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Partial equilibrium model of Czech beef trade

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Abstract

The paper is focused on the modeling of a partial equilibrium on the beef market in the Czech Republic. The goal of the paper is a construction and a quantification of a partial equilibrium model of mentioned trade, used for simulation purpose and enabling delimitation of main determinants of beef supply and demand. Data was gained from standard statistical reports of the Ministry of Agriculture and from Statistics of Households Accounts from the year 1995 – 2009. Proposed model respects three levels of beef chain – farmer, processer and consumer. Simultaneously, it respects trade flows on an open market. From the functional point of view, it respects nonlinearity of suppose relationships. The model was quantified by OLS with respects of recursive relationship between endogenous variables. The model is robust enough to be used for simulations. The paper resulted from contribution to an institutional research project MSM 6046070906.

Key words

Beef, Partial Equilibrium Model, Czech Republic, Time Series, Panel Data.

Anotace

Příspěvek se zabývá modelováním dílčí rovnováhy na trhu s hovězím masem v České republice. Hlavním cílem předloženého příspěvku je konstrukce a kvantifikace modelu dílčí rovnováhy výše uvedeného trhu, využitelná pro simulační účely a umožňující vymezit hlavní determinanty nabídky a poptávky po hovězím mase. Použitá data byla získána ze Situačních a výhledových zpráv Ministerstva zemědělství ČR a ze statistiky rodinných účtů, a to za období let 1995-2009. Navržený model respektuje tři úrovně vertikály hovězího masa – zemědělského výrobce, zpracovatele a spotřebitele, zároveň zohledňuje otevřenost trhu. Z funkčního hlediska je respektován nelineární průběh uvažovaných funkcí. Odhad modelu byl proveden běžnou metodou nejmenších čtverců při zohlednění rekurzivních vazeb mezi endogenními proměnnými. Získaný model vykazuje dostatečnou robustnost pro analýzu trhu a případné simulační propočty. Předložený příspěvek je výstupem výzkumného záměru MSM 6046070906.

Klíčová slova

Hovězí maso, model dílčí rovnováhy, Česká republika, časová řada, panelová data.

Introduction

After 1989 significant changes in food consumption in the Czech Republic have occurred and the market has been exposed to a number of significant shocks, the consequence of which is fall of the overall demand for animal products regardless their different quality and dietetic value. Within their attempt to balance the excess of supply over demand, the agricultural producers are forced above all to reduce the numbers of farm animals, and to reduce thus their production. The mentioned development affects thus the cattle numbers significantly, which can be characterized with long-term downward tendency. In the course of the reference period 1995 – 2009 their fall by 33% occurs. The mentioned facts influence the supply of beef in the Czech Republic, which admittedly consists prevailingly of domestic production (86%), however, from the point of view of the structure, significant drop in the share of domestic production and, to the contrary, significant increase in the share of the foreign trade can be experienced in the reference period. (Mach, Křístková, 2010).

Czech breeders contend with a number of significant problems, which do not contribute to satisfactory development of slaughter cattle production. In this respect, e.g. increased export of fattening cattle, which consequently necessitates increased import of beef, reduced consumption of concentrates in general, reduced consumption of bulk feed compared to growth in the areas with permanent grass stands, reduced utilization of slaughter capacity of the processing companies and coherent food industry. An unpleasant factor is also continuous beef consumption fall, which has its impulse in particular in the price development. Within the monitored period, beef became the most expensive meat commodity, which showed up in partial consumers' change-over towards cheaper types of meat. (Malý, Kroupová, 2006)

The main objective of the presented contribution is construction and quantification of partial equilibrium model of the above-mentioned market, utilizable for simulation purposes and enabling to define the main determinants of supply and demand for beef.

Material and Methods

The beef market analysis was based on the partial equilibrium model respecting three levels of the product vertical of the monitored commodity. The agricultural producers, the basic level of the mentioned vertical, were modeled as the entities offering live animals for the purpose of slaughter processing. Production behavior of the mentioned entities was assumed as depending on the price, for which they had realized their production in the previous period, but also from the price currently valid in the market. The mentioned variables explained numbers of cattle, of which beef production in live weight was derived subsequently. At the mentioned level, thus the farmers stand as the offering entities and the processors, the slaughterhouse in the case being considered, as the demanding entities.

The coherent vertical level is thus represented by slaughterhouses, as the case may be meat packing plants, the product of which is packaged fresh meat, which travels then to the consumers through a distribution chain. The processors' supply thus takes into account not only the yield, but also the existence of derived meat products (meat products and semi-finished products); however, these have not been taken into account any more in the presented model.

The beef market is modeled as an open one, thus the total beef supply in the consumer market consists of the aggregate of the packaged fresh meat gained from domestic production and of import of the foreign production. In the construction of the import function, the decisive influence of the import price and of the domestic currency exchange rate was assumed.

The part of the demand in the consumer market consisted in particular in domestic beef consumption, which was modeled at the level of households. The explanatory variables of the mentioned consumption were the consumer price of beef and the consumer's income. The aggregate demand was still supplemented with beef export depending on dominance of the export price over the domestic processing price. Also the inventories being created were classified to the part of the demand.

