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Analysis of the Effects of Subsidies on the Economic Behavior of Agricultural Businesses Focusing on Animal Production

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Anotace

Vstup do Evropské unie a přijetí Společné zemědělské politiky mělo zásadní dopad na ekonomické chování podniků živočišné výroby v České republice. Někteří autoři dochází dokonce k závěru, že útlum živočišné výroby je nejmarkantnějším projevem Společné zemědělské politiky. Předložený článek kvantifikuje dopad dotační politiky na produkci, náklady a technickou efektivnost zemědělských farem. Analyzuje ekonomické chování podniků čerpající dotace a podniků, jež dotace nečerpaly. V rámci výzkumu jsou analyzována mikroekonomická data 173 podniků živočišné výroby. Hlavním metodickým nástrojem je konstrukce produkčních a nákladových funkcí. Vliv dotační politiky na technickou efektivnost byl analyzován pomocí modelu hraniční produkční funkce.

Příspěvek řeší jeden z cílů výzkumného záměru MSMT 6046070906 „Ekonomika zdrojů českého zemědělství a jejich efektivní využívání v rámci multifunkčních zemědělskopotravinářských systémů“.

Klíčová slova

Živočišná výroba, dotace, produkce, náklady, technická efektivnost.

Abstract

Entry into the European Union and the acceptance of Common Agricultural Policy had a fundamental impact on the economic behavior of animal production businesses in the Czech Republic. Some authors have even reached the conclusion that the slump in animal production is the most prominent manifestation of Common Agricultural Policy. The submitted article quantifies the effect of subsidy policy on production, costs and technical efficiency of agricultural farms. It analyzes the economic behavior of businesses receiving subsidies and of businesses that did not receive subsidies. As part of the study, the microeconomic data of 173 animal production businesses are analyzed. The main methodological tool is the construction of production and cost functions. The effect of subsidy policy on technical efficiency was analyzed by way of the frontier production function model.

The article was elaborated under one goal of research intention MSMT 6046070906 “Economics of Resources of Czech Agriculture and Their Efficient Use within Multifunctional Agri-Food Systems”.

Key words

Animal production, subsidies, production, costs, technical efficiency.

Introduction

The goal of the majority of subsidies in the first pillar and partially also in the second pillar of Common Agricultural Policy (CAP) is to support the income situation within the agricultural sector. The impact of such subsidies on the income of the farmer or the profit of agricultural businesses is evident and many businesses would generate a loss without subsidies (Chrastinová and Buriánová, 2009). Not only do subsidies determine the income or profit of agricultural businesses, but they also affect the level of production, costs and technical efficiency in a significant manner. The analysis of these effects is an important topic in agricultural economics and is also significant for drawing up the tools of Common Agricultural Policy.

The main methodical tool in the analysis of the effects of subsidies on the production behavior of agricultural entities is either mathematical programming (e.g. Arfini et al., 2001) or econometric

modeling (Bezlepkina et al, 2004, Henningsen et al., 2011, Bokusheva et al., 2012). Bezlepkina et al. (2004) analyzes the impact of subsidies on farm profit and input-output allocations among Russian businesses engaging in the production of milk. She reaches the conclusion that although subsidies deform the level of costs and production in such businesses, they have a significant effect on increasing the business profit. Henningsen et al. (2011) analyzed, by utilizing econometric methods, the effect of subsidies that are associated with production and which are fully separated from production. The results prove that subsidies that are tied to production have an effect on the utilization of inputs and the level of production. However, in the case of subsidies fully separated from production, such effect was negligible. Similar conclusions are also reached by Bokusheva et al. (2012). Direct payments have a negative effect on the level of production of farms, and thus, direct payments fulfill the original goal of not stimulating farmers to greater production. However, the results show non-optimal utilization of production resources.

