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PhD Thesis

**AN ECONOMIC ANALYSIS OF FACTORS DETERMINING EFFICIENCY
IN SELECTED LARGE-SCALE PIG-KEEPING FARMS OF HUNGARY'S
NORTHERN GREAT PLAIN REGION**

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INTRODUCTION AND OBJECTIVES

Pig keeping plays a major role in Hungarian agriculture. In 2001, pig keeping accounted for 37,1 percent of all animal husbandry GDP. Our country's EU accession is expected to have a significant effect on this sector, too. This is, on the one hand because of the 15 states that were EU members before May 1, 2004, only five are known to have a pig stock larger than ours and, on the other hand, because Hungary has been a key pork supplier of the European Union for several years, with a 65-70 percent share.

The number of pigs kept decreased considerably during the 1990s. After the change of political systems in 1990, we lost our Eastern European markets, export opportunities shrank, and a reduction in internal consumption, together with an increase in forage prices took place. A 15 year top drop in stock numbers occurred in 1992, with a reduction by 2.4 million. Production cycles were substituted by social, economic changes, and occasional state interventions. Besides conventional market fluctuations, processes in the former decade were influenced by other factors too. Hungary's allied membership to the EU, followed by the preparations for accession – the transition from a carcass/fat ratio based evaluation of meat quality to an evaluation based on the rate of flesh content (Széles, 2001) – have had a significant effect on product quality and stock numbers. Ináncsy (2002) concluded that in recent years, 60 percent of all pig products were marketed on domestic markets.

The number of pigs kept by business organizations has decreased ever since 1990, while the number of pigs kept by farmers corresponded to both production cycles and a downward tendency. In 1990, an equal share of 4,2–4,2 million animals were kept by the two sectors. At present, the composition of pig stocks in Hungary shows a peculiar structure. In effect, 50 percent of the animal stock in this enterprise is produced by 6-700 specialized, large-scale farms where average stock numbers amount to 3500-4000. Approximately 400000 small-scale producers deliver the other 50 percent of production.

Pig-keepers are foremost affected by the absolute and relative prices of meat and forage (Vadász, 1992). This price relation has worsened ever since the beginning of the 1990s, while in Denmark, for example, the relation of prices stagnated during the same period. Easily traceable is a decrease in profitability in this enterprise. Shrinking markets and rising input prices allowed only the best pig-keepers to produce profitably, thus keeping their stable market position.

In this dissertation I decided to analyse those key factors which determine the profitability of large-scale pig keeping in Hungary's Northern Great Plain Region.

The factors are listed below:

- The move of costs, revenues, profits and profitability, key determinants of competitiveness in large-scale pig keeping;
- Feeding costs (analysed with the help of Linear Programming)
- Meat and feeding corn prices (analysed through prognostic methods)
- The status of animal protection at regional level, emphasising:
 - the analysis of minimum stabling space per animal.
 - the economic analysis of stock numbers
 - the analysis of animal transports from the animal protection point of view
- An analysis of meat quality related profitability in the slaughter house of Debrecen Hús Co.

The page limitation for dissertations prohibited me from taking issues of environmental protection into account. However I plan to carry out such investigations in the future.

Eventually, my goal is to disclose unexplored capacities of large-scale pig keeping in the region by analysing determinative factors of production, in order to enable Hungarian farmers to keep up with foreign farmers in the common European market. We must clearly understand that pre-accession economic calculations forecasted the pig enterprise to become a disadvantaged branch of Hungarian agriculture. This is why I argue that enterprise is worth effort to find critical points and to prepare analyses that might orientate producers in this enterprise towards a narrow path of viability.

METHODOLOGY

As an initial step of my research work, I interviewed the chief correspondents of stockbreeding in the offices of the Ministry of Agriculture and Rural development in all three counties of the region and asked them for a list of large-scale pig keeping farms that operated between 1996 and 2000 in the region.

There turned out to be 28 farms in Hajdú-Bihar county and 12 in Szabolcs-Szatmár-Bereg county. In the case of Jász-Nagykun-Szolnok county, 10 farms proved to be of the desired kind and still operating. I used the list of farms to choose 18 worthy of investigation. I concluded to have gained reliable figures from ten farms, with a number of 8,086 sows altogether. I analysed 6 farms in Hajdú-Bihar, 2 in Szabolcs-Szatmár and 2 in Szolnok county, respectively, in order to create a model in line with the shares of the three counties within the aggregate stock number of the region. At that time, **the number of analysed sows amounted to a 15% fraction of the aggregate sow stock in large-scale fattening farms in the region.** One of the farms I investigated has already been liquidated, and there is another presently at risk. However, the same risk has applied and still applies to all pig keeping farms of the region.

When choosing the farms at issue, I particularly sought data representative of regional pig keeping as a whole.