For the sake of clearness, the partial equilibrium model in the dynamic form can be defined with the following functional transcription:

$$S_t = f(CZV_t, CZV_{t-1}, S_{t-1}) \quad (2.1)$$

$$VZHM_t = f(S_t) \quad (2.2)$$

$$PM_t = f(VZHM_t) \quad (2.3)$$

$$IM_t = f(IC_t, K_t, IM_{t-1}) \quad (2.4)$$

$$SPD_t = f(SPCH_t, PR_t) \quad (2.5)$$

$$DS_t = PD * SPD_t \quad (2.6)$$

$$EX_t = f\left(\frac{ECK_t}{CPV_t}, T\right) \quad (2.7)$$

$$PM_t + IM_t = DS_t + EX_t + Z_t \quad (2.8)$$

where:

S_t……………….cattle numbers in period t,

$VZHM_t$…………(agricultural) production of beef in live weight in period t,

CZV_t……………farm price of beef in period t,

PM_t……………..production of processed beef in period t,

IM_t……………...import of processed beef in period t,

IC_t………………import price of beef in period t,

K_t……………….exchange rate CZK/USD in period t,

SPD_t…………….consumption of beef in average household in period t,

$SPCH_t$…………..consumer price of beef in period t,

PR_t……………...average household income in period t,

DS_t……………...domestic consumption of beef in period t,

PD……………...number of households,

EX_t……………...beef export in period t,

ECK_t…………....export price of beef in period t,

CPV_t…………....producer price of beef in period t,

T………………...trend,

Z_t………………..beef stocks in period t.

The basic analytical form of the above-mentioned model was power function applied to the relations 2.1, 2.2, 2.4, 2.5, 2.7. The remaining relations were modeled linearly.

The common method of least squares was used for estimation of the mentioned models; in case of power functions, this was applied to the linearized form. Compliance of the estimated models with the data, quantified with the determination coefficient, was tested using F-test. Statistical significance of the estimated parameters was subjected to t-test. Multicollinearity was tested with VIF-test (see Green, 2008), heteroskedasticity with Breusch-Pagan test (see Gujarati, 2003) and existence of autocorrelation of residuals was tested with Durbin-Watson test (for more details see: Hušek, 1999). Stability of parameters was tested by CUSUM test (see Cipra, 2008)

The function of the households' consumption requested specific estimation, since contrary to other functions this was not quantified from the data arranged in the time series but from the panel data. The mentioned facts, together with the proven heterogeneity of the panel data, stimulated construction of the consumption function in a form of a model of fixed and random effects, while the choice of suitable specification of the model was based on Hausman test (further see Green, 2008). The model of fixed effects was estimated using the common method of least squares and tested, besides the above-mentioned tests, also with Breusch-Pagan test, verifying the homoscedasticity (see Gujarati, 2003), and Godfrey Lagrange Multiplier test (further see Green, 2008) verifying non-existence of autocorrelation of residuals. The model of random effects was estimated by generalized method of least squares and tested with Baltagi-Li Joint test, which verifies the homoscedasticity and non-existence of autocorrelation of residuals in summary (see Baltagi et al., 2008). Presence of the individual phenomena was tested subsequently with Breusch-Pagan Lagrange Multiplier test (Green, 2008), verifying non-existence of group heteroskedasticity, and Wooldridge test of autocorrelation of the random component (see Wooldridge, 2003). Presence of autocorrelation, proven by the above-mentioned tests, was eliminated by Cochrane-Orcutt method (further Cipra, 2008), or by Prais-Winsten transformation (for more details, see Green, 2007), namely not only within the panel data models, but also in the models based on the time series. Estimations of the mentioned models were carried out in Limdep program, version 4.0.

Data

Quantification of the partial equilibrium model in the beef market was based above all on the data obtained from Situation and Forecast Reports published by the Ministry of Agriculture of the Czech Republic and arranged in the time series for the period of 1995 – 2009. Other data source was also the household budget survey kept by the Czech Statistical Office, of which the data was drawn on average beef consumption, weighted consumer prices and income of ten groups of employees' households in the mentioned period. The balanced panel contained thus 150 observations. The basic characteristics of the data used after the necessary adjustment for distant values are mentioned in table 2.1.

Results and discussion

The model estimation is performed in accordance with the limited information principle. For this reason, the attention in the following commentary shall be paid gradually to particular results of the quantification. The first evaluated relation is the functional link between numbers of cattle and level of the farmer's price, respecting the development dynamics of the mentioned variables. The estimation carried out, which is mentioned in table 3.1, can be written down in the following way:

$$\hat{S}_t = 5.1967 * CZV_{t-1}^{0.1856} * CZV_t^{-0.1906} * S_{t-1}^{0.8862}$$

It results from the above-mentioned facts that the farmer's price from the previous period and delayed values of the numbers influence the numbers of cattle positively, which is expected development according to the model assumptions, which is, in addition to that, confirmed also by the results of Moro et al., 2002. From the point of view of intensity of the impacts, one percent increase of the above-mentioned variables means on average ca. 0.19% increase in the numbers based on the impact of CZV_{t-1} or 0.89% increase in the numbers (impact of the delayed values of the numbers of cattle), ceteris paribus. Higher intensity of the delayed value of the numbers of cattle is expected since the internal delayed values of the variable being explained are considered. In spite of that, it is slightly surprising that the reaction is not flexible, which is, naturally in the context with the following variable, confirmation of negative development of the numbers of cattle. The mentioned unexpected direction of impact is evoked in the quantified model by the farmer's price of the current period, one percent increase of which is accompanied with reduced numbers of cattle on average by 0.2%, ceteris paribus. According to the general assumptions, the agricultural producer's buying-in price should be an unambiguously positively impacting regressor; however, the mentioned model reflects in full the actual market development, where in the monitored period the *CZV* (price of agricultural production) was increasing only slightly, however, the numbers of cattle were reduced significantly compared to this.

