Influence of the production change on the return to scale

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Abstract: The paper deals with an assessment of cost efficiency of farms in 2006–2009 based on a sample of farms classified according to the cost/revenue ratio. The analysis of the sample of 101 farms revealed that the return to scale effect is not significant compared to other effects so that the real increase of the production volume may not determine the dynamic of the profit. The massive shift of farms with increasing cost efficiency to the category of the decreased cost efficiency reflects a significant influence of external conditions to the profit/loss of farms. A positive development of prices in 2007 has influenced an increased cost efficiency of the majority of sample farms. In 2008, the increased prices of agricultural inputs intensively influenced the development of the revenue function. The increase of variable costs influenced by increased input prices has wasted reserves resulted from the production use of fixed costs and the return to scale and caused a significant decrease of profit.

Key words: return to scale, costs, profitability, loss, profit, production

Literature related to agriculture offers a number of papers assessing costs. A majority of such papers is based on the technical analysis and limited to an overall development of unit costs or the cost/revenue ratio. Some studies are based on the fundamental analysis dealing with the relations of each cost item and the production volume. The return to the scale model offers a possibility to assess the change in the profit volume related to the volume of production and each cost indicators.

MATERIAL AND METHODOLOGY

Střeleček et al. (2007, 2008) discusses the assessment of cost efficiency of farms in a regular evaluation of the profit/loss of farms according to their own investigation and classification of farms according to the external farming conditions. They conclude that the insufficient profitability of agriculture in less productive years causing a relative cost overrun is a permanent problem to deal with.

The ÚZEI (Institute of Agricultural Economics and Information) studies and methodologies deal with the analysis of the costs of agricultural commodities (Novák 1996, Poláčková et al. 2008, 2010). The differences of agricultural production regions and production intensity and efficiency are discussed.

The most important task of the production preparation is to reach such relation of incomes, production volume and costs to have a satisfactory profit. This process is called proportioning the production costs (Střeleček 2007a). Its aim is to set a minimum production volume necessary to pay the costs by incomes with a satisfactory profit and to assess the way how the incomes and costs and the profit/loss will change with the increasing production.

The intensification cost efficiency is measured both directly and indirectly. The direct intensification cost efficiency consists of the economy of their spending and it is related to the intensification cost and production volume dynamics. The indirect intensification cost efficiency consists of the mediated effects mainly caused by the changes of the production volume (Brigham and Gapenski 1996) such as the relative change of fixed costs due to a change of production volume and a change of the profit/loss due to the volume of production. The assessment of the efficiency of the production volume change related to the management efficiency must be based on a perfect benchmarking performed by the comparison of results with the most successful enterprises and by the method of the optimal construction based on the empirical conclusion or mathematical models of the production economy. The assessment of the management efficiency based on mathematical model

is known as the technical efficiency defined as the ratio of real output to potential product with the appropriate inputs (Battese and Coelli 1988; Hadley 2006).

Alvarez and Arias (2004) analyse the relationship between technical efficiency and the size conditional on a set of control variables. These control variables are chosen using a production model where technical efficiency is introduced as a parameter. As a result, technical efficiency affects both the input demand and the output supply of a profit maximising producer.

A nonparametric analysis of technical, allocative, scale and scope efficiency of agricultural production is presented based on a sample of Wisconsin farmers. The results indicate the existence of important economies of scale on very small farms, and of some diseconomies of scale for the larger farms. Also, it is found that most farms exhibit substantial economies of scope, but that such economies tend to decline sharply with the size of the enterprises (Chavas and Aliber 1993).

