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ANALYSIS OF THE IMPACT OF COMMON AGRICULTURAL POLICY ON PLANT PRODUCTION IN THE CZECH REPUBLIC

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Abstract

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Common agricultural policy has fundamentally projected itself into the business management of individual agricultural businesses. The submission addresses the assessment of the effects of subsidy policy on the production, costs and profit of agricultural businesses that engage predominantly in plant production. At the same time, it determines the effects of subsidy policy on demand for the production factors of labour and land. To the research questions more than 100 agriculture businesses were analyzed. The date from financial statements enabled to construct production function model, to quantify the cost function, the function of demand for land, the demand for the production factor of labour and finally the profit function was constructed. The results of research evidence the fact that direct payments have a negative effect on the production of agricultural businesses, but on the other hand they initiate demand for agricultural land and increase the profit of agricultural producers. The results also show direct payments do not motivate agriculture businesses towards increased production. The direct payments also increase the demand for production factor of land and they have also a significant effect on the value of profit.

common agricultural policy, subsidies, plant production, production factors

The accession of the Czech Republic to the EU and the acceptance of Common Agricultural Policy (CAP) has been fundamentally reflected in the economic development of the agricultural sector in the Czech Republic and in the business management of individual agricultural businesses.

In principle, CAP contains instruments, the aim of which, according to Blaas (2009), is to deal with the problem of the income of farmers, for one, as well as instruments that are to ensure the rectification of the failure of the market or output for the benefit of certain public goods. The goal sets out above overlap in a number of political instruments. The impact of CAP therefore needs to be evaluated within the context of at least one of the declared goals.

Doucha and Foltýn (2008) state that the economic situation of Czech agriculture and agricultural businesses after the accession to the EU significantly improved, primarily thanks to increasing aid for agricultural businesses. However, gross agricultural production measured in constant prices fell by 4.6% in 2009 as opposed to 2004.

Chrastinová and Buriánová (2009), who focus on the economic development of agriculture in Slovakia, state that after 2004 this sector is characterized by a better income situation, but the paradox is that with growing aid, production falls, the level of wages stagnates and employment falls. There is a similar situation in the Czech agricultural sector as well.

Štolbová and Hlavsa (2008) point out the increasing dependency of economic results on the volume of subsidies paid out. The results of the analysis by Špička, Boudný and Janotová (2009) evidence that operating subsidies have a direct effect on the level and stability of the revenue of farmers. The authors state that payments partially or fully separated from production function as a "financial cushion", as they help to lower the risk of income variability and ensure farmers a steady income. This

effect then appears more distinctly particularly in plant production, which is more exposed to the effects of the weather, which increases the volatility of prices. Also, income support is primarily tied to the size of the area of agricultural land.

This article quantifies the impact of subsidies provided within CAP on selected plant production businesses in the Czech Republic, in particular on their production, profit and costs. Such results are then confronted and discussed with the anticipated effects of such political instruments.

MATERIALS AND METHODS

The goal of the presented submission is the evaluation of the effects of subsidy policy on the production, costs and profit of agricultural businesses engaging primarily in plant production. A partial goal is also the determination of the effect of subsidy policy on demand for the production factors of labor and land. The research is focused primarily on the verification of the following working hypotheses:

H_1: Subsidies (particularly in the form of direct payments) implicate a fall in plant production (Kroupová, Malý, 2010).

H_2: Subsidies cause waste of resources (Zemplinerová, 2006), which leads to a rise in costs of agricultural producers focusing on plant production.

H_3: Subsidies tied to the size of the area of farmed land implicate a rise in demand for land (Kroupová, Malý, 2010).

H_4: Subsidies do not initiate a rise in employment in plant production (Chrastinová and Burianová, 2009).

H_5: Agricultural producers engaging in plant production are, as regards profit, highly dependent on subsidy support (Hrabalová and Zander, 2006).

The verification of the hypotheses stated above was based on panel data of 109 agricultural businesses – legal entities, with predominating plant production, obtained from the Creditinfo Company Monitor database. As regards the time aspect, the data base represented the business management of the said agricultural businesses in the years 2004–2009.