In terms of the effect on technical efficiency, subsidies can have a positive as well as a negative effect. If subsidies constitute an impulse for the implementation of innovations or transition to new technologies for a business, then an increase in technical efficiency occurs (Zhu et al., 2008). A decrease in technical efficiency usually occurs if the higher income from subsidies weakens the effort of agricultural businesses for better performance. There are many empirical studies dealing with the effect of subsidies on technical efficiency among businesses with diverse production focuses. Some studies only focus on the effect of direct payments on technical efficiency, while others also deal with involvement in various investment programs, for example. Conclusions of a negative correlation between technical efficiency and subsidies within CAP are predominantly consistent; for example, see Iraizoz et al. (2005), Bakucs et al. (2006), Hadley (2006), Kleinhanss et al. (2007), Lambarraa and Kallas, (2009). Zhu et al. (2008) analyzes the impact of subsidies within CAP on the competitiveness of farms engaging in the production of milk in Germany, the Netherlands and Sweden. Zhu et al. (2008) reaches the conclusion that subsidies that are tied to production have a negative impact on technical efficiency in Germany and the Netherlands. Subsidies that are separated from production also contribute to a reduction in technical efficiency, in all three states. Further, Zhu et al. (2008) states that an increase in the volume of subsidies that are separated from production has a much greater negative impact on technical efficiency than an increase in the share of subsidies tied to production in the total volume of paid subsidies. Latruffe et al. (2011) analyzes the correlation between the volume of agricultural subsidies and the effectiveness of agricultural businesses also focusing on the production of milk. He utilizes data from the accounting data network FADN for the period of 1990 – 2007 and for seven EU countries. The results show that businesses with a greater dependence on subsidies and on hired labor forces have a lower level of technical efficiency, in all analyzed countries. His conclusion is consistent with the predominant portion of the existing literature – subsidies within CAP reduce the technical efficiency of agricultural businesses.

The main aim of the article is the assessment of the effects of CAP subsidies on the economic behavior of animal production businesses in the Czech Republic. While a greater share of animal production is typical for highly developed economies, where there is the opportunity to create greater added value, its decline is occurring in the Czech Republic. Such decline then brings with it a decrease in self-sufficiency among the majority of animal commodities. Svobodová (2011) states that the development of agricultural production, primarily of animal production, is suppressed throughout the territory of the Czech Republic, and reaches the conclusion that the slump in animal production is the most prominent manifestation of CAP. She attributes the decrease in the volume of animal production to external conditions set by EU CAP as well as by the approach of national policy, which is not capable of regulating the situation.

This paper is connected to previous paper dealing with the impact of subsidies on plant production in the Czech Republic (Malá, Červená, Antoušková, 2011). However, issue itself of determining the effects of receiving subsidies on animal production in the Czech Republic is dealt with insufficiently in the literature.

Material and Methods

The goal of the submitted report is the assessment of the effect of subsidy policy on the production, costs and technical efficiency of agricultural businesses engaging in animal production. A partial goal of this article is to assess the economic behavior of businesses receiving and not receiving subsidies.

In order to achieve the said goal, the following working hypotheses are subjected to verification:

H1: Subsidies predicate an increase in agricultural production (Kroupová, Malý, 2010; Malá, Červená, Antoušková, 2011).

H2: Subsidies bring about the wasting of resources (Zemplinerová, 2006), which leads to an increase in the costs of agricultural producers focusing on animal production.

H3: Subsidies cause a decline in the technical efficiency of agricultural farms (Kroupová, Malý, 2010).

The verification of the hypotheses is based on the panel data of 173 agricultural businesses – legal entities, with predominating animal production, acquired from the database of the Creditinfo Company Monitor. In terms of time, the said data base represents the economic activity of the said agricultural businesses within the years 2004 – 2009, which enables a comparison with previously conducted research of the effect of subsidies on businesses with predominating plant production, see Malá, Červená, Antoušková (2011).

Data from accounting statements were further supplemented with the volume of acquired subsidies in the following segmentation:

- direct payments (representing the sum of SAPS and TOP-UP payments),
- other subsidies including agro-environmental subsidies (paid out on the basis of both Horizontal Rural Development Plan (HRDP), as well as Czech Rural Development Program for the years 2007 – 2013 (PRV)), support of less favorable areas including NATURA 2000 areas (on agricultural land), other subsidies from the HRDP and the PRV, support of common market organization including intervention storage.

Further, the number of employees was added, determined as the proportion of wage costs of individual entities and the average wage in agriculture, actualized according to the database of the Czech Statistical Office within the region where the analyzed business had its registered address. The area of agricultural land was determined on the basis of the volume of SAPS subsidy as the proportion of the total amount of the received subsidy and the annual rate.

The elaboration of the analysis of the effect of subsidy policy required the definition of the indicator of the total production of the analyzed businesses. The said indicator was set at the level of accounting production. The effect of price development was, in the case of production, eliminated through conversion to real value by way of agricultural producer price indexes, taking into consideration the production specialization, as published by the Czech Statistical Office. The year 2005 was selected as the basic period. Price development was also eliminated in the case of production consumption entering into the production function as an explanatory variable, through the utilization of input price indexes also published by the Czech Statistical Office.

The data, acquired in the manner as stated above, were further adjusted to account for incomplete and remote observations, detected by way of graphic analysis. The resulting set of data utilized for the analysis contained 703 observations of 173 agricultural businesses with predominating agricultural production.

