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Modelling The Cattle Breeding Production in the Czech Republic

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Abstract

This paper proves that the use of the Cobb-Douglas form of production function is suitable for modelling the technological efficiency of selected production factors used in cattle breeding. Furthermore, it is possible to use the estimated function to analyse economic efficiency, considering also the prices of the production factors. The results of the econometric estimation show that higher initial weight affects negatively the dynamics of weight gain. Analysing the efficiency of the two main feedstuff components, i.e. the haylage and hay, it was found out that the increases in weight react inelastically with respect to the volume of feedstuffs, which is in line with the physiological limits of the animal production. The results further reveal that the increases in weight react more sensitively to haylage compared to hay. Thus, it is possible to conclude, that haylage provides technologically more efficient way of cattle breeding in comparison to hay.

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Key words

Cobb-Douglas production function, panel data, fixed effects, gain in weight, beef fattening.

Anotace

Tento příspěvek potvrzuje vhodnost využití Cobb-Douglasovy funkce pro modelování chovu skotu. Sestavenou funkci je dále možné využít pro optimalizační výpočty za účelem zjištění ekonomické efektivnosti výkrmu býků v souvislosti s cenovými relacemi jednotlivých výrobních faktorů. Výsledky ekonometrického odhadu ukazují, že vyšší hmotnost býků při zařazení do produkčního procesu snižuje dynamiku výkrmu. Při posouzení efektivity využívání dvou hlavních skupin krmiv a to senáže a sena bylo zjištěno, že přírůstky reagují nepružně na změny objemu krmiv, což odpovídá fyziologickým limitům živočišné výroby. Z výsledků však také vyplývá, že při krmení senáží reagují přírůstky citlivěji než při krmení senem. Je tedy je možné zobecnit, že senáž představuje technologicky efektivnější způsob výkrmu v porovnání se senem.

Poznatky prezentované v článku jsou výsledkem řešení grantu MSM 6046070906 „Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů".

Klíčová slova

Cobb-Douglasova produkční funkce, panelová data, fixní efekty, hmotnostní přírůstek, výkrm skotu.

Introduction

In the context of the Czech Republic's accession to the European Union, the performance of the agricultural sector has presented itself in economic debates. In view of this, the debates address both the amount of subsidies, which are granted to Czech farmers, and the competitiveness of the agricultural produce. Even though, so far Czech agricultural producers cannot benefit from the equal amount of subsidies as their "EU-15 fellows", the support given to agriculture has increased noticeably since EU enlargement. In the accession year of 2004, the EU subsidies represented a 40% share of the total support envelope dedicated to Czech agriculture.

This is to say, the conditions for doing business in the agrifood sector have improved as the income stability in agriculture increased. However, concerning the outcome of the agricultural companies, the results are not so convincing. There has been supporting evidence that the growth of agricultural output is still more attributable to the crop production sector than the animal production sector. The Green Report on agriculture highlights the record of harvest in 2005 and at the same time it reports a 7% decrease of beef and 5.7% decrease of pork production (Ministry of Agriculture, 2005).

One reason why the animal production sector is gradually losing its competitiveness in the internal EU market is its inefficiency in using resources, which in this sector is mostly determined by the efficiency of feedstuff use. As the European Commission points out, the conversion coefficient for the use of cereal feedstuffs ranges around 6 t per ton of produced meat in the newly accessed EU countries, while in the EU15 it is only 3.5 t (European Commission, 2002).

Taking into account the growing price inflation of the main cereal commodities in the world markets, the efforts to minimise feeding costs require flexibility on the part of producers to substitute traditional feedstuffs for cheaper ones.

In view of this, special attention should be paid to the economics of animal production, especially regarding the efficiency of feedstuff usage. This notion is fully addressed in this paper. The main aim of the paper is, with the use of appropriate econometric techniques, to estimate the relationship between the use of primary production factors representing different kinds of feedstuffs, and cattle production, as the cattle breeding sector belongs to the traditional sectors of agricultural production in the Czech Republic. The estimation of the production function will thus enable the efficiency of feedstuffs used in the cattle production process in the Czech Republic to be analysed.