From the statistical point of view, it is possible to state that the parameters of the explanatory variables, with an exception of the constant, are statistically significant at the chosen significance level (α=0.05), tightness of dependence measured by the corrected determination coefficient is relatively very high (R^2=0.98), while conclusive evidence of the indicator was checked by F-test.

For verification of the econometric assumptions and achievement of other required characteristics of the estimation, Breusch-Pagan test of heteroskedasticity was carried out subsequently, whose p-value of quantified LM statistics confirms the presence of homoscedasticity. DW test did not prove the presence of autocorrelation of residuals. For verification of other required characteristics, the tests of stability of the estimated parameters (CUSUM test) and verification of the required normal distribution of the random component ut were carried out, the results of which are mentioned in graphs 3.1 and 3.2. In case of both tests, the required property of the estimation stability and normality of distribution of the random component was verified positively.

	Mean	Standard deviation	Skewness	Kurtosis	Minimum	Maximum
Cattle numbers (S) [mil.]	1.58	0.223589	0.868227	2.34669	1.36321	2.02983
Agricultural beef production (VZHM) [t live weight]	218131	52796.4	0.895666	2.30552	166900	322861
Farm price (CZV) [CZK/kg live weight]	19.4833	1.69745	-0.154042	1.31408	17.2313	21.7132
Beef import (IM) [t]	9379.88	6610.12	0.284161	1.52065	200	19300
Production of processed beef (PM) [t]	115137	24214.9	0.791099	2.19966	90100	163368
Producer price (CZV) [CZK/kg]	96.8167	9.59679	-0.0879509	1.76077	79.63	109.42
Total beef consumption (DS) [t]	86629	9578.83	0.11555	1.98635	70385.8	102644
Beef export (EX) [t]	19324	9961.92	-0.173365	1.63658	3964.26	33000
Beef consumption (SPD) [kg/month/household]	3.18604	0.926112	0.278936	2.84538	1.23	5.83
Consumer price (SPCH) [CZK/kg]	113.338	8.80935	0.415535	2.36	95.7118	137.238
Income (PR) [ths. CZK/month/household]	104.733	50.0314	1.578	6.21674	31.21	309.564