In order to verify hypothesis H1, a production function model was constructed, expressing the correlation between the amount of inputs into the production process of the analyzed entities and the amount of output, taking into consideration the effect of subsidies. The said correlation was modeled in the form of a Cobb-Douglas function:

$$y_{kt} = \alpha WU_{kt}^{\beta_{WU}} K_{kt}^{\beta_K} VS_{kt}^{\beta_{VS}} PP_{kt}^{\beta_{PP}} OD_{kt}^{\beta_{OD}} e^{e_{kt}}, \quad (1)$$

where:

y_{kt}…….volume of production of the *k-th* farm in time *t*,

WU_{kt}…amount of the factor of production of labor utilized by the *k-th* entity in time *t*,

K_{kt}…….amount of the factor of production of capital, corresponding to entity *k* in time *t*,

VS_{kt}…..performance consumption within the *k-th* entity in time *t*,

PP_{kt}…..value of direct payments, acquired by the *k-th* entity in time *t,*

OD_{kt}…value of other subsidies, acquired by the *k-th* entity in time *t*,

α…….constant,

$\beta_{WU,K,SV,PP,OD}$…parameters of the production function,

e_{kt}……..random variable of the model with assumed normal distribution $e_{kt} \sim N(0,\sigma^2)$,

$k = 1,2,....K,\ t = 1,2,...T.$

The output, quantified by way of the said function, was represented by production in constant prices from the year 2005 in thousands of CZK. The explanatory variables represented the basic factors of production and subsidies:

- Labor (WU), represented by the average number of workers;
- Capital (K), expressed in the form of the sum of the tangible and intangible long-term assets in thousands of CZK;
- Material, energy and services (VS), defined as performance consumption in constant prices from the year 2005 in thousands of CZK;
- Direct payments (PP), representing the sum of SAPS and TOP-UP payments in thousands of CZK;
- Other subsidies (OD), containing other subsidies provided from EAFRD and EZZF, expressed in thousands of CZK.

Alternatively, a production function with a dummy variable was quantified, representing the receiving of subsidies by the farm within the given year. The said specification change thus meant the elimination of variables PP and OD from the production function set out in formula 1 and the inclusion of zero-one variable D. The cost function was also derived from the above model, taking into consideration the effect of subsidies on the costs of agricultural businesses with predominating animal production. The reason for the construction of the cost function was the assumption regarding the positive effect of the amount of subsidies on the volume of costs of the analyzed farms, as subsidies provide agricultural producers with additional income, which implies a lesser rationality in the behavior of agricultural producers and the wasting of resources (see, for example, Zemplinerová, 2006). The cost function was derived by way of the Lagrange method dealing with the dependent minimization of the cost function under the assumption of a specific production technology given by the production function:

$$\begin{aligned} C(w,y) &= \min_{VS,WU} w_{VS}VS + w_{WU}WU, \\ s.t. y &= (\alpha + \beta_D D)\phi VS^{\beta_{VS}} WU^{\beta_{WU}}, \end{aligned} \tag{2}$$

where:

WVS…price of the factor of production of performance consumption,

WWU…price of the factor of production of labor,

D……dummy variable representing subsidies,

φ…….....constant effect of capital.

In order to verify hypothesis H3 regarding the effect of subsidies on the technical efficiency of agricultural producers, the recursive model of the stochastic frontier function and the function of the rate of technical inefficiency was modeled (for more, see Madau, 2007):

$$\begin{aligned} y_{kt} &= \alpha VS_{kt}^{\beta_{VS}} WU_{kt}^{\beta_{WU}} K_{kt}^{\beta_K} e^{e_{kt}-u_{kt}} \\ u_{kt} &= \delta_{PP} PP_{kt} + \delta_O ODH_{kt} + w_{kt}, \end{aligned} \tag{3}$$

where:

DPP_{kt}…volume of acquired direct payments by the *k-th* entity in time *t*,

OD_{kt}…..volume of other acquired subsidies by the *k-th* entity in time *t*,

δ_0…….....constant,

$\delta_{O,PP}$…..parameters of the function of inefficiency,

u_{kt}……..rate of technical inefficiency with semi-normal distribution $u_{kt} \sim iidN(0,\sigma_u^2)$,

e_{kt}……..random variable of the model with assumed normal distribution $e_{kt} \sim N(0,\sigma^2)$,

w_{kt}.....random variable of the model of the rate of technical inefficiency, $w_{kt} \sim N(0,\sigma_w^2)$,