Aim and methodology

On the basis of a survey carried out across the agricultural companies in the Czech Republic, a set of data providing production characteristics of 23 agricultural companies within the period 2004–2007 was obtained. The set provides 92 observations for each production characteristic, concerning the number of head of cattle entering and leaving the production process, the number of sold cattle, the average gain in weight in the breed, the amount of feedstuffs consumed in the particular year and the company, and the total costs incurred in the respective breeding group.

Due to the arrangement of the set of data, the estimation of the production function was carried out by means of a fixed effect method instead of the regular OLS, since the method of fixed effects takes into account a heterogeneity of different agricultural farms included in the panel of data providers. It is assumed that the slopes of the production functions are identical for all observed farms, thus the farm heterogeneity is expressed by different constants for every farm. The differences are measured in relation to a chosen, baseline farm, whose constant represents a benchmark for the other farms. The differences in constant measure the heterogeneity of technologies used in the data panel.

In order to model the relationship between the production factors used in the cattle breeding production process and the cattle production, a Cobb-Douglas type of production function was chosen. In economic terms, the function models the dependence of cattle weight gain relative to the initial weight as of the cattle entering the production process, the consumption of hay and the consumption of haylage. In logarithmic form, the Cobb-Douglas function is expressed as follows:

$$\ln YKit = \ln \alpha 0 + \beta 1 \ln Naklhmtit + \beta 2 \ln SNKDit + \beta 3 \ln SEKDit + \alpha 1 \ln I1 + \alpha 2 \ln I2 + \ldots + \alpha n\text{-}1 \ln In\text{-}1 + u_{it} \qquad (1)$$

where:

YP gain in weight in grams per feeding day and per head (dependent variable),

Naklhmtinitial weight of the breed at the beginning of the production period in tons,

SNKD consumption of hay in kg per feeding day, SEKD consumption of haylage in kg per feeding day,

α0 constant of the baseline farm,

β1 β2 β3 regression parameters of each independent variable,

Ii (i=1…n-1) the respective dummy variables characterising each farm,

αi (i=1…n-1) the differences from the baseline farm's constant measuring farms' technology.

The model was estimated with the use of PcGive 12 software.

Results

Characteristics of the panel data

Before presenting the results of the estimation, chosen production characteristics of the respective farms included in the panel are described. First of all, it is possible to provide an overview about the type of housing the different farms use. In the analysed panel, the type of free cattle housing prevails and represents a share of 87%, whereas only 13% of farms use a hutch type of housing. With respect to the preferred type of breed, 30% of farms are specialized in Czech Pied (Czech Fleckvieh) type, 22% of the farms breed Holstein type, and the rest which counts for almost 50%, uses hybrid breeds or combines multiple kinds of breeds. The cattle was fed with the normal feeding dose, (e.g. silage, cereals, hay and haylage), but statistically significant gains of weight were observed only in case of feeding with hay and haylage. It could be attributed to the type of housing. Therefore, only hay and haylage was considered in the model, being the cheapest feeding components.

Concerning the size of the breed in a yearly breeding cycle, the farms have on average 232 head with an average weight gain of 886 g per feeding day. With respect to the study published by the Institute of Agricultural Economics and Informatics (2008), the average weight growth of cattle in the Czech Republic reaches around 800 g, suggesting that the farms included in the panel have approximately comparable production results to the country's average.

Information about consumed feedstuffs, initial weight and average weight gain of the farms included in the panel is shown in Table 1. With respect to the gain of weight, it can be seen that 95% of values are in the range of 590 g to 1,192 g per feeding day.

With regards to the consumption of feedstuffs in the chosen farms, considerable variability of data can be found, which could be explained by possible substitutability of the feeding components. The average consumption of haylage per feeding day is 6 kg, whereas some farms register haylage consumption up to 16 kg. The highest variability can be seen in case of hay consumption, which has also the lowest number of observations. Hay represents an important part of the animal's nutrition; however, it can be substituted by other dietetic components corresponding to its availability at each farm.