Data from financial statements was further supplemented with the volume of subsidies obtained, with a categorization into:

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

The processing of the analysis of the effects of subsidy policy also required a definition of the indicator of overall production of the monitored businesses. The said indicator was set at the output level, because a low proportion of consumed self-produced intermediate goods may be presumed in the case of plant production. The effect of price development was, in the case of production, eliminated through conversion to real value by way of agricultural producer price indices, with consideration given to production specialization, published by the Czech Statistics Office, with the basal time period being the year 2005. Price development was also eliminated in the case of the consumption of materials and energies entering the production function as explanatory variables, with the help of input price indices also published by the Czech Statistics Office.

Data acquired through the process described above was further adjusted for detected incomplete and outlying observations. The resulting set of data used for analysis contained 455 observations of 102 agricultural businesses with predominating plant production.

For the purpose of verifying hypothesis H_1, a production function model was constructed, expressing the relationship between the quantity of inputs into the production process by the examined entities and the quantity of output, taking into consideration the impact of subsidies. The said relationship was modeled in the form of the Cobb-Douglas function:

$$y_{kt} = \alpha L_{kt}^{\beta_L} WU_{kt}^{\beta_{WU}} K_{kt}^{\beta_K} SME_{kt}^{\beta_{SME}} PP_{kt}^{\beta_{PP}} OD_{kt}^{\beta_{OD}} e^{\epsilon kt}, \quad (1)$$

where:

y_{kt} is volume of production of the *k-th* farm in time *t*, L_{kt} is quantity of the production factor of land used by the *k-th* entity in time *t*, WU_{kt} is quantity of the production factor of labor used by the *k-th* entity in time *t*, K_{kt} is quantity of the production factor of capital corresponding to entity *k* in time *t*, SME_{kt} is quantity of material and energy consumed by the *k-th* entity in time *t*, PP_{kt} is value of direct payments obtained by the *k-th* entity in time *t*, OD_{kt} is value of other subsidies, obtained by the *k-th* entity in time *t*, α is constant, $\beta_{L,WU,K,SM,PP,OD}$ are parameters of the production function, e_{kt} is random element of the model with presumed normal division $e_{kt} \sim N(0,\sigma^2)$, $k = 1,2,\ldots K$, $t = 1,2,\ldots T$.

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

- Land (*L*), defined with a standardized hectare area size of farmed agricultural land;
- Labor (*WU*), represented by an average number of workers;

- Capital (*K*), expressed in the form of the sum of tangible and intangible long-term assets in thousands of crowns;
- Material and energy (*SME*), defined as the consumption of material and energy in constant prices for the year 2005 in thousands of crowns;
- Direct payment (*PP*), representing the sum of SAPS, TOP-UP payments, separate payments for sugar, support for the growing of energy crops and separate payments for tomatoes, expressed in thousands of crowns;
- Other subsidies (*OD*), containing other subsidies provided from EAFRD and EZZF, expressed in thousands of crowns.

The inclusion of subsidies into the said model was tested by way of the J-test (see Cipra, 2008).

The verification of hypothesis H_2 was based on the quantification of the cost function. For the purpose of preventing the unfounded transfer of the impact of subsidies on costs from the production function, for such purpose the approach of Varian (1992) was not applied by way of the Lagrange method (see Kroupová, Malý, 2010), but the cost function was separately quantified and verified in the following form:

$$C_{kt} = \alpha W_{L,kt}^{\beta_{WL}} W_{WU,kt}^{\beta_{WWU}} y_{kt}^{\beta_y} PP_{kt}^{\beta_{PP}} OD_{kt}^{\beta_{OD}} W_{VF,kt}^{\beta_{WVF}} e^{\epsilon_{kt}}, \quad (2)$$

where:
C_{kt} are costs at the *k-th* farm and in time *t*, $W_{L,kt}$ is price of the production factor of land at the *k-th* farm and in time *t*, $W_{WU,kt}$ is price of the production factor of labor at the *k-th* farm and in time *t*, $W_{VF,kt}$ is price of other production factors at the *k-th* farm and in time *t*, α is constant, $\beta_{WL,WWU,y,PP,OD,WVF}$ are parameters of the cost function, e_{kt} is random element of the model with presumed normal division $e_{kt} \sim N(0,\sigma^2)$, $k = 1,2,\ldots K$, $t = 1,2,\ldots T$.