$k = 1, 2, ...K,\ t = 1, 2, ...T.$

The utilization of panel data in order to estimate the above models required an analysis of the heterogeneity of the utilized variables to be conducted. The presence of heterogeneity, verified by way of an analysis of the variance of the values of the explained variables of the estimated models (see Jackson, 2009), defined the need to utilize a special construction of the model in the form of a fixed effects model (FE) and a random effects model (RE), for more see Hsiao (2003). The estimate of the parameters of the said models was conducted by way of the generalized least squares method. The quality of the acquired estimates was verified by way of standard statistical methods. The statistical significance of the estimated parameters was tested by way of the t test. The concordance of the estimated model with the empirical data was quantified with the coefficient of multiple

determination, also including in an adjusted form, and verified by way of the F-test.

The statistical significance of the parameters of the explanatory variables in the function of technical inefficiency was tested by way of the LR test with a zero hypothesis presuming a zero effect of the explained variable on the level of technical inefficiency and its changes, i.e. H_0: $\delta_j = 0$ for j = 1,2,…J. The acceptance of the said hypothesis meant that the chosen variables do not explain technical inefficiency.

The correctness of the specification of the model was tested by way of two methods:

- the construction of the model, taking into consideration farm specifics, i.e. FE or RE model as opposed to a model with an identical constant, was tested by way of the Baltagi-Li Lagrange Multiplier test (Green, 2008);
- the inclusion of farm specifics into the random variable, i.e. RE as opposed to FE, was tested by way of the Hausman test (Wooldridge, 2003).

The fulfillment of the general assumptions regarding the attributes of the random variable was further tested by way of the Baltagi-Li Joint Lagrange Multiplier test of homoskedasticity and serial correlation of the random variable (for more, see Baltagi et al., 2008), by way of the Breusch-Pagan test of homoskedasticity of the random variable, and by way of the Wooldridge test of autocorrelation (see Wooldridge, 2003). The established heteroskedasticity or autocorrelation of residues was subsequently eliminated by way of transformation of variables of the unbalanced panel (for more, see Green, 2007). Estimates of the parameters and the relevant tests were conducted through the NLogit econometric program, version 4.0.

Results and Discussion

Table No. 1 characterizes the selected set of businesses on the basis of the selected indicators for the period of 2004 – 2009 including the average values and the rate of growth. This overall set of businesses was further divided up according to the fact of whether the business did or did not receive subsidies, and subsequently, a characterization was also conducted for these two groups of businesses (Table No. 2 and No. 3).

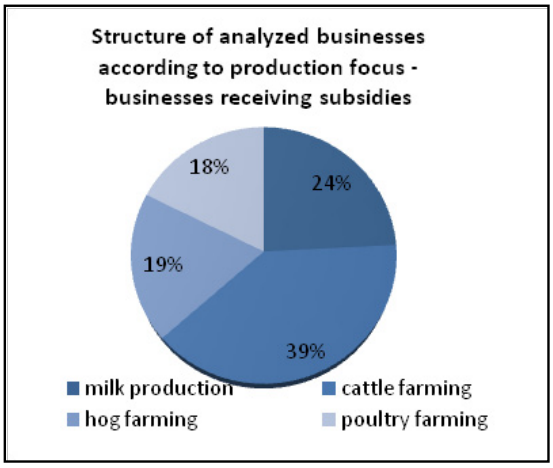
Graphs No. 1 and No. 2 document the average representation of businesses within the analyzed period according to the production focus in view of receiving or not receiving subsidies. Therefore, it is evident that businesses receiving subsidies have a 63% representation of businesses engaging in the production of milk and raising cattle. On the other hand, businesses in the group not receiving subsidies have a 91% constitution of businesses focusing on hog and poultry farming.

In terms of the development of the number of

Indicator	2004	2005	2006	2007	2008	2009	Growth rate	Average
Number of workers	42.2	38.2	33.4	39.1	38.1	34.8	-17.6	37.7
Land area	0.0	542.9	405.8	462.0	532.1	541.6	-0.3	414.1
Liabilities	99857.5	97451.6	76680.4	77398.6	83188.7	68348.6	-31.6	83820.9
Equity capital	58903.2	62159.1	44853.3	42440.4	44800.5	37000.5	-37.2	48359.5
Production	71173.3	57748.3	57647.9	63349.7	67701.5	39715.5	-44.2	59556.0
Added value	18597.1	18067.3	15358.3	14150.3	12106.0	12946.1	-30.4	15204.2
Operating ER	2754.9	3102.2	3054.1	891.8	-563.4	1506.0	-45.3	1790.9
Total ER	1678.6	2017.8	1659.7	-327.4	-1655.8	446.6	-73.4	636.6
Direct payments	0.0	1009.8	1706.4	2222.4	2719.7	3557.3	252.3	1869.3
AEO	0.0	1325.9	1202.3	1319.4	1619.6	1848.7	39.4	1219.3
LFA	462.4	937.6	1233.8	1282.6	1389.5	1351.6	192.3	1109.6
PRV	0.0	0.0	0.0	0.0	177.0	636.5	x	135.6
SOT	323.8	94.9	43.4	220.6	17.7	0.0	x	116.7