The initial weight was chosen as another variable due its to expected influence on the dynamics of growth. In the sample of farms, the initial weight reaches 40 t ranging from 11 t to 79 t.

The descriptive overview of the analysed data leads to the assumption that the explanatory variables of feedstuff components and initial weight will not have a homogenous influence, but rather it is possible to expect certain deviations in explaining gain of weight. The high variability of consumed feedstuffs is, to a certain extent, a positive finding since it better explains the efficiency in reaching production growth.

Econometric estimation and statistical verification of the model

The estimated econometric model has a following form:

Variable	Number of	Mean	Min	Max
YP	90	886	438	1200
SEKD	86	6,043	0,72673	16,353
Naklhmt	74	40,596	10,993	79,476

SNKD	63	1,1941	0,029734	8,1028

Table 1: Description of variables included in the econometric estimation.

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Econometric estimation and statistical verification of the model

The estimated econometric model has a following form:

$$YP = -0.1125*Naklhmt^{**} + 0.03915*SNKD^{**} + 0.07989*SEKD^{**} + 7.197^{**} + 0.03757*I_1 + 0.04287*I_2$$

(SE) (0.0471) (0.0178) (0.0348) (0.154) (0.0472) (0.0328)

$$+ 0.06629*I_3^{**} - 0.2185*I_4^{**} - 0.03142*I_5^{**} - 0.2693*I_6^{**} + 0.1586*I_7^{**} - 0.1329*I_8 + 0.05317*I_9$$

(0.0239) (0.0207) (0.012) (0.0571) (0.0247) (0.0735) (0.0277)

$$- 0.1278*I_{10}^{**} - 0.02454*I_{11} - 0.3956*I_{12}^{**} - 0.3894*I_{13}^{**} - 0.1599*I_{14}^{**} - 0.1539*I_{15} - 0.03364*I_{16}$$

(0.0283) (0.0191) (0.0587) (0.0667) (0.0378) (0.0776) (0.0174)

$$+ 0.1763*I_{17}^{**} - 0.1132*I_{18}^{**} - 0.6025*I_{19}^{**} - 0.2714*I_{20}^{**}$$

(0.05) (0.00454) (0.164) (0.0293) **(2)**

sigma	0.078989	sigma^2	0.006240
R^2	0.8071448		
RSS	0.193419	TSS	1.002924
no. of observations	55	no. of parameters	24
Using robust standard errors			

Table 2: Statistical characteristics of the estimation.

Wald (joint):	Chi^2(3)	=	14.97 [0.002]
Wald (dummy):	Chi^2(21)	=	2094. [0.000]
AR(1) test:	N(0,1)	=	-1.808 [0.071]
AR(2) test:	N(0,1)	=	-2.732 [0.006]

Table 3: Wald test and AR test.

The values in brackets display standard errors of the parameters. The parameters which are significant on the level of α = 0.05 are marked with two stars.

The results of the statistical verification of the estimated model are displayed in Table 2. In total, there are 55 observations and 24 variables in the model (including the dummy variables). The index of determination indicates that changes in weight gain can be explained by the changes in initial weight and use of feedstuffs by 81%, thus suggesting a relatively strong relationship between the endogenous variable and the included exogenous variables.

Concerning the significance of each parameter, the t-test shows that all the parameters linked to the exogenous variables of initial weight and feedstuff components as well as the constant are significant (tested for α = 0.05). Furthermore, 13 out of 20 parameters linked with dummy variables are also significant.

The results of the Wald test show the impact of total fixed effects in the model, which confirms the significance of the whole equation (Table 3). Thus it is possible to conclude that statistically significant differences exist between the constants of each farms, and hence between their particular technologies.