For the purpose of verifying hypothesis H_3, the function of the demand for land was further quantified, in the following form:

$$L_{kt} = \alpha W_{L,kt}^{\beta_{WL}} y_{kt}^{\beta_y} PP_{kt}^{\beta_{PP}} e^{\epsilon_{kt}}, \quad (3)$$

where:
L_{kt} is quantity of land in the *k-th* farm and in time *t*, α is constant, $\beta_{WL,y,PP}$ are parameters of the cost function, e_{kt} are random element of the model with presumed normal division $e_{kt} \sim N(0,\sigma^2)$, $k = 1,2,\ldots K$, $t = 1,2,\ldots T$.

A further constructed model was the demand for the production factor of labor, enabling the verification of hypothesis H_4:

$$WU_{kt} = \alpha W_{WU,kt}^{\beta_{WWU}} y_{kt}^{\beta_y} PP_{kt}^{\beta_{PP}} OD_{kt}^{\beta_{OD}} e^{\epsilon_{kt}}, \quad (4)$$

where:
WU_{kt} is quantity of labor at the *k-th* farm and in time *t*, α is constant, $\beta_{WWU,y,PP,OD}$ are parameters of the cost function, e_{kt} is random element of the model with presumed normal division $e_{kt} \sim N(0,\sigma^2)$, $k = 1,2,\ldots K$, $t = 1,2,\ldots T$.

Further, the effect of subsidies on the business management of agricultural businesses was also examined as regards profit. The effect of subsidies on the financial results for the accounting period was analyzed. The estimated model enabled the comparison of the effects of subsidies with the impact of proceeds from the sale of a business's own products and services and thereby the verification of hypothesis H_5. The said function was once again modeled under the assumption of a power progression, see the following relationship:

$$P_{kt} = \alpha ICV_t^{\beta_{ICV}} ICVF_t^{\beta_{ICVF}} PP_{kt}^{\beta_{PP}} OD_{kt}^{\beta_{OD}} e^{\epsilon_{kt}}, \quad (5)$$

where:
P_{kt} is result of business management for the accounting period of the *k-th* entity in time *t*, ICV_t is agricultural product price index in time *t*, $ICVF_t$ is input price index in time *t*, α is constant, $\beta_{ICV,ICVF,PP,OD}$ are parameters of the cost function, e_{kt} is random element of the model with presumed normal division $e_{kt} \sim N(0,\sigma^2)$, $k = 1,2,\ldots K$, $t = 1,2,\ldots T$.

The use of panel data for the estimation of the above models required the execution of an analysis of the heterogeneity of the applied variables. The presence of heterogeneity, verified by way of an analysis of the variance of the values of the explained variables of estimated models (see Jackson, 2009), defined the need to use a special construction of the model in the form of a model of fixed effects (FE) ad random effects (RE) (for more see Hsiao, 2003). The estimate of parameters of the said models was made by way of a generalized method of smallest squarest. The quality of the estimates obtained was verified by way of standard statistical procedures. The statistical significance of the estimated parameters was tested by way of the ttest. The correspondence of the estimated model with empirical data was quantified by way of a coefficient of multiple determination, including the adjusted form, and verified by way of the F-test. The accuracy of the specification of the model was tested through two methods:

a) the construction of a model taking into consideration farm specifics, i.e. the FE or RE model as opposed to a model with a congruent constant, was tested by way of the Baltagi-Li Lagrange Multiplier test (Green, 2008);
b) the inclusion of farm specifics in the random element, i.e. RE as opposed to FE, was tested by way of the Hausman test (Wooldridge, 2002).

Assumptions regarding the qualities of the random element were verified by way of the Baltagi-Li Joint Lagrange Multiplier test of homoscedasticity and serial correlation of the random element (Baltagi *et al.*, 2008), the Breusch-Pagan test of homoscedasticity of the random element (Green, 2007), the Wooldridge test of serial correlation of the random element (see Drukker, 2003), the Godfrey Lagrange Multiplier test of serial correlation of the random element (for more, see Green, 2008) and the VIF test of multi-colinearity (Green, 2008).