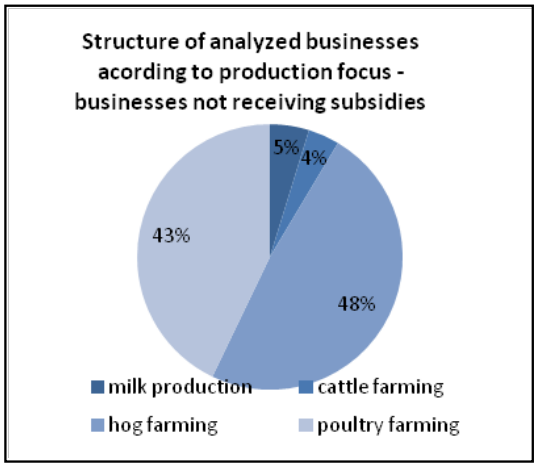
Note: Rate of growth is for the period of 09/04 and by land area, direct payments and AEO 09/05
Data other than the number of workers and land area are set out in thousands of CZK
ER = economic result
Source: Own processing

Table No. 1: Characterization of the set of agricultural businesses for the period of 2004 - 2009.



Source: Own processing

Graph No. 1: Structure of businesses receiving subsidies.



Source: Own processing

Graph No. 2: Structure of businesses not receiving subsidies.

Indicator	2004	2005	2006	2007	2008	2009	Growth rate	Average
Number of workers	30.9	39.4	31.0	42.5	40.8	41.1	33.2	37.6
Land area	0.0	542.9	405.8	462.0	532.1	541.6	-0.3	414.1
Liabilities	80367.6	74894.0	73533.5	77885.6	86493.8	77933.2	-3.0	78517.9
Equity capital	45518.0	48112.3	44129.5	45065.1	49305.8	39713.7	-12.8	45307.4
Production	49465.8	55012.7	45504.9	56615.9	58056.3	35572.6	-28.1	50038.0
Added value	14469.1	15945.0	13129.9	16025.0	13820.5	15748.9	8.8	14856.4
Operating ER	3228.0	4928.7	4175.5	3975.2	4361.9	4941.0	53.1	4268.4
Total ER	2485.2	3897.8	2937.8	2788.8	2840.6	2648.4	6.6	2933.1
Direct payments	0.0	1009.8	1706.4	2222.4	2719.7	3557.3	252.3	1869.3
AEO	0.0	1325.9	1202.3	1319.4	1619.6	1848.7	39.4	1219.3
LFA	462.4	937.6	1233.8	1282.6	1389.5	1351.6	192.3	1109.6
PRV	0.0	0.0	0.0	0.0	177.0	636.5	x	135.6

Note: Rate of growth is for the period of 09/04 and by land area, direct payments and AEO 09/05
Data other than the number of workers and land area are set out in thousands of CZK
ER = economic result

Source: Own processing

Table No. 2: Characterization of the set of agricultural businesses receiving subsidies.

workers, it is evident that among the analyzed animal production businesses, there was a decline of 17.6% in the years 2004 - 2009 (see Table No. 1). Such decline was primarily brought about by a sharp decline in the number of workers among businesses that did not receive subsidies within the analyzed period (Table No. 3), i.e. businesses engaging in hog and poultry farming, by 53.7%.

The land area of the agricultural business decreased among all of the analyzed businesses, by 0.3%. The land area among businesses not receiving subsidies could not be determined, as it was derived from the volume of SAPS payments.

The value of liabilities among the entire set of businesses decreased by 31.6% and once again, such decrease was caused primarily by the decrease in the amount of liabilities among businesses not receiving subsidies. However, businesses not receiving subsidies, i.e. primarily businesses with a production focus on hog and poultry farming, can be characterized as having a higher level of liabilities per business. The equity capital decreased in both groups of businesses, whereby among the group of businesses not receiving subsidies, such decrease was significant. The decline in equity capital is primarily caused by an accumulation of losses from previous years.