In order to assess the dependence of random errors in time, the autoregressive test of first and second order was carried out. The results of AR(1) do not prove the presence of autocorrelation of residuals expressed in the first order differences. This finding is supported by the autocorrelation function displayed in Figure 1. The results of the autoregressive test AR (2) show that the dependence of residuals in time is proved when considering second order differences. However, the transformation to second order differences significantly reduces the length of the time series, thus the informative value of the AR(2) test is very low.

Figure 2 provides comparison of the model's residuals with the curve of normal distribution. As Figure 2 shows, it is possible to assume normal distribution of the residuals, with only a minor skew.

Comparison of the real values of weight growth (YP) and the theoretical values estimated by the function (Fitted) is shown in Figure 3. It is necessary to take into account that the values are expressed in their logarithmical forms, thus they do not directly provide the value of weight gain. As Figure 3 shows, the estimated model captures relatively well the variation of real values of the endogenous variable. This finding is also supported by the index of determination, as already mentioned. Another view on the quality of the estimation is given in Figure 4, where the development of the residuals is displayed. As observed, most of the residuals are located in the range of (-0.5, 0.5), only a smaller number of residuals have extreme values.

Economic interpretation

The interpretation of the estimated function considers the influence of both the included explanatory variables as the main production factors which explain the production level, and the parameters regarding the dummy variables, which indicate the differences in technological level of the farms included in the panel. The parameters which concern the impact of each production factor on the growth of weight are as follows:

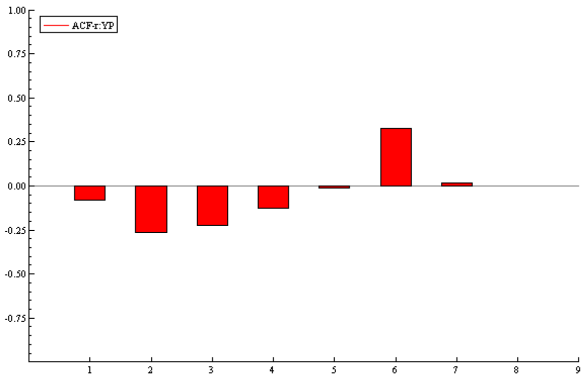

Figure 1: Autocorrelation function.

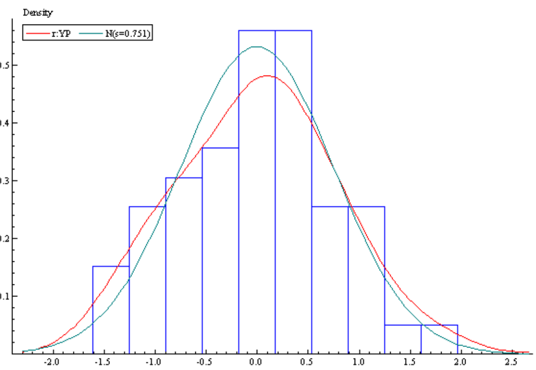

Figure 2: Distribution of the model's residuals.

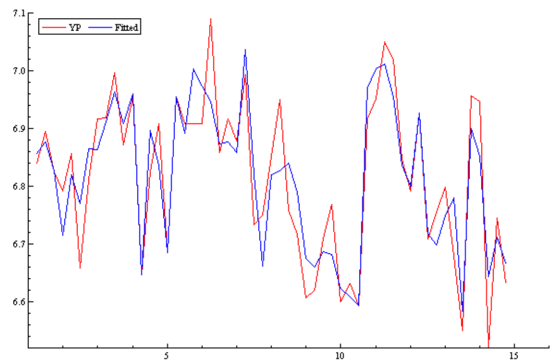

Figure 3: Real and fitted values.

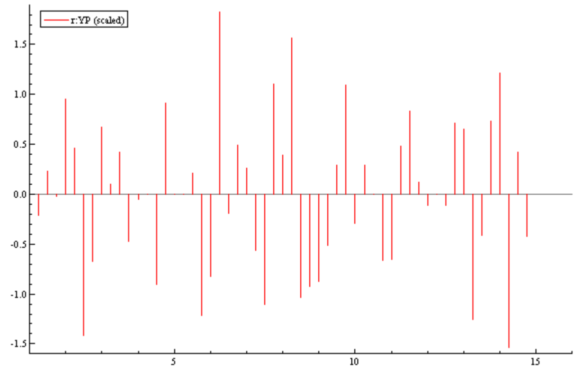

Figure 4: Model residuals.

