector (1.000; –1.029) for LFP and the LPP represents the equilibrium relationship between farm-gate and processing prices. The co-integrating vector is significant in both equations at the 5% significance level (see Table 3). That is the evidence of simultaneous relationship between prices. Moreover, the simultaneous relationship was tested based on the weak exogeneity test. The test rejected the zero hypothesis of the weak exogeneity in both cases at the 5% significance level.

Furthermore, assuming that there are no strong knock-on and feedback effects, which could make interpreting the coefficients difficult (see Lloyd et al., 2004), then the coefficients of the equilibrium relationship, i.e. the co-integrating vector, represent, considering the logarithmic transformation, price transmission elasticity.

In this case, the 'pass-back' price transmission elasticity is not significantly different from 1. That is, there is no evidence that the processing stage exercises oligopsonistic power (see the theoretical framework).

Moreover, the residual analysis shows that the model has good statistical and econometric properties and thus it is acceptable for the following structural analysis.

The VECM for regions were estimated in the same format as the VECM for the Czech Republic. Except for region Stredni Cechy, which contains 6 lags in the VAR space, all regional models have 8 lags. The Trace test in all cases suggests that the models contain one co-integrating vector either at 5 or 10% significance level, respectively. The normalization shows that the simultaneous relationship is not confirmed in all cases (see Table 4). The parameter alpha was significant in both equations in models: Severovychod, Severozapad and Jihovychod. Only one-way relation contains models for Stredni Cechy, Jihozapad and Moravsko-slezsko. These results were confirmed by the test for weak exogeneity (see Table 5). Moreover, the estimated 'pass-back' price transmission elasticities are significantly different from 1 in all models. That is, there is evidence in the regional models that the processing companies abuse their market power (see again the theoretical framework).

Impulse-response analysis

Fig. 1 shows the reactions of LFP and LPP to a transitory and to a permanent shock (orthogonal innovation) in

Table 2. I(1) analysis

p-r	*r*	Eig. value	Trace	Trace*	Frac95	*P*-value	*P*-value*
2	0	0.253	23.966	23.966	15.408	0.002	0.002
1	1	0.024	1.846	1.846	3.841	0.174	0.174

Source: own calculations

Table 3. The matrices based on 1 cointegrating vector

Beta (transposed)			Alpha(1)			
	LFP	LPP	DLFP	–0.285	DLPP	0.343
Beta(1)	1.000	–1.029		(–2.598)		(3.221)

Source: own calculations

Table 4. Selected results of VECMs

Region	Stredni Cechy	Severovychod	Severozapad	Jihozapad	Jihovychod	Moravsko-slezsko
Lags	6	8	8	8	8	8
PP → FP	S	S	S	S	S	S
FP → PP	I	S	S	I	S	I

PP → FP: PP influence on FP, FP → PP: FP influence on PP; S = significant, I = insignificant
Source: own calculations

the processing price in the model for the Czech Republic. The first reaction of farm-gate prices to the transitory shock is negative, then, it oscillates around the zero value. The system returns to equilibrium after approximately 100 periods. The response of farm-gate price to permanent unitary orthogonal innovation is positive in almost all periods, the system returns to the equilibrium after approximately 80 periods. The reaction of processing price is different in the case of transitory and permanent shock. After the transitory shock, the system approaches equilibrium quite quickly, approximately after 20 periods. The reaction of LPP to a permanent shock is positive in all periods, the system approaches equilibrium after approximately 50 periods.

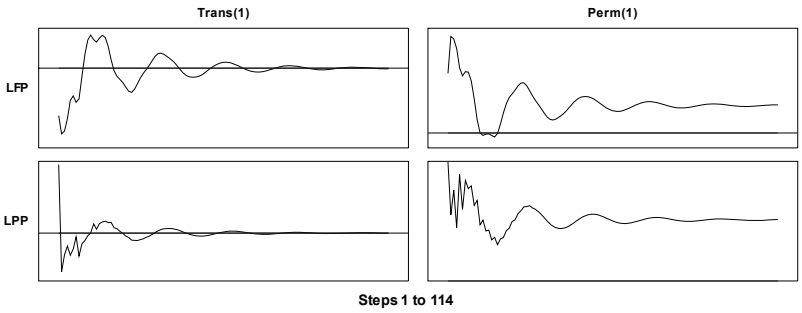

Fig. 1. Impulse-response functions of price transmission – model Czech Republic
Source: own calculations