Banker and Thrall (1992) examine the links between the returns to scale and the most productive scale size in the multiple-output-multiple-input production environments. Savastano and Scandizzo (2009) show that when the hypothesis of decreasing return to scale holds, the relation between the threshold value of the revenue per hectare and the amount of land cultivated is positive. Tao and Dai (2007) decompose index of labour productivity into technical efficiency, pure technical progress, scale efficiency of capital/labour and change of intensity for capital/labour. Wei and Yan (2004) analyze the problems of congestion of inputs, increasing, constant and decreasing return to scale by the output oriented DEA (Data Envelope Analysis) models. Fiorillo et al. (2000) analyse an economy where firms use labour as the only production factor, with a constant return to scale. Sharma et al. (1999) compare the parametric and nonparametric methods for measuring the technical, allocation and economic efficiency and to examine the potential for reducing costs through the improved efficiency. Al-Khoury and Abu Al-Dahab (2009) analyze the technical performance efficiency of Jordanian industrial companies using the DEA under the assumption of input minimization with the constant return to scale. Numbers of employees paid in capital and the total fixed assets were used as inputs and the market value per share; net sales and return on assets were used as outputs.

Managi and Karemera (2004) applied DEA methodology to a state-level data set of the US agriculture over 1960–1996 to measure the total factor productivity and other indexes as technological change and efficiency change. Both the constant return to scale and the variable return to scale technologies assumption in the DEA were employed. Hadley (2006) used English and Welsh farm-level survey data for the period 1982 to 2002 to estimate production functions for eight different farm types. The analysis showed that, farms of all types are relatively efficient with a large proportion of farms operating close to the production frontier. The factors that consistently appear to have a statistically significant effect on differences in efficiency between farms are farm or herd size, farm debt ratios, farmer age, levels of specialisation and ownership status.

The intensification and fixed costs are influenced by a number of factors. The exact defining is rather difficult (Schroll et al. 1997) so that the assessment is usually based on the evaluation of the most important cost items. The degrees of cost efficiency express quality differences in the development trends based on the relation of the production volume and costs. These trends influence the most important changes in the profitability rate, profit/loss and production volume dynamics (Střeleček 2007b).

According to the relation of the production volume and cost dynamics, nine basic degrees of efficiency may be described. The assessment of cost efficiency is influenced by the production volume dynamics. Therefore, we classify the efficiency degrees as:
– increasing volume of production
– constant volume of production
– decreasing volume of production

To assess the cost efficiency, the following indices were chosen:

Index of output $\qquad i_V = V_1/V_0$

Index of cost $\qquad i_{VN} = VN_1/VN_0$

Cost/revenues ratio $\quad n = VN/V$

Differential cost $\qquad dn = \dfrac{VN_1 - VN_0}{V_1 - V_0}$

Variable differential cost
$$dn(v) = \frac{VN(v)_1 - VN(v)_0}{V_1 - V_0}$$

Relative change in cost due to cost/revenues ratio
$$\Delta VN|n = (n_1 - n_0) \times V_1$$

Relative change in costs due to output
$$\Delta VN|V = n_0 \times (V_1 - V_0)$$

Relative change in profit due to output
$$\Delta Z|V = (1 - n_0) \times (V_1 - V_0)$$

Cost/revenues ratio of variable cost
$$n(v) = NV(v)/V$$

It is possible to adjust the assessment of the relation of the profit volume and the cost dynamics to the production function that gives the relation of input and output (Figure 1).

Replacing the output by the profit volume enables transforming the production function to the revenue function used to analyse the production costs. In addition, the relation among indicator of cost and profit may be added to each stage of this function in order to express the relative changes of the cost items and the profit/loss as a relative cost saving or the overrun relative increase or decrease of profit in each stage of the production function respectively.

Business & Management Dictionary (2007) defines the return to scale as "The proportionate increase in a country's or company's output as a result of increases in all its inputs". The return to scale in the production function expresses the change of the profit/loss due to a change of the unit cost items. The effect of the extensive change of production is a part of the total return to scale. This effect depends on the cost/revenue ratio in the basic period when $(1 - n_0) \neq 0$ and on the index of production when $i_V \neq 1$.

Under the above mentioned condition, the effect of the extensive change of production is expressed as $\Delta Z|V = (1 - n_0)(V_1 - V_0)$; $\Delta Z|V = (1 - n_0) V_0 (i_V - 1)$ respectively; in which $(1 - n_0) V_0$ stands for the profit/loss in the basic period.

This adjustment enables us to perform a simple calculation – the profit/loss of the basic period is multiplied by the relative change of production. The return to scale with the increasing production volume will bring the increase of the profit. The return to scale with the decreasing volume of production will bring a negative effect (a decrease of profit or an increase of the loss).