1. Parameter of Naklhmt $\beta_1 = -0.1125$

The value of the parameter β1 indicates that a growth of input weight by 1% leads to a decrease of the weight by 0.1125%. This is to say that, with increasing initial weight, the efficiency of the production process decreases. This foundation is supported by the following reasons:

Following the production growth curve, breeds with a lower initial weight of cattle entering the production process reach higher dynamics of growth as compared to breeds with a higher weighted cattle, which is in line with the physiological maximum.

Concerning the nutrition process, only a part of the energy is used for the growth; the rest is saved as a maintenance dosage.

Based on the above arguments, it is possible to conclude that the results of the estimation correspond to the real production process, taking into account its physiological aspect. With respect to the intensity of reaction, the weight growth of cattle does not react elastically on the change of the initial weight.

2. Parameter of SNKD $\beta_2 = 0.03915$

This parameter quantifies the impact of hay consumption on the growth of weight and indicates that with a 1% increase of consumption of hay, the weight increases by 0.04%. In this case the results show that hay contributes positively to the cattle weight gain, however, the production elasticity is very low.

3. Parameter of SEKD β3 = 0.07989

Parameter β3 indicates that with a 1% increase of haylage use, the weight increases by 0.08%. In comparison to the elasticity of hay feeding, the consumption of haylage has a higher contribution to the production growth level.

It can be summarised that the initial weight of cattle entering the production process is the strongest factor influencing the development of cattle production, where the breeds with lower initial weights have a higher dynamics of growth. The main feedstuff components, represented by hay and haylage, lead to a continuous weight growth, however, with only marginal contribution.

The estimated Cobb-Douglas function also enables one to calculate the returns to scale reached in the cattle breeding sector. As the sum of the parameters shows, with increasing volume of input factors – i.e. the combination of input weight and the feedstuffs, the returns to scale decrease thus indicating that the dynamics of production growth goes down.

4. The constant and the dummy variables

In logarithmic form, the constant has a value of 7.197 which corresponds to the amount of weight increase of the baseline farm at zero level of input variables.

Parameters αi, attached to the dummy variables, represent the estimated fixed effects across the panel of farms. They represent the difference of each farms´ individual constant from the constant of the baseline farm. The higher the value of constant, the higher the levels of increment in weight are reached with the same amount of inputs (assuming equality of the regression parameters β). It therefore follows that the production process in farms with higher constants is more efficient in comparison to other farms.

In the interpretation, only parameters with accepted levels of significance are considered relevant. The farms with no statistical difference of their estimated constant from the constant of the baseline farm are assumed to have homogenous technology. In Figure 5, representation of farms with homogenous technology coincides with the baseline constant at the level of 7.2. The farms with a statistically different level of constant from the baseline, which are assumed to have a heterogeneous technology, are displayed by columns with respective deviation from the baseline. From the total of 20 enterprises, 13 farms were found to have a heterogeneous technology, where 10 farms were registered to reach a lower technological level. The biggest difference from the baseline constant (0.6) is observed in the case of farm 19. On the other hand, three farms reach a higher technological level against the baseline farm. However, the values of the deviations range in the interval of (0.60, 0.18) suggesting that the farms in the panel are not burdened with substantial technological differences.

The results of the technological differences in the panel of farms were further analysed with respect to a possible relationship to some qualitative characteristics of the farms, concerning both the type of cattle housing and the type of breed.

The baseline farm, representing the benchmark for assessing the technological differences, uses free type of housing. Seven out of ten farms with lower technological levels operate with the same type of housing. However two farms out of three which have above average technology also prefer free type of housing. Based on these facts, it is clear that the type of cattle housing does not play a substantial role in determining the level of technology.