Appointing model farms was also problematic, as though basic similarities in the structure of the different farms did exist, the reconstructions of the 1980s and 1990s largely resulted in diverse solutions and dissimilar constructions. Very often there are among the various technologies individual solutions, which characterize a particular farm. Thus, when making my choice, I decided to choose on the basis of the most common **combined fat stock producing structure**. In this framework, I intended to incorporate farms with different structures and architecture, pavilion, half-blocked and blocked types equally. I also made efforts to include farms with dissimilar feeding techniques and floor types (platforms). The tables in the dissertation were prepared using Microsoft Excel software, while text was written using Microsoft Word.

Questionnaires, Critical interviews

When investigating profitability, I processed cost figures of 18 large-scale pig-keeping farms situated in the Northern Great Plain Region of Hungary, but the results of this work have turned out to be reliable in the case of only 10 farms. With only these farms did I find

it reasonable to take a closer look at cost figures concerning the 1996-2000 period. I also managed to confront my accumulated figures with data from the AKII (The Research and Information Institute for Agricultural Economics). Unfortunately, I did not succeed in collecting each of the necessary national figures, which is why I could only make comparisons to some of the findings of my research work. The accountants employed by the farms I investigated provided the cost figures in this dissertation. During my research, I sought to emphasise fix costs; therefore, I accepted offers of cooperation to analyse such figures from both accountants and managers.

I used general and specially-designed question forms and data sheets to measure and record production capacities and technology on the farms. Besides general farm information, my questions were aimed at feeding techniques, animal protection, meat quality and cost structure. I personally visited each of the farms several times, prepared critical interviews and – where allowed – also made a close inspection of the yards.

The model for stabling space calculations

I prepared a model for stabling space calculations suitable to determine the rate of stock reduction necessary to configure adequate stabling spaces for every age group in order to meet EU regulations.

With this model, I investigated present stock numbers on the farms, and the need for sow stock reduction, in order to work out optimum stabling spaces per animal for the different age groups. Based on the results of this model, I compared figures before and after the reduction. This detailed comparative analysis covered incomes, profits, profitability and costs, respectively.

Statistical methods

Simple statistical methods

Cost and profitability related figures were analysed using the following simple statistical methods:

- indexes of frequency
- dynamic indexes
- mean values

- indexes of deviation

Methods of time series analysis

I employed **dynamic indexes** to analyse the move of prices for corn (this being a key element of a hog's seeds mixture) and meat; however, I used the **season index calculation** to analyse seasonal fluctuations in prices.

In order to carry out price estimations for the market price of corn and meat, I incorporated the method of **Brown's exponential smoothing**. The method was carried out as follows:

Let $\hat{y}_i$ be our estimation for the i -period and e_i the error of our estimation, ergo the difference between the observed figures and our estimation. Smoothing methods are equipped with the ability of systematic learning (HARVEY, 1989), which means that when making the following estimation concerning the $i+1$ period, incorporated is some kind of function to build in the error of the estimation for the i -period (Ralph et al. 2002). The generic equation form is the following:

$$\hat{y}_{i+1} = \hat{y}_i + \alpha f(e_i), \quad 0 \leq \alpha \leq 1 \quad (1)$$

The α (so called smoothing parameter) is responsible for the extent, to which the model takes the error into account (RAPPAI, 2001). When the value of α is close to 0, we should "disregard" the error, we barely take it into account when preparing the next estimation. This estimate will then be very close to the value of the previous one, the model will smooth the fluctuations of the actual time series. It is when the value of α is close to 1 that we should incorporate the error into the model. The problem with the latter method is that the model becomes inappropriate to describe existing tendencies as random fluctuations infiltrating into our calculations (HUNYADI et al., 1996).

Let us start the elaboration of our model with the most simple case, when constant is the f function of error correction. Thus our equation would look like:

$$\hat{y}_{i+1} = \hat{y}_i + \alpha (y_i - \hat{y}_i) \quad (2)$$

Then

$$\hat{y}_{i+1} = \alpha \hat{y}_i + (1 - \alpha) \hat{y}_i \quad (3)$$

This is the equation we write down for the previous period:

$$\hat{y}_i = \alpha \hat{y}_{i-1} + (1 - \alpha) \hat{y}_{i-1} \quad (4)$$

Let us multiply equation (4) with $(1 - \alpha)$:

$$(1 - \alpha) \hat{y}_i = \alpha(1 - \alpha) \hat{y}_{i-1} + (1 - \alpha)^2 \hat{y}_{i-1} \quad (5)$$

Then let us substitute the right half of our new equation into equation (3)

$$\hat{y}_{i+1} = \alpha y_i + \alpha(1 - \alpha) \hat{y}_{i-1} + (1 - \alpha)^2 \hat{y}_{i-1} \quad (6)$$

If we continue on with this step for previous periods of time, we arrive at the following equation:

$$\hat{y}_{i+1} = \alpha y_i + \alpha(1 - \alpha) y_{i-1} + \alpha(1 - \alpha)^2 \hat{y}_{i-2} + \dots + \alpha(1 - \alpha)^{i-1} y_1 + (1 - \alpha)^i \hat{y}_1 \quad (7)$$

This equation clearly shows the characteristics of this model, namely that the estimation for the $i+1$ period in this model is a function of previous values of the time series, in a way that the older the value (the lower the index belonging to that particular y), the smaller the multiplier of the $\alpha(1 - \alpha)^i$ value is. Thus, older values count less and less when creating our prognosis.