The return to scale is realized in the fifth stage of the revenue curve and its size is determined by the change of production and by the direction of $(1 - n_0)$ tangent. The full realization of the return to scale is empirically conditioned by $dn = n$. If $n < dn < c$, the poorer cost efficiency (variable cost usually) will decrease the return to scale according to the following relation:

$$\Delta Z|V - \Delta Z|n = (1 - n_0) \times (V_1 - V_0) - (n_1 - n_0) \times V_1$$
$$\text{for} \quad n_1 > n_0$$

$$\lim_{dn \to c} \Delta Z|V - \Delta Z|n = 0 \qquad \text{in case of } n_0 < dn$$

Production utilization of the fixed costs

Production utilization of the fixed costs is the second factor influencing the volume of production. The relative change of profit due to the production utilization of fixed costs may be expressed as $\Delta Z|V = -SN|V$. If the output converges to infinitude, the fixed costs
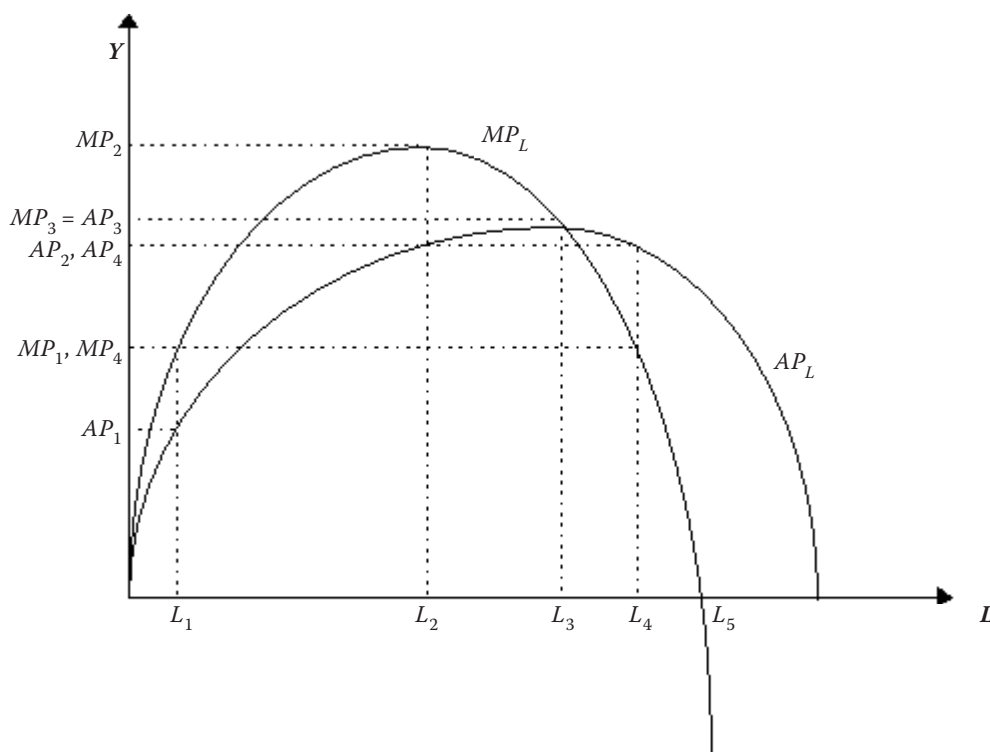

Figure 1. Development of profit in the relation to production

Source: Peterson (1991)

will converge to zero. The relative change of fixed costs is expressed as $\Delta SN | V = SN \times (1 - i_V)$.

An increase of production will cause a relative saving of the fixed costs. A decrease of production will cause an overrun of the fixed costs due to the lower production utilization of the fixed costs. Compared to less investment intensive technologies, the investment intensive technologies show greater relative changes of the fixed costs with the change of the production volume due to the change of production.

The increasing production utilization of fixed costs due to the expanded production is another source of profit in the revenue function. A relative change of costs due to the cost/revenue ratio of production consists of the relative change of the fixed costs due to their production utilization and of the relative change of the variable costs.