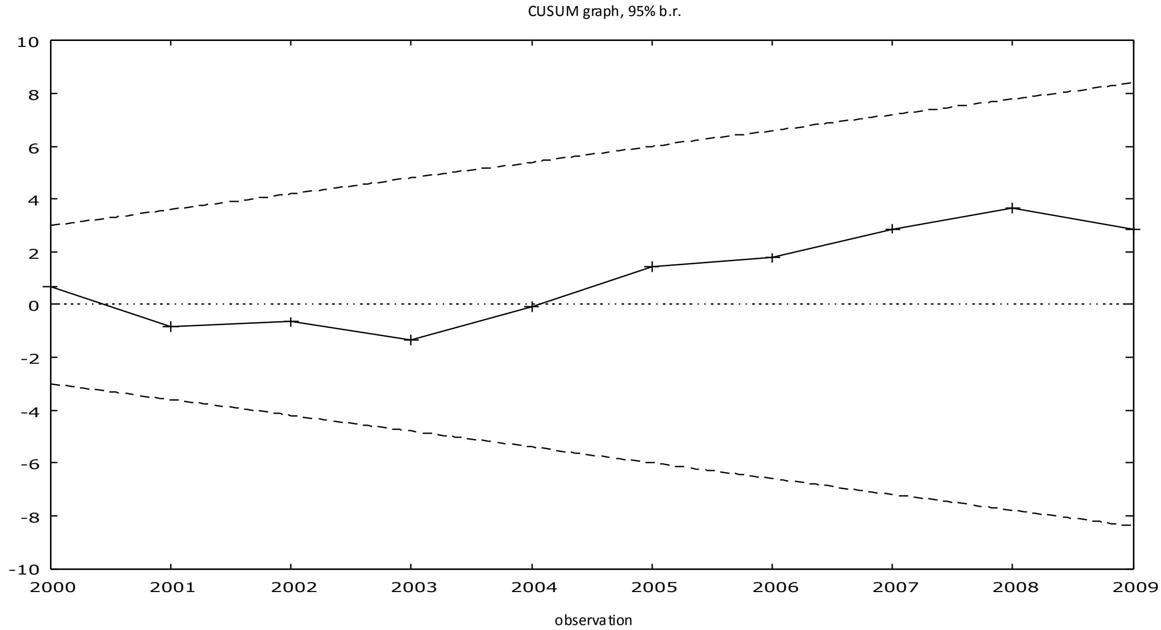
Source: own calculation

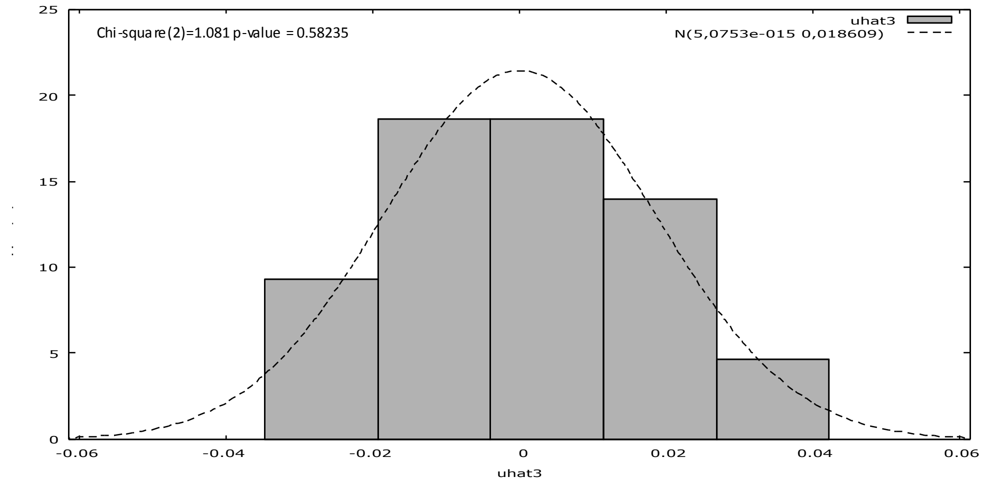
Tab. 2.1 – Deskriptive statistics of used variables.

	Parameter	Standard error	t-value	p-value
konst.	1.648	1.0701	1,54	0.1546
CZV_t	-0.1906	0.0634	-3.008	0.0132
CZV_{t-1}	0.1856	0.03808	4.873	0.0006
S_{t-1}	0.886229	0.0473439	18.72	0.0000
R^2	0.981079			
Kor. R^2	0.9754			
F (3,10)	145.8603			0.0000
LM	2.7165			0.4374
Durbin-Watson	1.53627			0.0586322

Source: own calculation

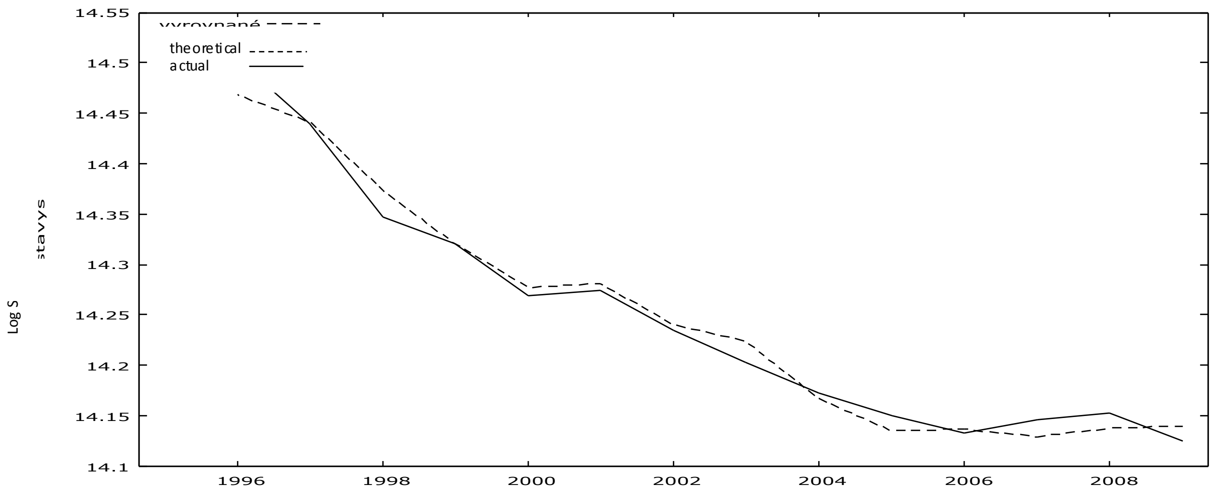
Tab. 3.1 – Results of estimation of linearized function of cattle numbers.





Source: own calculation

Graph 3.1 and 3.2 – Cusum test and normality test of residual (function of cattle numbers) .



Source: own calculation

Graph 3.3 – Actual and theoretical values of cattle numbers.

It is possible to conclude about certain quality of the estimation performed also from the compliance of the course of actual and theoretical values of the variable being explained, see graph 3.3.

Another estimation carried out was simple link between total numbers of cattle in the Czech Republic and beef production in tons of live weight at the primary producer's level. The specified relation interprets the necessary recalculation of cattle pieces to actual beef production in tons of live weight, while the levels of the parameters achieved, respecting the recursive relation between meet production and numbers of cattle after elimination of autocorrelation proven by DW test are summarized in table 3.2.

The estimated function has a following form:

$$\widehat{\mathrm{VZHM}}_t = 0.000005 * \hat{S}_t^{1.7135}$$

Expression of the influence of the numbers of cattle on production is, according to the expectation, positive with adequate intensity, since one percent increase of the numbers evokes ca. 1.7% increase in beef production, ceteris paribus. The described relation may be characterized as flexible, which is indicative of the fact, that if increase in the numbers of cattle occurs, then this probably happens at the very categories of fattening cattle, the consequence of which is more intensive growth of meat production in live weight. The value of the constant represents only technical recalculation of the pieces to the live weight in relative expression.