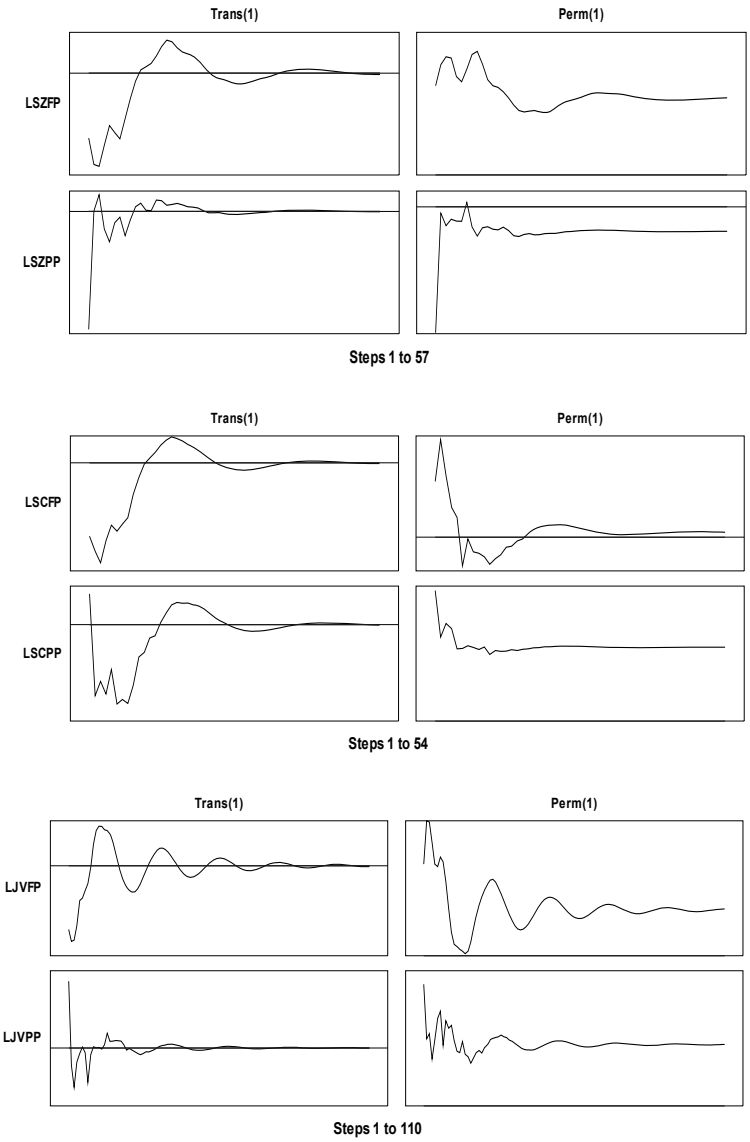

Fig. 2. Impulse-response functions of price transmission – regional models
Source: own calculations

Fig. 2 shows the results of impulse-response analysis (reaction of LFP and LPP on transitory and permanent market shock in the processing prices) in all analyzed regions of the Czech Republic. The reaction of both, farm-gate price and processing price on both, transitory and permanent shock in processing price might be considered to be very similar in almost all analyzed regions. The reaction of LFP to a transitory shock in all the analyzed regions is firstly negative, then, approximately after 80 periods approaches to market equilibrium (except for Stredni Cechy region in which a negative reaction was also detected in some periods). The reaction of LFP on permanent innovation is positive in all periods, equilibrium is also reached approximately after 80 periods. The first reaction of the processing price to a transitory shock is slightly different in all analyzed regions (usually firstly positive, then negative), however approximately after 20 periods system returns to equilibrium in all cases. The reaction of LPP to a permanent shock is the same in almost all the analyzed regions. The reaction is positive in all periods (except Severozapad region, where the reaction is negative), the system approaches equilibrium approximately after 20 periods in all cases.

After the comparison of results of impulse-response analysis of the Czech Republic model and regional models, it might be deduced that the reactions of farm-gate price and processing price to a transitory and permanent shock (orthogonal innovation) in the processing price in all regions are similar to the average reaction of farm-gate price and processing price within the Czech Republic, however some differences might be considered.