Variable cost efficiency

It is not possible to express an influence of the change of production volume on the variable costs efficiency explicitly; however, it depends on the relation between the variable differential costs and the variable cost/revenue ratio in the basic period. The extent of variable costs related to the shape of the revenue function determines the overall volume of profit. An analysis of a revenue function is based on the following condition:

Revenues increase $i_V > 1$; the production is profitable in the basic period; the total costs consist of variable and fixed costs $n(v)_0 < n_0 < 1$.

Regarding efficiency, eight stages of the revenue function are described.

The first stage is based on the following relations:

If $dn(v) < n(v)_0 < n_0 < 1$, the increasing production volume will increase the variable costs efficiency; the cost/revenue ratio will decrease and a relative saving of variable costs due to the production volume will occur. It is possible to show that regarding the efficiency of the increasing the volume of production, all possible effects of revenue yield curve are performed. The efficiency of variable costs grows. The production utilization of fixed cost increases and the return to scale of production is performed.

The second stage of the revenue curve is characterised by the maximal efficiency of variable costs $dn(v) = \min. \ n(v)_0 < n_0 < 1 \ \Delta VN/n(v) = \max., \ \Delta Z = \Delta Z/V - \Delta VN/n(v) - \Delta SN/Q$. The total profit increase consists of the return to scale of production, the relative saving of variable costs and a greater production utilization of the fixed costs.

The third stage of the revenue curve is characterised by the constant variable costs efficiency $n(v)_0 = dn(v) < n_0 < 1$. The return to scale is performed as well as the whole relative saving of production utilization of the fixed costs.

The fourth stage of the revenue function is described by the decreasing variable cost efficiency $n(v)_0 < dn(v) < n_0 < 1$. Full return to scale of production is performed as well as a partial effect of the production utilization of the fixed costs. The remaining part of the production utilization of the fixed cost covers the decreasing efficiency of the variable costs. If $dn(v) \rightarrow n_0$ then in absolute terms

$$\lim_{dn(v) \rightarrow n_0} \Delta VN | n(v) = \Delta SN | V \ \wedge \ \lim \Delta Z = \Delta Z | V$$

The fifth stage of the revenue function is described as $n(v)_0 = n_0 < 1, \ n_1 = n_0$. In this stage, the cost/revenue ratio of production remains constant and the production volume effect is performed.

Sixth stage of the revenue function is described as $n(v)_0 < n_0 < dn(v) < 1$. The cost/revenue ratio of production increases. Only a part of the return to scale of production is performed with the increasing volume of production. The remaining parts compensate the decreasing variable costs efficiency.

$$\lim_{n(v)_0 \rightarrow 1} \Delta Z | n(v) = \Delta SN | V + \Delta Z | V \ \wedge \ \lim Z = 0$$

Seventh stage of the yield curve is described as $n(v)_0 < n_0 < dn(v) = 1$. In this stage of the revenue curve, the profit is constant with increasing production volume remaining at a level of profit of the previous period.

Eight stage is described as $n(v)_0 < n_0 < 1 < dn(v)$.

The profit decreases due to the decreasing efficiency of the variable costs.

Other possibilities of the development of production, profitability and other relation are discussed in Střeleček and Zdeněk (2008).

RESULTS AND DISCUSSION

Economic development of agriculture 2006–2008

In 2006, the production of agricultural sector expressed in the current basic prices amounted to 101 254 million CZK; 48.3% of which was plant production with the most important share of cereals (37.7%) and industrial crop (27.0%). Animal production reached to 46.4% of agricultural production in the current basic prices with the most important share of milk production (42.9%) and production of pigs for fattening (25.1%).

Agriculture producer prices increased by 2.2% in 2006 compared to the previous year. Prices of plant products increased by 13.3%, however animal products decreased by 2.9% in a year-to-year comparison.

The index of inputs to agriculture increased by 1.6% compared to the previous year; prices of products and services currently consumed in agriculture increased by 1.7% and the prices of products and services related to agricultural investment increased by 1.1%.