The relationship between the technology and type of breed was also assessed. Concerning the baseline farm, the Holstein type of breed prevails. The farms having their technology homogeneous with the baseline farm also use Holstein type of breed, while the farms with different technology are those specialised in breeding of the Czech Pied type.

Following these findings, the type of cattle breed might have considerable influence on the production process of cattle breeding.

Characteristics of production function

Estimated production function should be verified in terms of the existence of continuous first and second order partial derivations. It is assumed that the first partial derivation is positive as the gain in weight increases together with the increasing input of production factors. Conversely, the second order partial derivation is negative as the rise of the first factor leads to the decreasing marginal productivity when fixing the second factor at the constant level – ceteris paribus.

Due to marginal technological differences in the panel, it was abstracted from the fixed effects and the production function is defined by:

$$YP = 7.197\ Naklhmt^{-0.1125}\ SNKD^{0.03915}\ SEKD^{0.07989}\ e^{uit} \qquad \textbf{(3)}$$

After modifications we obtain first order partial derivations of the first explanatory variable:

$$\partial YP/\partial Naklhmt = -0.1125 * YP/Naklhmt \qquad \textbf{(4)}$$

Analogically, it is possible to obtain the first partial derivations of other explanatory variables:

$$\partial YP/\partial SNKD = 0.03915 * YP/SNKD \qquad \textbf{(5)}$$

$$\partial YP/\partial SEKD = 0.07989 * YP/SEKD \qquad \textbf{(6)}$$

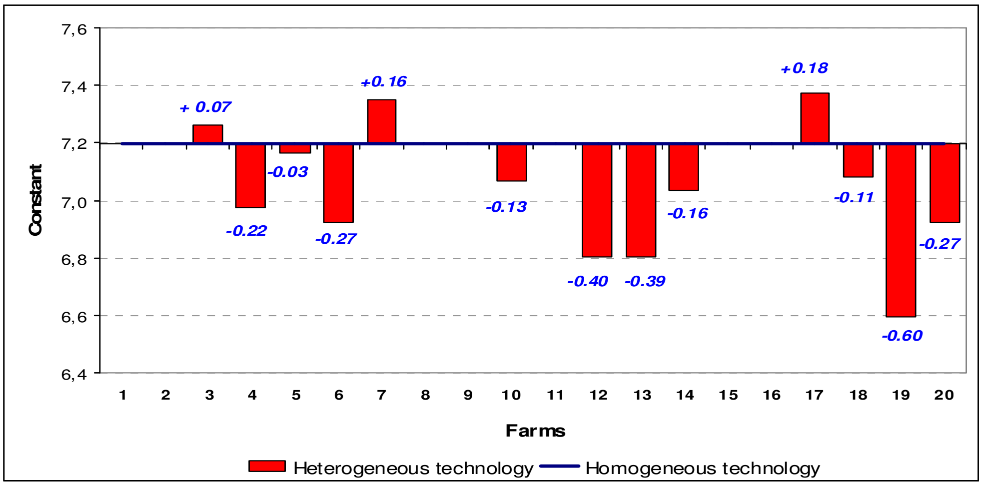

Figure 5: Technological differences of the analysed farms (source: authors´ elaboration).

Whereas the first partial derivations represent marginal production of a given factor, it is evident that each additional metric ton of initial weight induces, ceteris paribus, a reduction in the gain in weight. On the other hand, concerning the consumption of hay and haylage, their marginal productions will be always positive. From the form of the marginal production it is also possible to observe that with the increase in growth of weight, the marginal production of haylage will rise faster than the marginal production of hay consumption. This is explained by the higher value of elasticity of haylage as opposed to hay.

It is also possible to find the relationship between derived marginal productions and the unit productions of each factor. The term YP/SNKD represents the gain of weight per consumption unit of hay, i.e. unit production of hay consumption. Thus it is evident, that the production elasticities determine the share of marginal production from the unit production. In the case of hay and haylage consumption, their marginal productions will always be below the level of their respective unit productions.