Indicator	2004	2005	2006	2007	2008	2009	Growth rate	Average
Number of workers	56.4	36.5	36.3	35.1	34.7	26.1	-53.7	37.5
Land area	x	x	x	x	x	x	x	x
Liabilities	124120.4	127946.2	80399.4	76818.5	79013.8	55112.6	-55.6	90568.5
Equity capital	74200.6	78547.0	45598.9	39507.0	39583.8	33253.7	-55.2	51781.8
Production	96424.8	60939.8	70710.9	70776.6	78531.1	45042.2	-53.3	70404.2
Added value	23146.2	20543.2	17485.5	12413.4	10301.2	9876.4	-57.3	15627.7
Operating ER	2252.9	1343.3	2102.6	-1692.8	-4970.3	-2256.1	-200.1	-536.7
Total ER	839.0	416.3	652.7	-2847.8	-5363.3	-2174.6	-359.2	-1412.9

Note: Data other than the number of workers and land area are set out in thousands of CZK
ER = economic result
Source: Own processing

Table No. 3: Characterization of the set of agricultural businesses not receiving subsidies.

The production of businesses within the analyzed period decreased overall by 44.2% and the added value decreased by 30.4%. The decline in production was seen in both groups of businesses. When looking at Tables No. 2 and No. 3, it is evident that businesses that do not receive subsidies achieve greater production and also generate greater added value when converted to a per business basis as compared to the first group of businesses. Even despite such fact, they achieve negative values of operating economic result as well as overall economic result. The group of businesses receiving subsidies ends, on average, with a positive economic result, which is undoubtedly the result of a significant increase in operating subsidies. Direct payments have created 48.1 % of total subsidies in 2009. Direct payments increased within the analyzed period by 252.3% and LFA subsidies by 192.3%. Among the group of businesses receiving subsidies, there was thus an increase in the overall economic result of 6.6%.

The impact of subsidy support in agriculture on the production of agricultural businesses primarily focusing on animal production was analyzed with the utilization of the production function model in Cobb-Douglas form. The results of the estimate of the said function by way of the generalized least squares method while taking into consideration group heteroskedasticity, verified by way of the Joint Baltagi-Li test (LMPLJ = 9513,1 with a p-value = 0.0000) as well as by way of the Breusch-Pagan test (LMBPG = 6990,4 with a p-value = 0.0000) are set out in the following Table No. 4.

Inter-farm heterogeneity was taken into consideration in the said model both by way of dummy variables, corresponding to the fixed effects model, as well as by way of the differentiation of the random variable, corresponding to the random effects model. The appropriateness of the said specification was declared with a probability of 99% by way of the Baltagi-Li Lagrange Multiplier test. On the basis of the results of the Hausman test (see Table No. 4), the construction of the model was then selected, including farm specifics in the random variable.

In economic terms, the parameters of the basic variables of the production function correspond to the economic assumptions. The increase of all analyzed factors of production implies an increase in production. The parameters of the said variables are also statistically significant, at a level of significance of 0.01. Out of the analyzed factors of production, the consumption of material, energy and external services shows the strongest effect, as a 1% increase in consumption of the said factor of production implies a 0.54% increase in production. The second most significant factor is labor with an elasticity of 0.26%. On the other hand, the production of businesses focusing on animal production is least affected by capital, a 1% increase of which brings about only a 0.09% increase in production. Both analyzed categories of subsidies show a negative effect on production. In the case of direct payments, a 1% increase in their receipt by an agricultural business decreases its production by 0.004%. However, in the said estimate, the parameter of direct payments is statistically insignificant. The said fact is associated with the low and indirect dependence of animal production on land. A stronger effect can be anticipated only in the case of a pastoral farming method, which is not, however, separately analyzed within the described model. The category of other subsidies also predicates a decline in production,

	Parameter	Estimate error	t-value	p-value
LWU	0.2549	0.0333	7.6434	0.0000
LHANM	0.0886	0.0239	3.6995	0.0002
LDVS	0.5478	0.0347	15.8079	0.0000
LPP	-0.0041	0.0037	-1.1201	0.2627
LODOT	-0.0168	0.0046	-3.6928	0.0002
ONE	2.5910	0.3233	8.0135	0.0000
Var [e]	0.0854			
Var [u]	0.3262			
AR1 (ρ_1)	-0.3330			0.0000
Baltagi-Li LM test versus OLS [1]	29.27			0.0000
Hausman [5]	0.13			0.9997
R2	0.4869			
F-hodnota$_{[5,379]}$	88.73			0.0000
kor.R^2	0.4858			

Source: Own calculation

Table No. 4: Results of the estimate of the production function in logarithmic expression with consideration of group heteroskedasticity.

with an elasticity of 0.02%. The parameter of other subsidies is statistically significant at a level of significance of 0.01, which enables the dismissal of hypothesis H_1.