In 2007, the production of agricultural sector significantly increased compared to 2006 (the 2007/2006 index = 118.8%); with the index of plant production of 134.0% and the index of animal production of 103.4%. The sharp increase of plant production was a result both of the overall greater harvests of cereals, potatoes and rape and of a significant increase of agricultural product prices.

The development of agriculture producer prices registered a significant increase by 16.8% in 2007 compared to the previous year. Prices of plant products have increased by 32.8% in a year-to-year comparison. Prices of animal products have increased as well, however, by 1.7% only. The significant increase in the year-to-year comparison was caused by a lower harvest in some traditional growing areas and the related increase of demand. In 2007, prices of inputs to agriculture increased by 5.9%. Generally, it is possible to conclude that an average year-to-year increase of agriculture input prices differed from an average increase of agriculture producer prices. That means that the price scissors has began to close significantly in 2007, however, an average year-to-year increase of agriculture inputs has intensified its rate of increase and another increase was predicted in 2008, mainly in the case of products and services currently consumed in agriculture. The 2007 has to be seen as uncommon due to an increase of agriculture producer prices mainly (ČSÚ 2008).

Regarding the output of agriculture, agricultural production has slightly decreased in 2008 (by 2.4%) compared to 2007; plant production decreased by 8.1%, on the other hand, animal production increased by 4.5% in the year-to-year comparison.

Agriculture producer prices were increased by 8.8% in 2008 compared to 2007; when the prices of plant products increased by 11.8% and those of the animal products increased by 5.2%. The positive overall development of agriculture producer prices in 2008 was a result of the different development during the year. The positive development of 2007 continued in the first half of 2008; however, the second half of 2008 registered a significant decrease – especially in the fourth quarter.

In 2008, the prices of inputs to agriculture significantly increased – due to an increase of the prices of fertilizers and soil improvers (increased by 38.3%). The prices of seeds and planting stock increased in 2008 as well (by 16%). In the year-to-year comparison, the prices of feeds increased by 18.4%. Similarly, the prices of energy and lubricants increased by 10.3% – of which the motor fuel registered the most significant increase (by 10.5%) (ČSÚ 2009).

In the 2009 summary, agriculture producer prices were lowered by 24.8%, which is the biggest year-to-year decrease within the period under investigation. The prices of plant products were decreased by 32.2%; the prices of animal products decreased by 15.2% in 2009.

The production of the agricultural sector in the current basic prices reached 97 380.5 million CZK as a preliminary result for 2009 with 52.2% share of plant production. Both plant and animal production significantly decreased compared to 2008. This situation was caused mainly by a huge decrease of the prices of cereals, industrial crop, milk, and the decrease of pig production.

In 2008, the situation may be assessed as favourable as the production volume in the current prices was increased and the rate of increase of the producer prices was faster compared to the input prices. In 2009, the price scissors between the producer and input prices have further widened (ČSÚ 2010).

In 2009, the production significantly decreased in connection to the unfavourable development of prices. This trend influenced the results of farms in the sample.

To assess the cost efficiency, the database of the sample of farms was used. The data collection included the copies of financial statements – the Balance Sheet as at 31.12 and the Profit/Loss Statement as at 31.12. Within this paper, 101 farms were investigated and the data of the same farm in each year were used. The cost analysis and the analysis of the revenue curve were performed for 2007 and 2008. Economic results of farms in the third to five stage of the revenue curve

There were two strong tendencies in the development of profit during the investigated period:
(1) Increasing profit in 2007 compared to 2006 in the groups of each size.
(2) Significant decrease of profit in 2008 compared to 2007 in groups of each size (Table 1).

This development of profit is related to the cost efficiency and the dynamics of production volume, as Table 2 revealed.