Smoothing methods depend largely on our choosing the value of the α parameter. There is no single perfect solution for this problem, so researchers use several techniques to decide on the α parameter. The most common method is when α is determined by the method of smallest squares, but there might be other techniques, providing even better smoothing or smaller errors of estimation. The method of smallest squares implies a reckoning, where we calculate $\sum e_i^2$ deviations between the smoothened and the original series for each α , and later in our analysis we operate with the parameter for which the resulting figures are the smallest (GARDNER et al., 2001)

Double exponential smoothing methods

Single exponential smoothing methods are inapplicable methods of smoothing and estimation in cases where time series following linear trends are at issue, because the obtained results would surely be distorted (HUNYADI et al., 1996). In such cases, Brown's double exponential smoothing constitutes the easiest way to smooth time series (Brown, 1959). With this technique, we basically smooth the time series we once have already smoothened. Single smoothing looks as follows:

$$s_i^{(1)} = \alpha y_i + (1 - \alpha) s_{i-1}^{(1)} \quad (8)$$

where $s_{i-1}^{(1)}$ means the single smoothing that was carried out for the i^{th} period. We then smooth the time series that has previously been smoothened, in an analogous way:

$$s_i^{(2)} = \alpha s_i^{(1)} + (1 - \alpha) s_{i-1}^{(2)} \quad (9)$$

From these, we calculate the projection as follows:

$$\hat{y}_{i+1} = 2 s_i^{(1)} - s_{i-1}^{(2)} \quad (10)$$

We consider the first unit of the process to be our starting value.

We still have to admit that this projection is distorted, but the level of distortion is lower than that of the single smoothing. With great α values the level of distortion is even lower, and disappears when $\alpha=1$.

A developed variation of Brown's double smoothing is called Brown's corrected double exponential smoothing, which – beyond estimating trend value – is capable of correcting, modifying the a and b parameters of the trend step by step, so future projections become dependent upon the fluctuations of the trend function itself, where the starting parameters are that of the parameters of the fitted linear trend functions (ERTSEY, 2002).

This technique starts with the above-discussed smoothing equations (8 and 9), and uses the parameters of the fitted trend function to estimate the initial values as follows:

$$s_0^{(1)} = a - \frac{1 - \alpha}{\alpha} b \quad (11)$$

and

$$s_0^{(2)} = a - 2 \frac{1 - \alpha}{\alpha} b \quad (12)$$

From this point, we calculate the a and b parameters in every single i period, thus correcting the trend function itself:

$$a_i = 2 s_i^{(1)} - s_i^{(2)} \quad (13)$$

$$b_i = \frac{\alpha}{1 - \alpha} (s_i^{(1)} - s_i^{(2)}) \quad (14)$$

With the resulting trend parameters, it becomes possible to estimate the forecasted values. From the trend function corrected regarding the i^{th} period, we now can make projections relevant to the $i+k^{\text{th}}$ period, as follows:

$$\hat{y}_{i+1} = a_i + b_i \cdot k \quad (15)$$

Calculations of correlation and regression

During my investigations, I decided to statistically underpin and analyse each of the quantifiable references of facts to their causes. This is why I monitored 180 animal transports in one of the regional slaughterhouses. The transports were surveyed right upon arrival. The circumstances of unloading were identical. I surveyed the physical injuries and the stress status of the animals. In order to prepare the desired technical analyses, I used the built-in modules of the Microsoft Excel software to calculate the coefficient of correlation and the function of linear regression (SZÚCS and TÖRCSVÁRI, 2002).

I carried out an analysis of linear correlation on the obtained data in order to investigate presumed connections between transport distances and either the rate of injuries, or the rate of perished plus stressed animals. As regards these investigations, I managed to make distinctions between transports from large-sale farms and consignments from small farms, between transports according to their time of delivery, and I also made sure to distinguish the type of vehicles used for transportation. After correlation analyses, I also calculated linear regression in cases, where there turned out to be a significant connection between the influencing factors.

Using Linear Programming models to plan and analyse feed mixtures, the analysis of sensitivity.