The performed model verification proved the statistical significance of the estimated parameters at the chosen significance level (α=0.05), the tightness of dependence measured by the corrected determination coefficient is also relatively very high (R^2=0.98), while conclusive evidence of the indicator was checked by F-test. Breusch-Pagan test confirmed absence of heteroskedasticity.

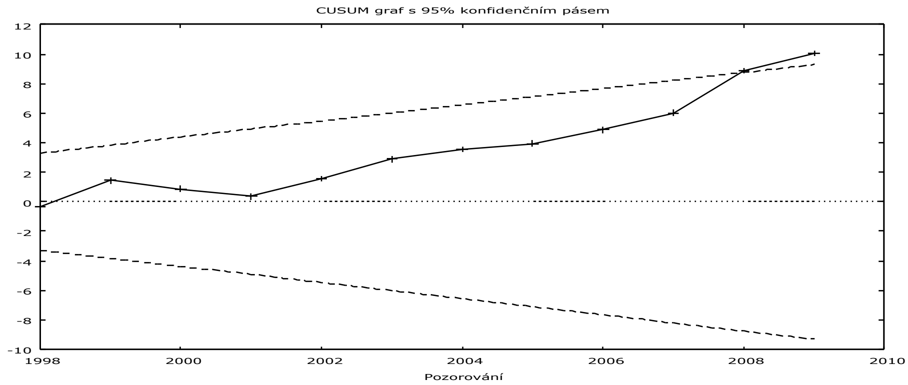
When evaluating the CUSUM stability test (see graph 3.4), it is possible to state that in the end of the period the estimation is already slightly unstable, since the testing statistics already exceed the confidence interval at α=0.05. To the contrary, the p-value of Jarque-Bera normality test (see graph 3.5) confirms the assumption of the normal distribution of the random component u_t.

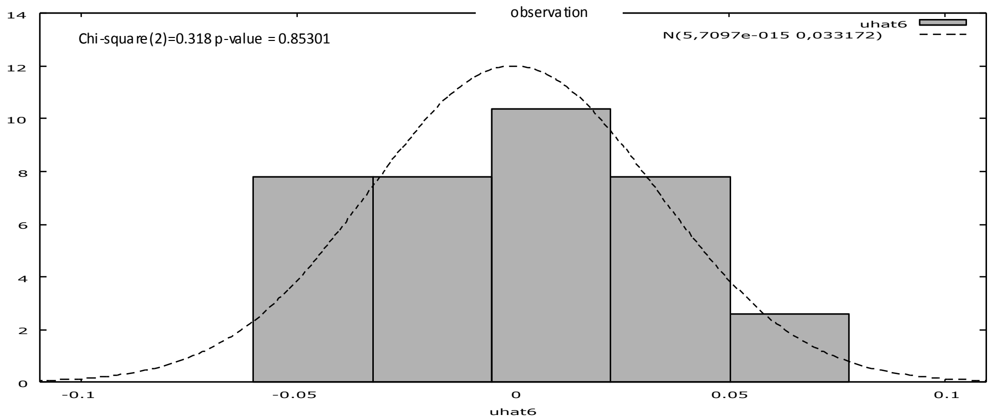
	Parameter	Standard error	t-value	p-value
konst.	-12.1738	1.4488	-8.403	0
S_t	1.71354	0.10165	16.86	0
R^2	0.977947			0
Kor. R^2	0.976109			
F(1,12)	14911.56			0

Source: own calculation

Tab. 3.2: Results of estimation of linearized function of agricultural beef production in live weight (elimination of autocorrelation)

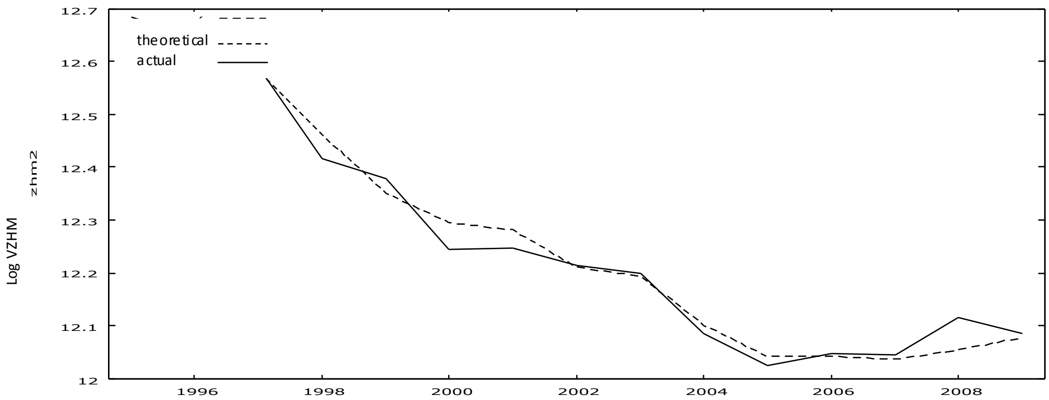
CUSUM graph, 95% b.r.