In 2007–2009, two important changes in the economy of farms occurred:

Table 1. Development of profit of farms classified according to production in 2007

	Production in 2007 (thousand CZK)				
	up to 50 000	50 000–100 000	100 000–200 000	above 200 000	total
Number of farms	33	42	18	8	101
Profit 2006 (thousand CZK)	1 520	1 708	2 030	12 404	2 551
Profit 2007 (thousand CZK)	2 831	6 412	9 564	28 082	7 520
Profit 2008 (thousand CZK)	1 415	3 649	6 204	23 717	4 964
Change of profit (2007–2006)	1 311	4 704	7 534	15 678	4 969
Change of profit (2008–2007)	−1 416	−2 763	−3 359	−4 365	−2 556

Source: Own investigation of a sample of farms

(1) The number of farms did not change regarding the development of the production volume. In both years, 86 farms registered an increasing production volume. The number of farms with the decreasing production volume was significantly lower. A decrease was registered by 15 farms only. This situation was a result of certain persistence; however, the development of prices influenced it as well.

(2) The number of farms with different cost efficiency has significantly changed. In 2007, 86 farms registered the increased cost efficiency in the year-to-year comparison. In 2008, 89 farms registered the decreased cost efficiency in the year-to-year comparison. The massive shift of farms from the increased to decreased cost efficiency is a reflection of a significant influence of external condition to economic results of farms.

The groups of farm may be classified according to the revenue curve stages to assess the cost efficiency. The return to scale may be evaluated in relation to this classification.

The price changes in 2007 have created favourable conditions for the farms with the increased production volume. 74 farms registered an increasing production volume in both years and created favourable conditions for the return to scale. In 2007, an increased

Table 2. Relation of cost efficiency and production volume

Production volume	Cost efficiency	2007	2008
Increases	increases	78	7
	decreases	8	79
Decreases	increases	8	5
	decreases	7	10
Total		101	101

Source: Own investigation of a sample of farms

production volume, low differential costs (approximately half of a cost/revenue ratio of 2006) and the profitable production of the basic period of all size groups resulted into the realization of all three effects, i.e. the return to scale, the increment of profit due to cost/revenue ratio and the increment of profit due to a greater production utilization of fixed costs.

Assessing the share of each part, the relative change of profit due to cost/revenue ratio represented more than 95% of the total change of profit. Regarding this fact, the return to scale is almost unimportant. The extremely favourable output price dynamics and production prices were the most important factors influencing high cost efficiency. The balanced average cost/revenue ratio in all size groups is also a reflection of the above mentioned situation.

The multiple increase of profit in 2007 compared to 2006 makes searching for some causes of inefficiency unethical. 2008 brought a further increase of production and the production output prices.

The massive increase of differential costs (with values of more than one) completely draws off the effect of the production use of fixed cost as well as the return to scale and it decreases the profit volume as well.

The significant decrease of profit is very slightly moderated by the return to scale which is based on the slow rate of the production increase of 1–6%. Increasing the cost efficiency by 10% together with the constant cost/revenue ratio would mean increasing the production volume in each size group by the following values in 2008 compared to 2007:

By 7.85% within the farms with production of less than 50 million CZK; by 6.39% within the farms with production less than 100 million CZK; by 3.05% within the farms with production up to 200 million CZK and by 1.15% within the farms with production of more than 200 million CZK.

Regarding the relative increment, the above mentioned substitution of the return to scale and the change of costs due to the cost/revenue ratio are

Table 3. Return to scale with the increased volume of production and working cost efficiency in 2007 and the decreased working cost efficiency in 2008

Production in 2007 (thousand CZK)	Up to 50 000	50 000–100 000	100 000–200 000	Above 200 000	Total
Number of farms	23	30	14	7	74
Average production 2006 (thousand CZK)	27 891	61 937	128 265	270 213	83 605
Index of outputs (2007/2006)	1.167	1.143	1.142	1.146	1.146
Index of outputs (2008/2007)	1.010	1.037	1.034	1.061	1.041
Average cost/revenue ratio (2006)	0.979	0.974	0.982	0.966	0.974
Average cost/revenue ratio (2007)	0.910	0.902	0.923	0.913	0.912
Average cost/revenue ratio (2008)	0.980	0.962	0.946	0.922	0.947
Differential cost (2007)	0.494	0.395	0.507	0.549	0.485
Relative change in cost due to cost/revenue ratio (2007)	−2 261	−5 116	−8 675	−16 400	−5 969
Change of profit (2007)	2 358	5 344	9 003	17 747	6 281
Return to scale (2007)	97	228	327	1 346	312
Differential cost (2008)	7.959	2.602	1.612	1.078	1.803
Relative change in cost due to cost/revenue ratio (2008)	2 302	4 438	3 443	3 101	3 460
Change of profit (2008)	−2 273	−4 182	−3 058	−1 460	−3 118
Return to scale (2008)	29	256	385	1 641	341

Source: Own investigation of a sample of farms

almost impossible. A decrease of differential cost a decisive factor for these farms (Table 3).