The database of this analysis is the result of a most detailed investigation of one of the pig-keeping farms situated in Hungary's Northern Great Plain Region. Based on factual data, I managed to construct the yearly livestock shift plan of the farm, through which I determined the number of feeding days for each of the age groups. Based on feed-consumption figures (such as feed consumption per animal per day or the amount of feed consumed to produce 1 kg live-weight), I planned the yearly consumption in natural units, and – by a multiplication after calculating optimum seeds mixture prices – in valorised costs. The model calculations I made also included analyses regarding the effect of feed

prices on the constitution and price of seeds mixtures. Consequently, obtained seed mixture prices constituted a basis for calculating costs, profits and cost specific profitability in fattening.

I carried out an analysis of sensitivity, which is considered to be an effective tool for establishing planning decisions and systemic, complex analyses (ERTSEY, 1978; ERTSEY, 1986; FORGÁCS, 1981; DANYI and VARRÓ, 1995).

Variables of the model

x_j ($j = 1 \dots n$): is the variable for the different types of feeds

b_i ($i = 1 \dots m$): stands for the expected minimum nutritive content of the seeds mixture regarding the i^{th} nutritive element.

a_{ij} ($i = 1 \dots m, j = 1 \dots n$): the specific nutritive content of the j^{th} component of the seeds mixture regarding the i^{th} nutritive element

P_j ($j = 1 \dots n$): represents the specific cost of the j^{th} component of the mixture

The conditions of balance for the model

A special condition of balance for the model is the assumption of unit quantities in the form of an equation looks as follows:

$$\sum_{j=1}^n x_j = 1$$

Bottom conditions of balance are to be set up for each of the different types of nutritive elements (TÓTH and VARGA, 1974):

$$\sum_{j=1}^n a_{ij} x_j \Rightarrow b_i$$

Minimum and maximum quantity conditions can be set up for the different constituents of the feed mixtures

$$q_{j0} \leq x_j \leq q_j^0$$

where:

q_{j0} is the bottom condition for the j^{th} prescribed constituent of the mixture,

q_j^0 is the ceiling condition for the j^{th} prescribed constituent of the mixture.

In my model, I prescribed equations for concentrates and premixes marketed by HÓD-MEZŐGAZDA Rt., with reference to the recommendations of the company.

The target function of the prepared models:

$$\sum_{j=1}^n p_j x_j \rightarrow \min.$$

By incorporating this target function, the model generates the cheapest readout of all possible solutions.

I used the Solver application within Microsoft Excel 7.0 to resolve the models. I harnessed the shadow prices earned during the above detailed model calculations to carry out the analysis of sensitivity.

As regards feed mixtures, a further analysis of the effect of changes in component prices on the composition and price of mixtures and feeding costs has become available. The shadow prices, constituting target functions for resources, facilitate the analysis of the competitiveness of feeds left out from the optimum program. The difference between the target function value and the shadow price of a particular feed equals with its marginal unit cost. At this point, the feed remains competitive and becomes involved in the optimum model (NEMESSÁLYI, 1982).

The simulation of cost-profit relations

When analysing the effects of feeding costs on profitability, I assumed the circumstances of fattening (the fattening capacity of animals and resulting yields) to be static when feeding optimised mixtures of the different feeds (SZÉKELY, 1981). After the calculation of optimum mixture prices, I used these figures to evaluate annual feeding costs, profits (calculated at farm level and relative to 1 kg marketed live weight) and costs related profitability.

Model calculations regarding the effect of farm meat quality on slaughterhouse profits

In addition to the figures of the Hungarian Central Statistical Office (KSH) and the Livestock and Meat Product Board (VHT), it was the Debreceni Hús Company, which granted me access to their production database in order to be able to perform indispensable analyses.

In my model, I executed a Debreceni Hús Co. data based analysis of the move of costs, incomes and profits under favourable meat quality conditions. In this framework, I discerned on the effects of slaughterhouse processes on quality and then I analysed the move of slaughterhouse profits conditioned by increasing input meat quality.

CONCLUSIONS

During my research into the profitability of pig-keeping, although I managed to investigate 18 of the large-scale pig keeping farms of the region, I concluded I had gained complete and reliable figures from only ten farms. I also managed to confront my accumulated figures with those of the AKII (The Research and Information Institute for Agricultural Economics). I concluded that unit costs on the farms in the region exceeded the figures of farms in other parts of the country considerably between 1996-2000 especially because of a sharp increase in feed prices. However, pork prices in the region fell below national averages (meat quality on those farms did not catch up with quality standards achieved by other concurring farmers in the country), which contributed to the lack of competitiveness in the region.

Table 1.