The focus of the analyzed businesses on animal production is associated with a high representation of businesses that do not receive payments per area at all. For the said reason, the specification of the model was modified and an estimate working only with a dummy variable, expressing the receipt of any agricultural subsidy title within the given business within the analyzed year, was also conducted. The results of the estimate of the said model in the form of a random effects model and while taking into consideration heteroskedasticity ($LMBL_J$ = 31884,7 with a p-value = 0.000) are set out in Table No. 5.

As is evident, the described change in the specification significantly modified the estimate of all parameters. There was a strengthening in the effect of the consumption of material, energy and external services on the resulting production. The elasticity of the said variable increased to 0.94%, with the preservation of the statistical conclusiveness at a level of significance of 0.01. On the contrary, the elasticity of the factor of production of labor decreased to 0.09%, also with the preservation of the statistical conclusiveness at a level of significance of 0.01. On the other hand, the parameters of the variable of capital and intercept became statistically inconclusive. The parameter of the dummy variable is statistically significant in the described estimate at a level of significance of 0.01 and predicates a decline in the absolute element of the production function by 22% with the receipt of subsidy titles.

The said change also slightly increased the coefficient of determination, to 52.8%. The statistical significance of the coefficient of determination, verified by the F-test, remained established, at a level of significance of 0.01.

Further, a cost function with a dummy variable modifying its absolute element was derived from the above production function; see the following correlation:

$$C(w_{WU}, W_{VS}, y) = 2.042(1.582 - 0.282D)^{-0.969} w_{WU}^{0.087} w_{VS}^{0.913} y^{0.969}$$

The factor of production of capital, in view of the inconclusiveness of its parameter, entered the said cost function in a constant amount, corresponding to its average value within the analyzed selection set. The derived cost function thus describes the effect of production, the price of the factor of production of labor and the combined factor of material, energy and services on the costs of the business. Subsidies in the form of a dummy variable modify the intercept, as stated above. Cost functions can thus be more specifically divided up into the cost function of businesses that do not receive subsidies:

$$C(w_{WU}, W_{VS}, y) = 1.309 w_{WU}^{0.087} w_{VS}^{0.913} y^{0.969}$$

	Parameter	Estimate error	t-value	p-value
LWU	0.0898	0.0225	3.9891	0.0001
LHANM	0.0133	0.0146	0.9114	0.3621
LDVS	0.9421	0.0252	37.3317	0.0000
DUMMYDOT	-0.2445	0.0539	-4.5373	0.0000
ONE	0.3157	0.2313	1.3646	0.1724
Var [e]	0.1424			
Var [u]	0.2355			
AR1 (ρ_1)	-0.2561			0.0000
Baltagi-Li LM test versus OLS [1]	32.31			0.0000
Hausman [5]	0.47			0.9761
R^2	0.5282			
F-value$_{[5,379]}$	104.68			0.0000
kor.R^2	0.5272			

Source: Own calculation

Table No. 5: Results of the estimate of the production function in logarithmic expression while taking into consideration heteroskedasticity.

	Battese and Coelli with heterogeneity			
	Parameter	Estimate error (standard error)	t-value	p-value
ONE	3.0195	0.1468	20.5657	0.0000
LWU	0.1659	0.0191	8.6920	0.0000
LHANM	0.1097	0.0102	10.7993	0.0000
LDVS	0.6162	0.0126	49.0654	0.0000
λ	3.0296	0.0299	101.3170	0.0000
σu	0.9376	0.0705	13.3021	0.0000
PP	-0.0105	0.0125	-0.8392	0.4014
ODOT	0.0281	0.0057	4.9632	0.0000
Log-probability function	-269.7974			
AIC	0.7847			
σv2	0.0958			
σu2	0.8792			
σv	0.3095			
σ	0.9874			
Pseudo R^2	0.73			
H_0: γ_{PP} =0	4.63			0.0314
H_0: γ_{ODOT} =0	19.07			0.0000

Source: Own calculation

Table No. 6: Results of the estimate of the marginal production function.

And into the cost function of businesses that do receive subsidies:

$$C(w_{WU}, W_{VS}, y) = 1.404 w_{WU}^{0.087} w_{VS}^{0.913} y^{0.969}$$

From the comparison of the said functions, it is evident that businesses receiving subsidies have 7.3% higher costs on average than businesses that do not receive subsidies, with the same level of prices of the factors of production and the same production. Hypothesis H_2 can thus be considered verified.