Source: own calculation

Graph 3.4 and 3.5 – Cusum test and normality test of residual (function of beef production in live weight)



Source: own calculation

Graph 3.6 – Actual and theoretical values of beef production in live weight.

It is possible to become convinced of the estimation quality graphically from the following graph 3.6, which offers comparison of the course of actual and theoretical meat production values in live weight.

The coherent relation of the model drawn up above was the link between meat production and beef production in tons of live weight. The mentioned relation was not estimated explicitly within the model, but it was specified by means of a technical coefficient derived from the average values of the source data[15]. The stipulated value represents than

[15] The relation between the live weight of a piece and slaughter weight of a carcass may be described as technological, since the factors known in advance have decisive influence on its amount (in particular the breed, sex, age and subsequently the used technology of slaughter processing).

the slaughter processing coefficient or the relation between live and slaughter weight:

$$\widehat{\mathrm{PM}}_t = 0.5239 * \mathrm{VZHM}_t.$$

By means of the derived coefficient, it is thus possible to quantify subsequently the domestic production at the processor's level, i.e. the supply of the packaged fresh meat, which is further realized either through direct, or intermediated, logistic way in the consumer market, or it is utilized for production of meat products by another processing intermediary stage.

Within the framework of gradual quantification, the function of beef import was estimated subsequently[16]. The estimation performed is illustrated in table 3.3.

Transcription of the parameters into equational record of the original power function:

$$\widehat{\mathrm{IM}}_t = 116634.5 * \mathrm{IC}_t^{-0.2465} * \mathrm{K}_t^{-1.45} * \mathrm{IM}_{t-1}^{0.4631}.$$

It is obvious from the quantification that the import price and the exchange rate amount influence the monitored beef import negatively and the delayed import values themselves positively. In case of all variables, the direction of impact is in accordance with the expectations, since the higher the import price is, the more difficult it would be for the imported production to assert itself in the domestic market (from the point of view of the intensity, 1% increase in the import price evokes ca. 0.25% reduction of import, ceteris paribus). At the same time, the higher is the domestic crown exchange rate against the foreign currency, i.e. the "weaker" is the crown, the less gains the importer when importing foreign production priced in foreign currency after conversion from the stable domestic price (according to the results, one percent increase of the crown exchange rate (devaluation) leads to import reduction by 1.45%, ceteris paribus). Positive elasticity of import of the previous period documents actual increasing in beef import to the Czech Republic, whereas the parameter value may be interpreted as average interannual increase.

The parameters of the explanatory variables are statistically significant at the chosen significance level (α=0.05), with an exception of IC_t (import price), where significance was proven only at the level α=0.1. The tightness of dependence measured by the corrected determination coefficient achieves still a relatively high value (R^2=0.78), while conclusive evidence of the indicator was checked by F-test. The required characteristics of the random component were proven; see table 3.3 and graphs 3.7 and 3.8.

In the previous part of the text, the supply part of the partial beef market was modeled. However, also the demand part is equally important for creation of the partial equilibrium model; this is represented by domestic consumption, domestic inventories and beef export. Dependence of the beef consumption (in the form of average household consumption (*SPD*)) was expressed on the beef consumer price (since the consumer is able to react relatively very quickly, only the current period price was used) and on the consumer's income.

Compared to the previous relations and in order to ensure better quality of the estimation itself, the source data in the form of panel data were used (in particular, for the reason of higher count of the data). More detailed specifications and methodical aspects are mentioned above. The resulting quantification is described in table 3.4.

With regard to the estimation method (according to Hausman test, the method of fixed effects was chosen), both the values of the explanatory variable itself are described in the table of parameters, as well as the parameter values of dummy variables of particular income groups. For simplification of the record, the total value of the constant corresponding to an average household has been derived from the values of dummy parameters. The final equational record may be formulated:

$$\widehat{\mathrm{SPD}}_t = 80.1634 * \mathrm{SPCH}_t^{-0.8610} * \mathrm{PR}_t^{0.3328}$$

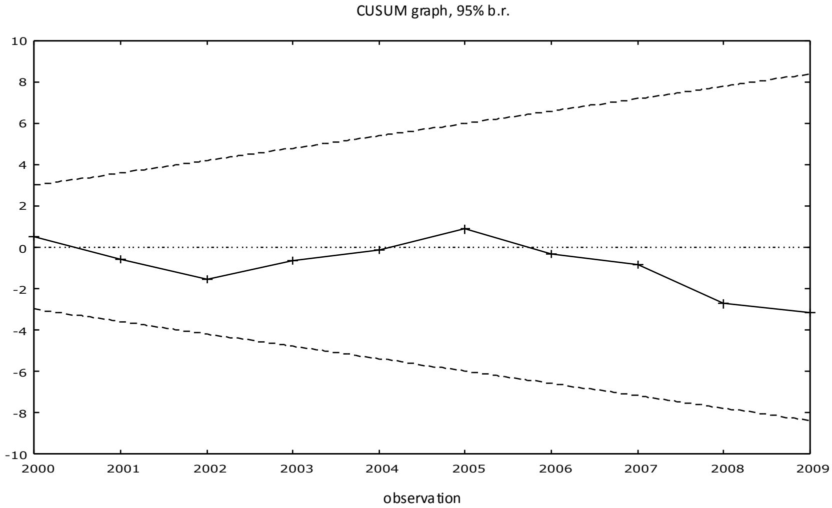
It is obvious from the output that the consumer price of beef impacts negatively according the assumptions, while the consumer's income impacts positively. Relatively high intensity of the price impact is slightly surprising – one percent increase of the price evokes 0.8% consumption fall, ceteris paribus, while foreign surveys mention flexibility 0.3% (Moro et al., 2002), 0.08% (Souza, 2008). The mentioned efficiency, in spite of the fact that still a non-flexible reaction is in question, is probably the consequence of high beef price compared to other meat types, i.e. the consumers react to potential increase of already high price very