Average production costs per 1 kg slaughter-pig, market prices and the move of meat-fat ratios between 1996-2000 in farms at national and regional level

Denomination	Me.:	1996		1997		1998		1999		2000	
		O*	R**	O*	R**	O*	O*	R**	O*	R**	O*
Feeding cost	Ft/kg	116,5	105,6	134,7	159,9	150,1	151,4	141,0	150,1	160,9	174,2
Unit cost	Ft/kg	152,3	146,3	182,4	203,6	196,9	206,1	196,8	199,6	220,2	228,5
Pork price	Ft/kg	183,2	173,2	234,2	232,1	229,4	220,4	201,5	192,5	251,8	247,1
Meat-fat ratio	%	51,9	51,4	52,8	52,7	53,9	53,3	54,3	53,8	54,5	54,2

Source: AKII, VHT 2002.

* national average

** averages of the investigated farms in the region

In the next phase of my research work, I elaborated 8 variations of a linear programming model in order to disclose the effect of prices of the different components of feed mixtures on aggregate costs and unit costs in the investigated farms (see table 2.). As an increase in feed costs by 1Ft/kg does not represent actual market fluctuations of prices, I decided to prepare 6 different models, in which feed prices were increased and decreased by 5 and 10 Ft/kg, respectively. This was the basic model I strictly kept to when I applied changes and made comparisons. As regards the seventh variation, I analysed the competitiveness of soy

if fed in a pig starter¹ mixture. In the eighth variation, I analysed the effect of a prescribed 2% fishmeal ratio in starter mixtures on the competitiveness of concentrated protein feeds. According to my calculations, it turned out that, in pig keeping the essential feeds are wheat, corn and barley, depending on the demands of the age group to which we intend to feed the particular mixture. Should the price of any of these feeds increase, they are known to be competitive substitutions of each other in a feed mixture. By taking the move of prices into account and by the substitution of expensive feeds with cheaper ones, the rise of feeding costs can be moderated.

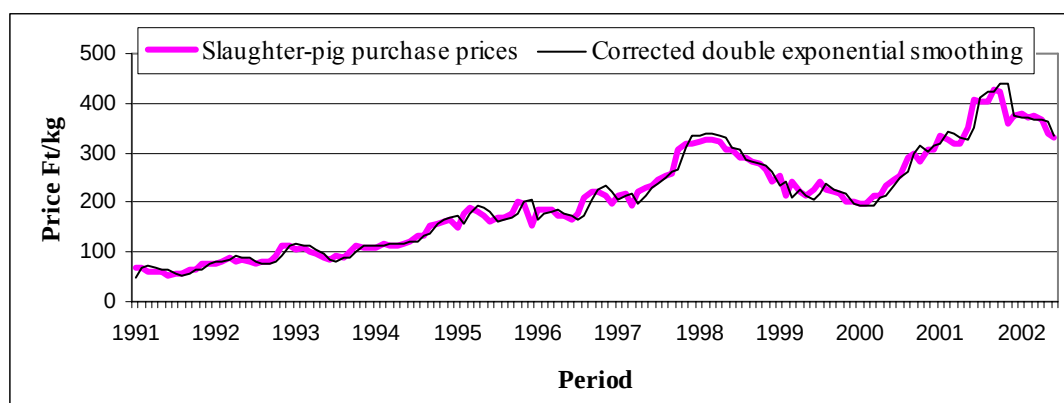
Table 2.

Feed prices dependent farm level cost and profit relations

Denomination	Basic values	I. version	II. version	III. version	IV. version	V. version	VI. version	VII. version	VIII. version
Feeding price (thousand Ft)	338 309	346 764	346 809	339 380	321 974	342 580	345 469	338 289	341 901
Total cost (1000 Ft)	541 944	550 400	550 445	543 016	525 610	546 215	549 104	541 925	545 536
Profit (thousand Ft)	75 310	66 855	66 809	74 238	91 644	71 039	658 150	75 329	71 718
Cost related profit (%)	14	12	12	14	17	13	12	14	13
Feeding price ratio in total cost (%)	62	63	63	62	61	63	63	62	63
Total cost (Ft/ 1 kg)	223,41	226,9	226,92	223,85	216,68	225,17	226,36	223,40	224,89
Specific profit (Ft/ 1 kg)	31,04	27,56	27,54	30,60	37,78	29,28	28,09	31,05	29,56

As a next phase of my dissertation, I analysed the monthly move of pork purchase and corn market prices for the period 1991–2001. Of the available smoothing methods, I adapted Brown’s exponential smoothing techniques. I concluded that with Brown’s double exponential smoothing method, prices could be faithfully projected in the short-run.