HORIZONTAL PRICE TRANSMISSION

Price transmission of farm-gate price

The fitted VECM model, which was considered as the most appropriate, contains 2 lags in the VAR space and

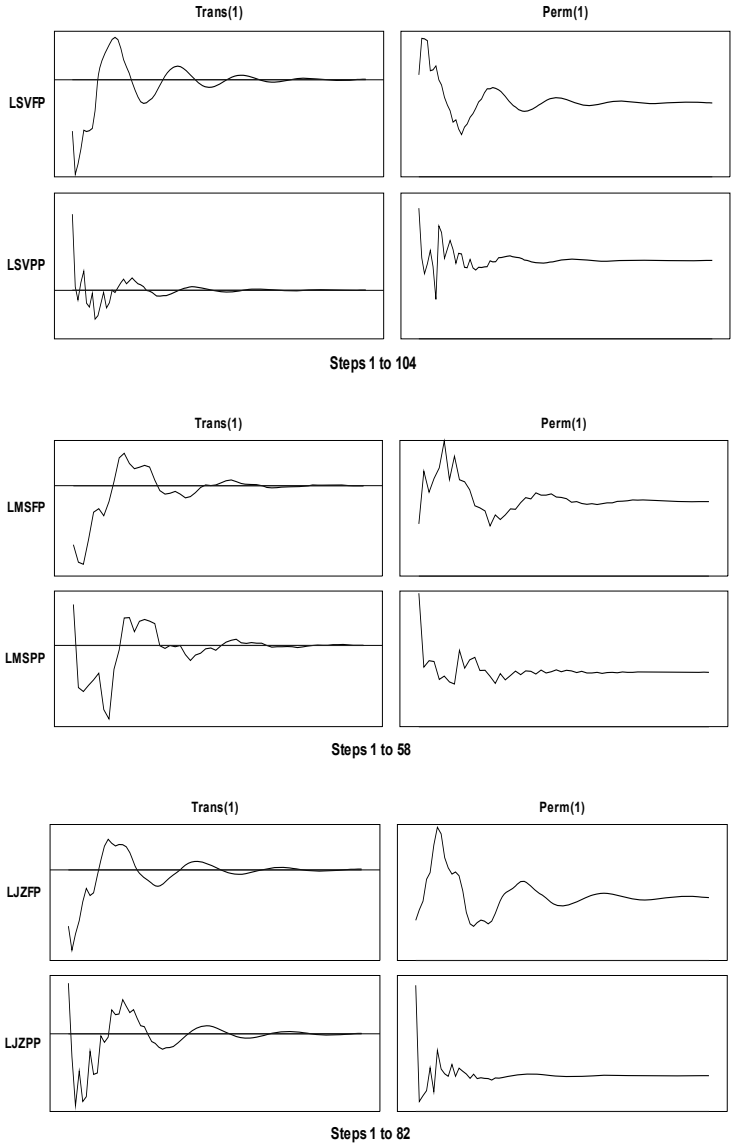

Table 5: Vertical price transmission – test of weak exogeneity

Region	Stredni Cechy		Severovychod		Severozapad		Jihozapad		Jihovychod		Moravsko-slezsko		Czech Republic	
Variable	LSCFP	LSCPP	LSVFP	LSVPP	LSZFP	LSZPP	LJZFP	LJZPP	LJVFP	LJVPP	LMSFP	LMSPP	LFP	LPP
Weak exogeneity	Y	N	N	N	N	Y	Y	N	N	Y	Y	Y	Y	N

Y = yes, A = no
Source: own calculations

Table 6: Horizontal price transmission – test of weak exogeneity and exclusion

LogFP Region	Stredni Cechy	Severovychod	Severozapad	Jihozapad	Jihovychod	Moravsko-slezsko
Weak exogeneity LFP	N	N	N	N	N	N
Weak exogeneity LPP	N	N	N	N	N	N
Exclusion LFP	N	N	N	N	N	Y
Exclusion LPP	N	N	N	N	N	N

Y = yes, A = no
Source: own calculations

constant in the co-integration space. Further, according to the Trace test this model contains 2 cointegrating vectors.