This degree of cost efficiency is typically connected with the output index lower than the index of costs. This indication is followed by the differential cost greater than the cost/revenue ratio in the basic period together with the cost/revenue ratio of production increasing with an increase of the yields.

Table 4. Return to scale with the increasing production volume and the decreasing cost efficiency in 2007 and 2008

Production in 2007 (thousand CZK)	Up to 50 000	50 000–100 000	100 000–200 000	Above 200 000	Total
Number of farms	5	4	2	1	12
Average production 2006 (thousand CZK)	35 186	56 902	95 124	258 942	71 061
Index of outputs (2007/2006)	1.067	1.429	1.094	1.067	1.170
Index of outputs (2008/2007)	1.047	1.091	1.019	1.032	1.051
Average cost/revenue ratio (2006)	0.869	0.920	0.960	0.867	0.902
Average cost/revenue ratio (2007)	0.910	0.909	0.964	0.871	0.910
Average cost/revenue ratio (2008)	0.932	0.888	1.000	0.961	0.939
Differential cost (2007)	1.515	0.884	1.010	0.931	0.956
Relative change in cost due to cost/revenue ratio (2007)	1 520	− 882	441	1 108	651
Change of profit (2007)	−1 212	2 837	−86	1 196	526
Return to scale (2007)	307	1 954	354	2 304	1 177
Differential cost (2008)	1.414	0.651	2.879	3.786	1.497
Relative change in cost due to cost/revenue ratio (2008)	886	−1 913	3 783	25 847	2 502
Change of profit (2008)	−727	2 585	−3 713	−24 700	−2 119
Return to scale (2008)	159	672	70	1 147	383

Source: Own investigation of a sample of farms

Table 5. Increasing cost efficiency with the decreasing production volume in 2007

Production in 2007 (thousand CZK)	Up to 50 000	50 000– 100 000	100 000– 200 000	Above 200 000	Total
Number of farms	1	6	1	0	8
Average production 2006 (thousand CZK)	19 597	75 987	117 106	–	74 078
Index of outputs (2007/2006)	0.714	0.940	0.999	–	0.944
Index of outputs (2008/2007)	1.056	1.078	1.164	–	1.095
Average cost/revenue ratio (2006)	0.914	0.997	1.067	–	1.008
Average cost/revenue ratio (2007)	0.810	0.927	0.981	–	0.935
Average cost/revenue ratio (2008)	0.950	0.944	1.048	–	0.967
Differential cost (2007)	1.176	2.092	62.376	–	2.237
Relative change in cost due to cost/revenue ratio (2007)	−1 463	−4 995	−10 116	–	−5 091
Change of profit (2007)	983	4 983	10 127	–	5 126
Return to scale (2007)	−480	−13	11	–	34
Differential cost (2008)	3.433	1.159	1.455	–	1.299
Relative change in cost due to cost/revenue ratio (2008)	2 072	1 285	9 126	–	2 425
Change of profit (2008)	−1 922	−881	−8 752	–	−1 995
Return to scale (2008)	150	404	374	–	430

Source: Own investigation of a sample of farms

The profitability rate decreases with the increasing production volume within this cost efficiency degree (Table 4).

In 2007, two size groups registered the differential cost greater than 1; in 2008, even three of them. The differential cost above one is connected with a signifi-cant decrease of profit which was not even inhibited by the increasing production volume.