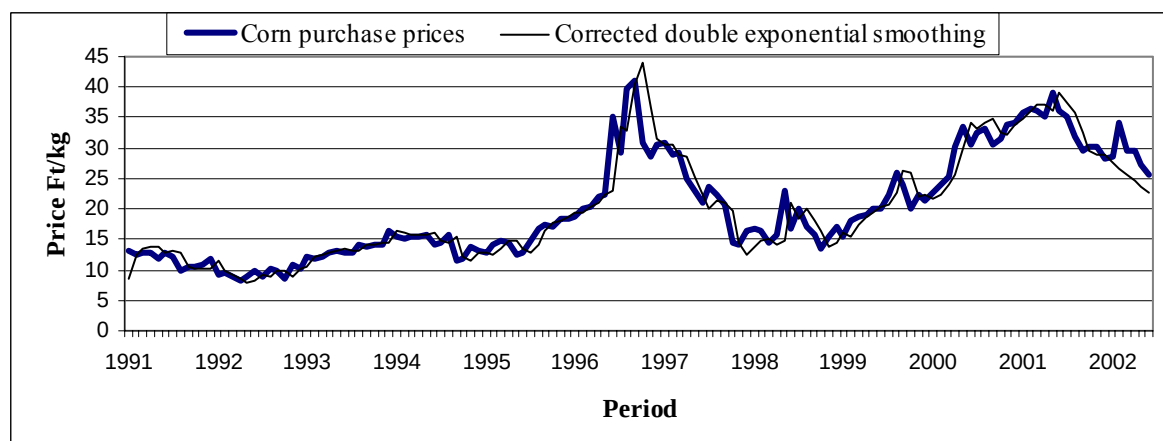
Figure 1.: Values of Brown’s double exponential smoothing



The figure shows that actual slaughter-pig purchase prices and basic tendencies follow the estimates.

As regards the move of corn prices, the figure also illustrates the effect of price fluctuations on the estimates and the decrease in prices in 2002.

Figure 2.: Values of Brown’s double exponential smoothing



Based on farm data, I managed to work out a model for stabling space calculations, with which the exact rate of stock reduction necessary for the farms to meet EU regulations regarding stabling space requirements can be determined. After a thorough analysis of the

farms at issue, I concluded that the phase of piglet post-raising constitutes a bottleneck regarding animal-protection regulations, as only one of the farms could satisfy all the expectations. Critical phases turned out to be categories between 25-30 kg and 30-35 kg (see table 3). Only one of the investigated farms could satisfy the expectations, issued in EU regulations, the remaining 9 farms are advised to carry out a reduction of sows by an average of 16,5%. If sow numbers were decreased according to EU regulations, a 10 farm average of 3,5% increase in the index of total costs/1kg live-weight would emerge.

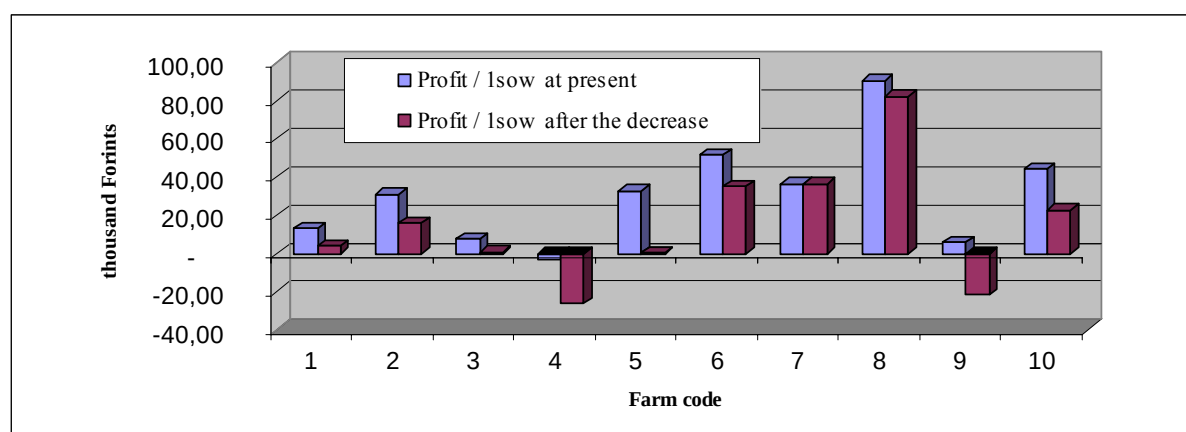
Table 3.

EU regulations and obtained farm data – a comparison of stabling space figures
Me.:m²

Weight	EU directive	Farm no. 1.	Farm no. 2.	Farm no. 3.	Farm no. 4.	Farm no. 5.	Farm no. 6.	Farm no. 7.	Farm no. 8.	Farm no. 9.	Farm no. 10.	Average m ²	Average - directive
<10 kg	0,15	0,27	0,27	0,25	0,26	0,24	0,25	0,24	0,24	0,18	0,16	0,24	0,09
10-20 kg	0,20	0,27	0,24	0,27	0,20	0,20	0,24	0,33	0,28	0,22	0,20	0,25	0,05
20-30 kg	0,30	0,27	0,24	0,27	0,20	0,20	0,24	0,33	0,28	0,22	0,20	0,25	-0,05
30-35 kg	0,40	0,27	0,68	0,27	0,70	0,20	0,24	0,65	0,60	0,22	0,60	0,46	0,06
35-50 kg	0,40	0,88	0,68	0,50	0,70	0,70	0,70	0,65	0,60	0,60	0,60	0,66	0,26
50-70 kg	0,55	0,88	0,68	0,50	0,70	0,70	0,70	0,65	0,60	0,60	0,60	0,66	0,11
70-85 kg	0,55	0,88	0,68	0,67	0,70	0,70	0,70	0,65	0,60	0,60	0,60	0,68	0,13
85-110 kg	0,65	0,88	0,68	0,67	0,70	0,70	0,70	0,65	0,60	0,60	0,60	0,68	0,03
110 kg<	1,00	1,20	1,20	1,12	1,20	1,54	1,00	1,76	1,54	1,00	1,00	1,27	0,27