The results of the test for weak exogeneity showed that none of the farm-gate prices was weakly exogenous (see Table 6), which means that all variables included in the model might be considered mutual (simultaneous) relationships.

The test for exclusion recommended removing the pork farm-gate price in the Moravsko-slezsko region from the fitted model (see Table 6). This means that this variable is statistically insignificant in the analyzed relationship.

On the basis of the results mentioned above, it may be concluded that the price transmission of farm-gate price among almost all the analyzed regions of the Czech Republic in the pork agri-food chain does exist. This means that the change of farm-gate price in any region influences the value of farm-gate price in other regions. The time delay for this reaction, based on the fitted VECM model, was considered as lag 2, i.e. one month. Furthermore, the long-run relationship among the variables included in the model was determined, however, just among some of the analyzed regions.

Price transmission of processing price

The VECM model contains 3 lags in VAR space and constant in VECM space in this case. Further, according to the Trace test the fitted model contains 5 cointegrating vectors which represent cointegrating relationships among the variables.

Again, the weak exogeneity of all variables was investigated. The results show that none of the analyzed variables were weakly exogenous (see Table 6). This means that the assumption of the simultaneous relationships among analyzed variables seems to be appropriate.

Then, a test of exclusion was employed to detect the possibility of removing any endogenous variable from the fitted model. The results of this test show that none of the endogenous variables could be excluded from the model (see Table 6). Again, this confirms the assumption of the mutual (simultaneous) relationships among the variables.

Based on the results mentioned above, it may be deduced that the price transmission of the processing price among all analyzed regions of the Czech Republic in the pork agri-food chain also exists. This means that processing price in any region is influenced by the change of processing price in other regions. The reaction delay based on the fitted VECM model was considered to be 3 lags, i.e. 6 weeks. Also the long-run relationship was determined.

CONCLUSIONS

The results show that a long-run relationship between the farm-gate and processing price in the Czech pork agri-food chain does exist. The same situation applies when testing the simultaneous relationship. The simultaneous relationship is found in the model of the Czech Republic, Severovychod, Severozapad and Jihovychod. In the case of regional models Stredni Cechy, Jihozapad and Moravsko-slezsko the relationship might not be simultaneous, i.e. these models contain only one-way relations. Then, according to the estimated value of the 'pass-back' price transmission elasticity and with respect to our theoretical framework the third hypothesis might be rejected for the whole market, however, it can be rejected in the case of regional markets. That is, the regional models show that the processing companies may abuse the market power since the 'pass-back' price transmission elasticity is significantly different from 1. The different parameter values (both long-term and short-term) of fitted regional models also suggest that there are differences among regional markets and price transmissions, respectively. Then, the analysis of horizontal price transmissions shows that there are significant interconnections between regional markets, however, in the case of farm-gate price not among all of them. The analysis also suggests that the derived conclusions from the model representing the price trans-

mission in the Czech Republic (based on the prices, which are the weighted sum of regional prices) are too general due to the significant differences among regional markets. Thus, to get unbiased conclusions the aspects of the regional vertical price transmission should be considered together with spatial interconnections of the regional markets.

REFERENCES

BAKUCS, L. Z. – FERTÖ, I.: Marketing margins and price transmission on the Hungarian pork meat market. 2005. Available on-line URL: <http://www.ivry.inra.fr/loria/eaaefichiers/ProgCom_fichiers/Backus.pdf >.

BAKUCS, L. Z. – FERTÖ, I.: Spatial Integration on the Hungarian Milk Market. In: 104th (joint) EAAE – IAAE Seminar Agricultural Economics and Transition, 2007.

BANERJEE, A. et al.: Co-integration, error correction and the econometric analysis of non-stationary data. Oxford, University Press 2003.

BOJNEC, S.: Price Transmission and Market Margins in the Slovenian Beef and Pork Markets During Transition. In: Xth EAAE Congr., 2002.

BOYD, M. S. – BRORSEN, B. W.: Dynamic Relationship of Weekly Prices in the United States Beef and Pork Marketing Channels. Can. J. Agr. Econ., *33*, 1988.

CHAREMZA, W. W. – DEADMAN, D. F.: New directions in econometric practice: General to specific modelling, cointegration and vector autoregression. UK, Edward Elgar Publishing 1993.