The behaviour of the marginal productions can be evaluated by means of the second order partial derivation of the production function. The second order partial derivation of weight increase with respect to the initial weight can be subsequently derived:

$$\partial^2 YP/\partial Naklhmt^2 = -0.1125(-0.1125-1).YP/Naklhmt^2 \quad \textbf{(7)}$$

Analogically for the other production factors:

$$\partial^2 YP/\partial SNKD^2 = 0.03915\ (0.03915\text{-}1).YP/SNKD^2 \quad \textbf{(8)}$$

$$\partial^2 YP/\partial SEKD^2 = 0.07989\ (0.07989\text{-}1).YP/SEKD^2 \quad \textbf{(9)}$$

With the second order partial derivation assessment of the weight growth relative to the initial weight it follows, that the second order derivation will always be positive, with positive values of variables YP and Naklhmt. In other words marginal production will be negative and convex if reaching the point of minimum. From the form of the marginal production derivations for fodder consumption results, that if the growth of weight and the quantity of fodder spent is positive, the second order partial derivations of the production function will be negative (given that both parameters β2 and β3 < 1). This fact acknowledges the conditions set on the production functions with the assumption that with an increasing quantity of consumed fodder (providing constant inputs of others production factors), the slope of marginal production declines and thus the efficiency of the input factors.

Discussion

From the mathematical point of view, the estimated production function of fattening bulls is acceptable. However, it is also necessary question the behaviour of the function from an agronomical point of view, where, above all, the decreasing gain in weights with growing initial weight must be explained. Therefore, it is necessary to discuss the growth curve in a more general form.

The growth curve is a graphical expression of real behaviour of growth, characterised by the phases of sigmoid (acceleration), break-even point and retardation at a different growth of the intensity level concerning various body parts in a given term (i.e. the non-homogeneity of growth). From the calf birth, there is a relatively intensive growth of skeleton replaced gradually by raising of musculature growth followed by the final phase where the accumulation of body fat dominates, which further continues at the age when the mass of muscles and especially the mass of bones is already unchanged. After reaching the inflexion point of the growth curve, the intensive stage starts with an increasing share of the fat components.

In the postnatal period, the growth of body depends especially on the health conditions, i.e. on the hygienic conditions, and on the level of nutrition. If the nutrition is not a limiting factor, then the live weight depends on the age according to the classic sigmoid curve, which accelerates at about 9 months of age and at a live weight of about 300 kg. Mathematically, this behaviour can be best described by the Gompertz equation:

$$yt = A.e^{-b.e^{-kt}} \qquad \textbf{(10)}$$

where yt represents weight in time t, the parameter A represents asymptotical weight, which can be understood as the average weight of the individual in his adult age and the parameter k defines the rate of growth change; the parameter b has not a specific biological meaning.

The derivation of the Gompertz function provides a growth rate, usually called average daily gain in weight. However, the growth curve and its mathematical model may be applied only in ideal environmental conditions. In reality, the growth curve shows the different accelerations and retardations, especially in relation to the level of nutrition and health conditions (Thornley and France, 2007).

In some cases it is sufficient to model growth only in a specific period of the organism evolution where it is easier to achieve the compliance of real data with estimated data from the growth curve. The Gompertz function was used for simulation of the bull-calf growth of Czech Pied cattle from the birth to the adult age by Pulkrábek (1980, 1985). Richards´s function, which uses four parameters, was applied by Nešetřilová (2005) for bull-calf of Czech Pied cattle from approx. 30 days up to 1400 days of age.

Nešetřilová with Pulkrábek (1995) have estimated parameters of growth function for bull-calves of Czech Pied cattle, and in a data base from 90 days of bull age they have determined the inflexion point (on the basis of Gompertz function), to be situated around 298 days (near the weight of 345 kg) as shown in Figure 6.

From the shape of the curve in Figure 6 it is evident, that from a certain level of weight corresponding to the inflexion point on the growth curve, the gain in weight begins to decrease subsequently. Realized negative dependence of gain in weights on the initial weight is then in accordance with the behaviour of the estimated growth function of the cattle breeding.