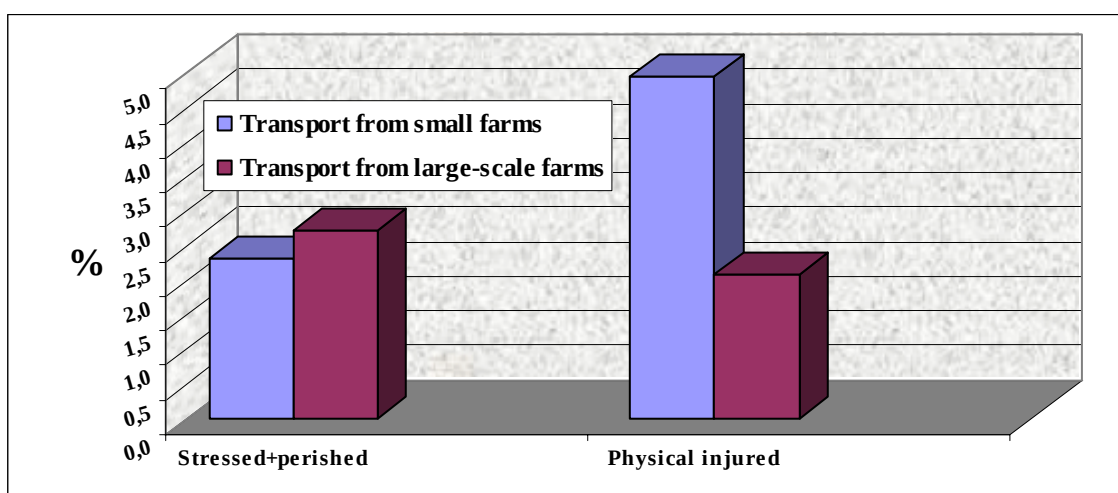
Figure 3 illustrates the economic effects of EU animal protection regulations. Profitability decreased on each of the farms, except for farm n.7, where stock numbers did not have to be decreased. Farms with former negative returns suffered further losses, whereas a significant drop in profitability occurred on farms with formerly positive returns. As regards farm 9, the adoption of regulation directives caused earlier profits to turn into significant losses.

Figure 3.: The move of Profit/1 sow indexes before and after stock reduction



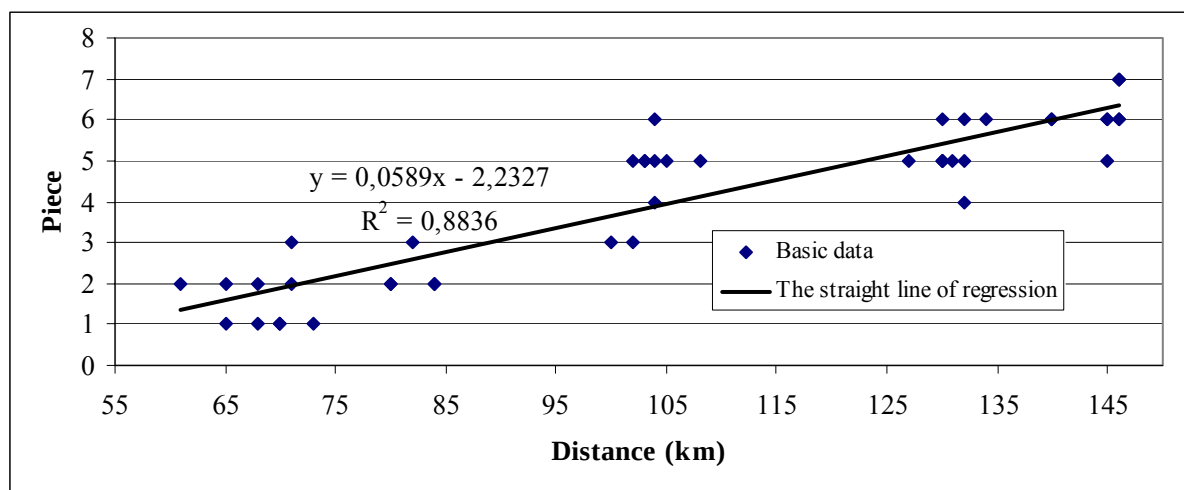
In connection with animal protection, I also investigated the effect of transport circumstances on slaughterhouse quality. I monitored 180 animal transports to one of the regional slaughterhouses, with observations aimed at the physical injuries and the stress status of the arriving animals. According to my findings, transport distance proved to be a key factor determining the rate of perished and injured animals. In point of numbers, 4,96% percent of the animals arriving from small-scale farms and 2,09% from large-scale farms turned out to be physically injured. However, stressed and perished animals constituted a 2,73% fraction in consignments from large-scale farms, and a 2,31% one in small-scale farm origin transports (see figure 4). Such results indicate that small-scale pigs are almost twice as exposed to physical injuries as those from large-scale farms, but large-scale farm pigs seem to be somewhat more susceptible to stress.