ČECHURA, L.: Prognostické metody (Prognostic methods). 2006. Unpublished materials.

ČECHURA, L. – ŠOBROVÁ, L.: The Price Transmission in Pork Meat Agri-food Chain. Agric. Econ., *54*, 2008 (2).

GOODWIN, B. K. – HARPER, D. C.: Price Transmission, Threshold Behavior, and Asymmetric Adjustment in the U. S. Pork Sector. J. Agr. Applied Econ., *32*, 2000 (3).

HEIEN, D. M.: Markup pricing in a dynamic model of the food industry. Am. J. Agr. Econ., *62*, 1980.

HOCKMANN, H. – VÖNEKI, É.: Assessing Market Functioning: The Case of the Hungarian Milk Chain. In: 104th (joint) EAAE – IAAE Seminar Agricultural Economics and Transition, 2007.

JENSEN, J. D. – MØLLER, A. S.: Vertical Price Transmission in the Danish Food Marketing Chain. 2007.

JUSELIUS, K.: *T*he Cointegrated VAR Model – Methodology and Applications. Oxford, USA, Oxford University Press 2006.

KINUCAN, H. W. – FORKER, O. D.: Asymmetry in Farm-Retail Price Transmission for Major Dairy Products. Am. J. Agr. Econ., *69*, 1987.

LLOYD, T. et al.: Price Transmission in Imperfectly Competitive Vertical Markets. Discussion Papers in Economics No. 04/09, University of Nottingham, 2004. <http://www.nottingham.ac.uk/.

ŠOBROVÁ, L. – ČECHURA, L.: Interregional comparison of price transmissions in pork agri-food chain. Prague, PEF ČZU 2008.

ŠOBROVÁ, L. – MALÝ, M.: Analýza vztahů ve vertikále vepřového masa. Prague, PEF ČZU 2008.

Market information system TIS SZIF: http://www.szif.cz

RATS, Version 6 – User's Guide. Estima, USA, 2006.

Situační a výhledová zpráva – vepřové maso (Prospective report – pork meat). Ministry of Agriculture, Czech Republic, Prague.

Received for publication on February 12, 2009
Accepted for publication on April 24, 2009

ČECHURA, L. – ŠOBROVÁ, L. (Česká zemědělská univerzita, Provozně ekonomická fakulta, katedra ekonomiky, Praha, Česká republika):

Podstata cenové transmise ve vertikále vepřového masa.

Scientia Agric. Bohem., *40*, 2009: 155–163.

Tento článek se zabývá analýzou cenové transmise ve vertikále vepřového masa v České republice. Analýza je zaměřena na vertikální transmisi mezi cenami zemědělských výrobců a průmyslových výrobců a na horizontální cenovou transmisi na zemědělském a potravinářském trhu v České republice a v jejích jednotlivých regionech. Na základě dat v podobě časových řad obsahujících 14denní údaje za období červen 2004–červenec 2007 jsou odvozeny VECM modely (Vector error correction model), které jsou použity pro analýzu cenové transmise. Získané výsledky ukázaly významné rozdíly jak mezi regionálními cenovými transmisemi, tak také ve srovnání s agregátní úrovní. Z analýzy vyplývá, že na agregátní úrovni nedochází ke zneužívání tržní síly, což však neplatí na regionální úrovni. Stejný závěr vyplynul i z analýzy dlouhodobých vztahů a předpokládaného simultánního vztahu mezi cenou zemědělských výrobců a potravinářských výrobců. Lze tedy konstatovat, že závěry, které vyplynuly pro agregátní úroveň, jsou vzhledem k významným regionálním rozdílům příliš obecné. Analýza horizontální cenové transmise prokázala významné propojení mezi jednotlivými regionálními trhy, avšak v případě cen zemědělských výrobců ne mezi všemi.

cena zemědělských výrobců; cena potravinářských výrobců; cenová transmise; vepřové maso; zemědělsko-potravinářská vertikála; VECM

Contact Address:

Ing. Lukáš Čechura, Ph.D., Česká zemědělská univerzita v Praze, Provozně ekonomická fakulta, katedra ekonomiky, Kamýcká 129, 165 21 Praha 6-Suchdol, Česká republika, tel.: +420 2 2438 2050, e-mail: cechura@pef.czu.cz