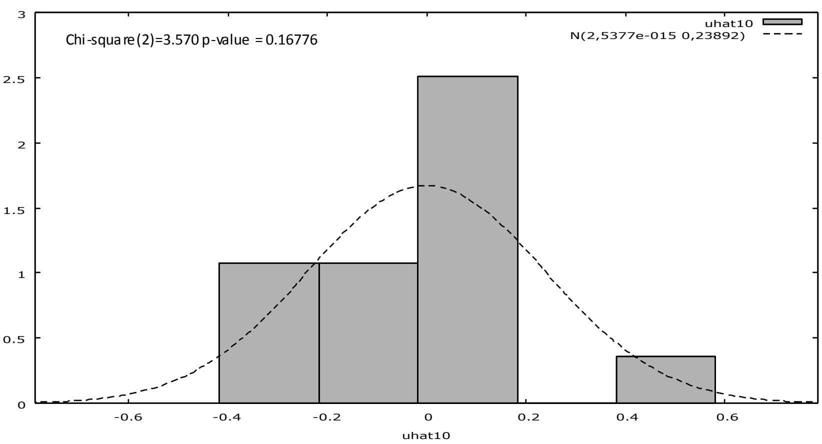
[16] The beef category was selected according to the customs tariff - TARIC nomenclature.

	Parameter	Standard error	t-value	p-value
konst.	11.6668	0.824947	14.14	0
IC_t	-0.246511	0.124948	-1.973	0.0768
IM_{t-1}	0.463097	0.109782	4.218	0.0018
K_t	-1.45016	0.222305	-6.523	0
R^2	0.830089			
R^2	0.779116			
F (3,10)	27.4731			0.000038
LM	0.632022			0.889064
Durbin-Watson	1.95838			0.167259

Source: own calculation

Tab. 3.3 – Results of estimation of linearized function of beef import.





Source: own calculation

Graph 3.7 and 3.8 – Cusum test and normality test of residual (function of beef import)

	Parameter	Standard error	t-value	p-value
$SPCH_t$	-0.86098959	0.414697	-2.076	0.0396
PR_t	0.32794477	0.147635	2.221	0.0278
I_1	3.98387			
I_2	4.19712			
I_3	4.33411			
I_4	4.38455			
I_5	4.44727			
I_6	4.45298			
I_7	4.45561			
I_8	4.48337			
I_9	4.5104			
I_{10}	4.52808			
ρ	0.486024			
R^2	0.4835			0.0000
LMBP	0.000296			0.9999
LM	330.7076			0.0000

Source: own calculation

Tab. 3.4 – Results of estimation of linearized beef consumption function

sensitively, and therefore the consumption fall is relatively higher than expected. The variable of the income then impacts according to the expectations; one percent increase of the income evokes 0.3% increase of consumption, ceteris paribus.

From the statistical-econometric point of view it is necessary to mention that the primary estimation was, according to the tests, burdened with autocorrelation of residuals, since the Baltagi-Li Joint aggregate test of heteroskedasticity and autocorrelation proved the presence of at least one of the mentioned phenomena. Therefore Breusch-Pagan Lagrange Multiplier test was carried out subsequently, which excluded heteroskedasticity, in consequence of which Prais-Winsten transformation (*Rhó*=0.486) was used subsequently in order to eliminate autocorrelations. In the following estimation, which is already the subject-matter of the commentary, all required characteristics are already complied with; see p-value in table 3.4. When assessing the statistical conclusive evidence, the parameters may be described as significant at the chosen significance level (α=0.05).

For the purpose of expression of the aggregate domestic consumption of beef, it was necessary to quantify the number of households. The mentioned procedure was carried out by means of quotient of the actual aggregate beef consumption and theoretical consumption value of an average household. The relation drawn up that enables to enumerate the theoretical total consumption value, the knowledge of which is necessary to set the market equilibrium is following:

$$\widehat{DS}_t = 2916117 * \widehat{SPD}_t.$$

The last quantified relation, which is necessary to be included in the partial equilibrium model, is illustration of export. When formulating the export function, according to the economic assumptions, the account was taken of the relation between the export price of beef expressed in CZK/t and domestic processing price also in CZK/t. The quotient variable expressed in this manner was specified as the main export determinant (similarly Moro et al., 2002). Based on the source data, estimation was carried out, the contents and characteristics of which are described in table 3.5.