Figure 4.: Percentual ratio figures of stressed+perished and injured animals within consignments of small-scale farm and large-scale farm origin.



When analysing linear correlation by analysing 33 coefficients of correlation, I managed to point out a close correlation between transportation distances and the types of injuries for both truck transports from large-scale farms and IFA transports from small-scale farms. Beyond the analysis of correlation, I also calculated liner regressions in cases where the connection between the factors at issue turned out to be quantifiable. When analysing the connection between consignments from large-scale farms and the sum of all injuries, I concluded the linear regression function describing the connection between them to fit well into the original cluster, with the distance of transportation determining the number of injured animals by 88%. Moreover, by increasing the distance of transportation by 10 kilometres, the number of injured animals increased by 0,6.

Figure 5: The connection between large-scale truck transport distances and the number of stressed+perished and injured animals



From these figures the conclusion can be drawn that the slaughterhouse is interested in its partners (both small- and large-scale ones) producing input meat of increased quality, in order to have the net-meat content of slaughter animals reach or even exceed the average meat quality of the EU.

ORIGINAL OR EQUIVALENT FINDINGS OF THE DISSERTATION

By analysing selected basis farms, I managed to evaluate the profitability of large-scale pig keeping in Hungary's Northern Great Plain Region, and the cost saving effect of rational animal feed management.

I analysed the monthly move of pork purchase and corn market prices for the period 1991–2001. I concluded that with Brown's double exponential smoothing method, prices could be faithfully projected in the short-run.

I prepared a model for stabling space calculations suitable to determine the rate of sow reduction necessary to configure stabling spaces answering EU regulations. I concluded that, as regards animal-protection regulations, the phase of piglet post-raising constitutes a bottleneck. I suggested carrying out a reduction of sows with an average of 16,5%, that would cause an average increase of 3,5% in the index of total costs/1kg live-weight.

I investigated the effect of transportation circumstances on slaughter-pig quality. I declared transport distances to be key factors for determining the rate of perished and injured animals. I found that small-scale farm pigs are almost twice as exposed to physical injuries as those from large-scale farms, but large-scale farm pigs seem to be somewhat more susceptible to stress. When analysing linear correlation, I pointed out a close correlation between transportation distances and the types of injuries for both truck transports from large-scale farms and IFA transports from small-scale farms. When analysing the connection between consignments from large-scale farms and the sum of all injuries with linear regression, I concluded the distance of transportation to determine the number of injured animals by 88%.

I modelled the move of slaughterhouse incomes, costs and profits conditioned by increasing input meat quality. As a result, improved input meat quality turned out to have a positive effect on profits. Provided the quality of large-scale pigs reached the average net-meat index of the EU (58%), a substantial (50%) increase in slaughterhouse profits emerged. Therefore, I advised slaughter-pig net-meat index to catch up with or exceed EU average.

THE USE OF RESULTS IN PRACTICE

As for the use of result findings in practice, when meeting the managers of regional pig farms, I was often asked to share the results of my research and was also suggested to introduce my models into actual decision-making processes.

I believe my results are useful in different fields of production, such as:

- I expect my findings to reduce uncertainty in decision-making processes, where managers may incorporate different methods of prognosis making to presume the size and course of short-term price fluctuations.
- With the help of the model designed to determine the size of optimum stabling-space, stock numbers in an actual farm can be modified in such a way, that stabling-spaces, meeting all animal protection requirements throughout the complete production process can be configured. Moreover, the economic effects of such alterations become computable.
- When investigating transportation circumstances from an animal protection point of view, I suggested a decrease in the numbers of physical injuries in consignments from small-scale farms to be executed by any means, while with large-scale farm consignments, stress factors need to be minimized. By monitoring the increases in transportation distances numerically, the calculation of the different losses caused by increasing transport distances might become an everyday practice for meat processing companies.
- I suggested slaughterhouses to get involved in making partners produce input meat of increased quality, as prepared models have clearly disclosed an existing positive connection between input meat quality and the profitability of production.

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