The estimate of the production function with a fixation of capital at an average level and the derivation of the cost function also enables, with the inclusion of the price of production, the modeling of the profit functions of businesses with subsidies and businesses without subsidies; see the following correlations.

The profit function of a business without subsidies:

$$\pi = 1.582WU^{0.089}VS^{0.0942}P - 1.309w_{WU}^{0.087}w_{VS}^{0.913}y^{0.969}$$

The profit function of a business with subsidies:

$$\pi = 1.239WU^{0.089}VS^{0.0942}P - 1.404w_{WU}^{0.087}w_{VS}^{0.913}y^{0.969}$$

The above functions make it evident at first glance that, with a comparable level of all inputs, prices as well as production, the acquisition of subsidies causes a decline in the economic performance of the business.

It is appropriate to further expand the above results through the analysis of the effect of subsidy policy on technical efficiency. The said problem can be analyzed with the utilization of the marginal production function model, proposed by Battese and Coelli. The results of the estimate of the marginal production function with heterogeneity are set out in Table No. 6.

The given estimate, which achieves 73% congruence with available data and a statistical significance of all basic parameters of the stochastic frontier function according to the t-test at a level of significance of 0.01 and a statistical significance of the parameters of the function of technical inefficiency at a level of significance of 0.05 according to the LR test, shows a negative effect of direct payments on technical inefficiency, while other subsidies increase technical inefficiency. As has been mentioned, other subsidies are a decisive category within the set of agricultural businesses focusing on animal production, and thus the said conclusion deepens the negative effect of subsidies on the economic performance of agricultural animal production businesses as described above.

Agricultural animal production businesses receiving subsidies produce, on average, only 44.6% of the potential product, while businesses without subsidies achieve, on average, 60.4% of potential production. The greatest performance within the analyzed sample was quantified at a level of 97.6% of potential production and was achieved by a business without subsidies. Hypothesis H3 was thus also verified.

Conclusions

The volume of support for animal production is significantly determined by the focus of production and, as compared to plant production, is significantly lower, as there is a lower dependence of production on land in this case, with which the majority of direct payments are associated. Some production focuses even receive subsidies only indirectly through the consumption of their own feeds or only receive subsidies of an investment nature.

The economic situation of the analyzed animal production businesses differs significantly in view of their production focus, which subsequently affects the fact of whether the business receives subsidies or not. Among businesses that do not receive subsidies, i.e. among businesses with a production focus on hog and poultry farming, there was a significant decline in production as well as added value within the analyzed period. Nevertheless, on average, they generate higher production and greater added value than businesses that do receive subsidies. However, unlike those businesses, they have regularly been ending up since 2007 with a negative economic result. On the other hand, among businesses that do receive subsidies, there has been an increase in the economic result within the analyzed period, although business production has gone down.

On the basis of the results of the conducted analysis, it may be stated that the effect of subsidies on production among businesses that received direct payments was reflected in a negative manner. Businesses that received subsidies achieved 22% lower production than businesses not receiving subsidies. Direct payments do not motivate these agricultural businesses to greater production; therefore, they fulfill their original goal of not stimulating agricultural businesses toward greater intensity of production. However, the effect of direct payments on all of the monitored agricultural animal production businesses regardless of whether the given business did or did not receive them, cannot be considered statistically significant.

In terms of the effect of other subsidies, a negative effect on production was also established.

Upon comparing the cost functions of businesses receiving and not receiving subsidies, it may be stated that subsidies cause the wasting of resources, which is reflected in the increase of costs of agricultural producers focusing on animal

production. Businesses that received subsidies have costs 7.3% higher, on average, than businesses that did not receive subsidies.

On the basis of the conclusions arising from the production and cost functions of businesses receiving and not receiving subsidies, it may be stated that subsidies cause a decline in the economic performance of a business, as businesses that received subsidies had lower outputs and higher inputs as compared to businesses that did not receive subsidies.

Further, the effect of subsidy policy on technical efficiency was analyzed, whereby a decline in technical efficiency of agricultural farms as a result of the effect of the receipt of subsidies was shown. Businesses receiving subsidies achieved only 44.6% of the potential product as compared to businesses not receiving subsidies, which on average produced 60.4% of the potential product.

On the basis of the conducted analysis, it may be stated that agricultural businesses focusing on animal production would benefit from a limitation of subsidies with simultaneous measures that will lead to the greater protection of the domestic market, to the support of the creation of greater added value in the form of the processing their production, as well as to the support of the expansion of the sales opportunities of agricultural businesses with animal production.

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