After transfer of the linear form and expressing of the parameters, the resulting estimation may be recorded as follows:

$$\widehat{EX}_t = 4465.56 * \left(\frac{ECK_t}{CPVV_t}\right)^{0.7056} * T^{0.7529}$$

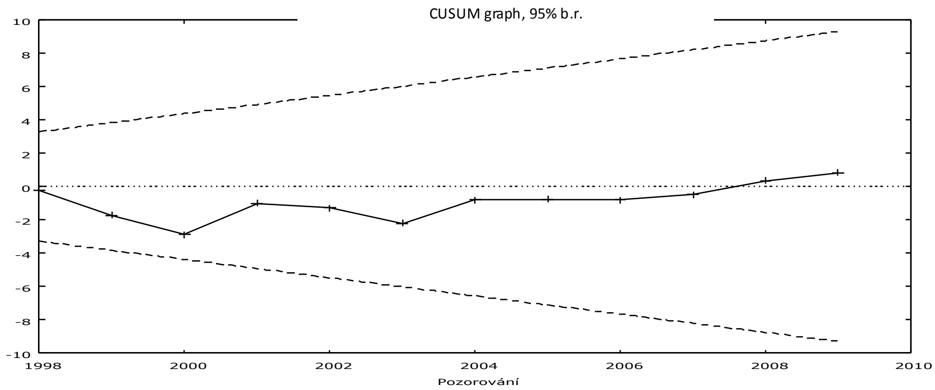
It is obvious from the equation that both explanatory variables impact the export amount positively. The positive time vector factor corresponds to the reality where the actual export values (in spite of ambivalence) were increasing in the monitored period. The positive parameter of the quotient of export and domestic prices expresses growth in export (on average by 0.7 %, ceteris paribus) in case of one percent increase of the mentioned quotient. The achieved parameter value probably corresponds to the assumptions, since the higher is the export price compared to the domestic one, the more will be the potential exporter motivated to export. The mentioned facts are of course conditioned by other factors, namely e.g. by competition types in the international market, assumption of barrier-free access to foreign markets and also e.g. by the exchange rate development, since the export price was expressed after conversion to CZK.

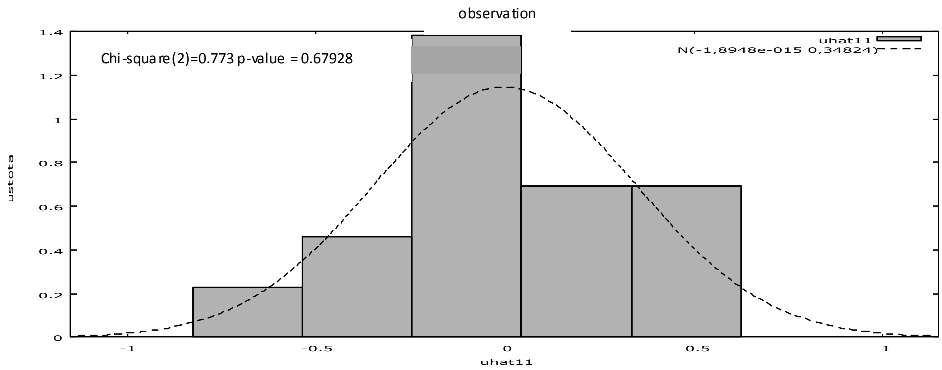
The required statistical and econometric characteristics are documented by table 3.5 and graph 3.9 and 3.10.

	Parameter	Standard error	t-value	p-value
konst.	8.40415	0.155472	54.06	0.0000
(ECK_t/CPV_t)	0.705612	0.343412	2.055	0.0624
T	0.752864	0.0744056	10.12	0.0000
R^2	0.740509			0.0000
Kor. R^2	0.69726			
F (2,12)	55.65716			0.0000
LM	2.67352			0.262695
Durbin-Watson	2.34947			0.55798

Source: own calculation

Tab. 3.5 – Results of estimation of linearized function of beef export.





Source: own calculation

Graph 3.9 a 3.10 – Cusum test and normality test of residual (function of beef export)

Conclusion

Significant changes occurred in the beef market during last twenty years, which affected not only its extent but also its structure. On the part of the supply, long-term drop in the domestic production and increase of supply from foreign producers may be observed. Drop in the domestic production was connected with the drop in the numbers of cattle as a rule, which were reduced by 33% in the monitored period of 1995-2009. According to the presented research, their development was influenced by the level of the farmer's price, which showed the growth only by 120% during the whole monitored period, while the consumer price was increased by 146%. The mentioned fact impacted not only fall of the demand for beef, which became the most expensive meat commodity, but it showed up also in growth of the import volume, which multiplied five times compared to the initial period of 1995, and on the other hand, also in increasing export of fattening cattle. In 2009 thus the import represented 14% of the overall beef supply in the Czech market, while this was influenced not only by the import price influencing the competitiveness of the imported goods in the Czech market but also by the exchange rate of the Czech crown. From the point of view of the demand, high consumers' sensitivity to the beef price was proven, which is one of the reasons for the falling consumption. The consumer reacts to one percent increase in the beef price by fall of the demanded quantity by 0.9%. The mentioned consumer behavior conditions high orientation of the Czech producers at foreign markets, which is declared by eight-time growth of the volume of beef export. The estimated model reflects the above-mentioned changes and declares the determinants of development of supply and demand for beef and also the basic links between the particular levels of the beef vertical, thus it is possible to be considered as a suitable tool for the analysis of the mentioned market and subsequent simulation calculations.

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