A close relation between the decreasing cost efficiency and the change of input prices in 2008 is suggested. The extreme differential costs of 3.786 are a clear sign that production capacity use and the

Table 6. Decreasing cost efficiency degree with decreasing production volume in 2007

Production in 2007 (thousand CZK)	Up to 50 000	50 000– 100 000	100 000– 200 000	Above 200 000	Total
Number of farms	4	2	1	0	7
Average production 2006 (thousand CZK)	34 485	85 397	128 898	–	62 519
Index of outputs (2007/2006)	0.954	0.946	0.949	–	0.949
Index of outputs (2008/2007)	1.113	1.069	1.277	–	1.144
Average cost/revenue ratio (2006)	0.912	0.974	0.964	–	0.952
Average cost/revenue ratio (2007)	0.953	0.998	0.965	–	0.974
Average cost/revenue ratio (2008)	0.882	0.973	0.982	–	0.948
Differential cost (2007)	0.077	0.570	0.942	–	0.539
Relative change in cost due to cost/revenue ratio (2007)	1 333	1 879	148	–	1 314
Change of profit (2007)	−1 473	−1 998	−385	–	−1 467
Return to scale (2007)	−140	−119	−237	–	−154
Differential cost (2008)	0.253	0.608	1.044	–	0.767
Relative change in cost due to cost/revenue ratio (2008)	−2 600	−2 168	2 658	–	−1 774
Change of profit (2008)	2 776	2 181	−1 484	–	1 997

Source: Own investigation of a sample of farms

return to scale are unable to cover decreasing efficiency of variable costs. This results into a decrease of profit in the majority of the size groups. Realization of this cost efficiency degree usually corresponds to the source draw off due to a decrease of costs or the uneconomical production process.

This cost efficiency degree (Table 5) is characterised by a decrease of outputs in all farms in 2007 and the increased outputs in 2008 compared to 2007. Differential costs were greater than one in both years. These costs are favourable in case of the decreased output of 2007, as they decrease the cost/revenue ratio of production, so that the profit volume increases. Differential costs of more than one are unfavourable in the case of the increasing production volume as they are followed by the increased cost/revenue ratio and this is connected with the decrease of profit in comparison with the previous year. A low return to scale was unable to significantly influence the change of the profit/loss in any year. In spite of the inertia of costs, the increased cost efficiency of 2007 was caused by a significant increase of the agricultural producer prices. In 2008, the cost efficiency decreased due to the inertia of costs and the unfavourable development of input prices in all farms that registered a decrease of production volume.

Table 6 assessed 7 farms with decreasing production volume that registered a decrease of the cost efficiency. In 2008, the increase of the output volume was proved to influence a change of cost/revenue ratio.

CONCLUSION

(1) It is possible to attribute an appropriate change of the variable costs, production utilization of the fixed cost and the return to scale and its influence on a relative change of costs as well as the profit to each stage of the revenue curve.
(2) Increasing production volume is connected with a relative cost saving due to the production utilization and the return to scale. A relative saving of fixed costs increases with a better technical equipment of labour. The return to scale is connected with profitability in the basic period.
(3) Each stage of the revenue function expresses the extent to which the above mentioned effects compensate the decreasing efficiency of fixed costs.
(4) The analysis of a sample of 101 farms revealed that the return to scale is not significant in comparison with other effects, so that the real increasing of the production volume does not have to be a determinant of the profit volume dynamics.

(5) Price changes that occurred in 2007 and 2008 significantly influenced each stage of the revenue curve as well as the profit/loss. In 2007, the positive development of prices in the majority of farms influenced the increasing cost efficiency. All three parts (increasing variable cost efficiency, production utilization of fixed cost and return to scale) have influenced the increment of profit. These changes have spontaneously impacted the differential costs and the efficiency within farms as well.
(6) In 2008, the increasing prices of inputs to agriculture intensively influenced the development of the revenue function. Due to this increase, the growth of variable costs has drawn off the reserves caused by the production utilization of the fixed costs as well as the return to scale; furthermore, it caused a significant decrease of profit. The spontaneity of such changes eliminates a possibility to prevent this unfavourable development of the economy of Czech agricultural holdings. The solution lies in an appropriate change of agricultural product prices. Only such change can compensate the unfavourable development.

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