From the findings above it would be also possible to derive an explanation for higher values reached in fattening of the Holstein breed, in comparison to the Czech Pied cattle breed. The average initial weight in companies specialising in fattening the Holstein breed, was 44.7 tons, and was the lowest, with exclusion of the "others" category, which forms only 17% from total observations (Table 4). This is in contrary to the companies, which focus on fattening of the traditional Czech Pied cattle breed and crossbreeds that start the fattening at a higher initial weight.

Within the context of these observations, the question of fattening effectiveness may arise, given that the smaller initial weight could bring higher gains in weight to the company. However, it is necessary to approach this problem comprehensively and in relation to other production factors considered in the production function.

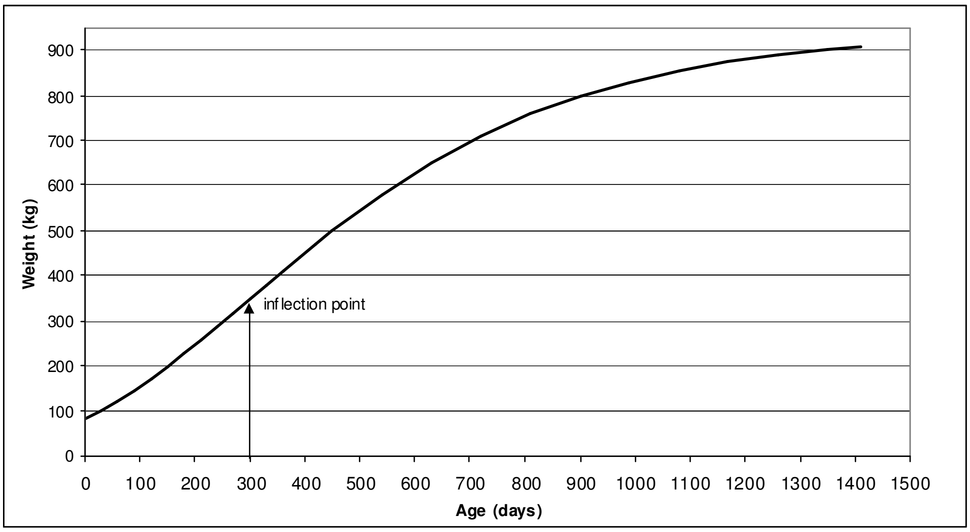

Figure 6: Gompertz function for bulls of Czech Pied cattle breed from 90 days of age (based on Nešetřilová and Pulkrábek, 1995).

Breeds	Average initial weight (t)
Holstein	44,7
CPC	46,7
Crossbreds	48,9
Others*	35,4

* Others are values, where the breed was not stated or where there was an incompetent value

Table 4: Initial weight of chosen breeds in selection data set (tons of live weight).

Conclusion

Based on the results of the estimation it can be concluded, that the Cobb-Douglas function is suitable for modelling the production process of cattle breeding. The method of fixed effects managed to address the issue of technological differences among the companies very well. Even though the monitored farms show certain variability with respect to the analysed variables, the estimation involving the fixed effects revealed very low levels of technological differences, thus the selective data set may be considered as homogenous.

When comparing the effect of the considered production factors – the initial weight, the haylage consumption, and the hay consumption – the first factor causes a gradual fall of gain in weight level as opposed to the positive effects of the other variables. However, this finding has been confronted with the biological behaviour of cattle growth showing that the empirically estimated production function is in compliance with biological aspects of the cattle livestock production.

The comparison of values in time shows, that maximum level of gain in weight was achieved at a higher feeding intensity level and with a lower initial weight, whereas in the less productive periods, the initial weight rises on account of the fodder consumption.

When monitoring the fattening efficiency, the haylage consumption brings more additional gain in weight than the hay consumption. This notion should be further analysed with respect to possible alternatives of reaching economic efficiency while taking into account the prices of the respective feedstuff components.

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