The proven heteroscedasticity or autocorrelation of residues was subsequently eliminated by way

of the transformation of variables of the non-equilibrated panel (for more see Green, 2007). Estimates of parameters and the relevant tests were conducted by the Limdep econometric program, version 4.0.

RESULTS

Characteristics of the Selected Group

The selected group of agricultural businesses entering the analysis is characterized by average outputs in the amount of CZK 21,265 thousand, which are achieved through the use of 767 ha of agricultural land. The said businesses end their annual business management with an average profit at a level of CZK 1,965 thousand, but with the drawing of CZK 2,363 thousand of direct payments. The profitability of the farms is thus strongly dependent on subsidy aid, see table Tab. I.

From a chronological viewpoint, the monitored group of businesses showed a fall in the volume of production within the monitored period of time, such production being measured as the volume of outputs of the business. In connection with the growth of wage expenditures and a lower rate of decrease of the output consumption than is the rate of decrease of outputs, such situation was reflected in a marked decrease in the operating result as well as in the overall financial results (by 71% or 79%, respectively). Despite substantial growth in subsidies – primarily in the case of title payments – there was a deterioration in the economic situation and a fall in the profitability of the overall capital. Just as the profitability of total capital fell, so too fell the profitability of equity capital with an average fall of 2.2%. The effect of subsidies may be seen in the results of the profitability of the proceeds for own products and services, where the subtraction of subsidies from the total financial result led to a negative value of profitability. Only in the years 2004 and 2007 was the profitability of proceeds positive.

Effect of Subsidies on the Economic Management of Plant Production Farms

The analysis of the effect of subsidy policy on the economic management of agricultural farms engaging in plant production was primarily based on the quantification of the production function, while taking into consideration the effect of subsidies. The appropriateness of including subsidies in the form of direct payments and other subsidies as explanatory variables into the said model was verified by way of the J-test. The inclusion of farm specifics into the random element of the model, conditioned by the non-correlativeness of farm specifics with the explanatory variables, was tested by way of the Hausman test. The said test declared the impossibility of the rejection of the null hypothesis on the nonexistence of the said correlation ($H = 7.99$, $p\text{-value} = 0.2386$), which defined the application of the model of random effects, which maintains its impartiality and is, in this case, more efficient than the model of fixed effects. The result of the Baltagi-Li LM test also confirms this conclusion ($BLLM = 8.81$, $p\text{-value} = 0.0013$).

The Baltagi-Li Joint LM test ($LMBP_j = 249.21$, $p\text{-value} = 0.0000$), was subsequently applied to

I: *Characteristics of the examined group of agricultural businesses*

	2004	2005	2006	2007	2008	2009	Rate of growth 09/04
Area size of agr. land	765.4	755.4	736.4	817.3	835.1	692.8	–9.5
Outputs	22724.7	17816.4	19229.1	23809.7	26730.6	17280.6	–24.0
Output consumption	16043.5	15811.8	16036.8	17490.5	19986.5	15658.2	–2.4
Wage expenditures	2631.6	2431.0	2948.5	2932.6	3176.5	3069.4	16.6
Operating results	2872.7	936.0	2310.7	4399.0	4067.6	839.9	–70.8
Overall financial results	2067.1	710.0	1899.9	3503.3	3181.5	427.8	–79.3
Total liabilities	36171.8	36868.4	36614.6	39804.4	43533.1	39633.3	9.6
Equity capital	15749.6	15958.0	16285.2	19693.6	22366.3	20360.3	29.3
Profitability of overall liabilities	0.057	0.019	0.052	0.088	0.073	0.011	–81.110
Direct payments	0.0	1556.7	3257.5	2927.0	2878.6	3560.0	128.7
AEO	48.5	201.7	259.8	199.6	194.4	126.7	161.3
LFA	0.0	20.4	13.6	9.7	17.5	98.1	380.4
PRV	0.0	0.0	0.0	0.0	11.6	23.4	14.9
Profitability of proceeds with subsidies	0.10	0.02	0.04	0.18	0.08	0.02	
Profitability of proceeds without subsidies	0.09	–0.12	–0.19	0.02	–0.07	–0.25	
Subsidies/Proceeds (V/S)	0.00	0.14	0.23	0.16	0.15	0.27	

Source: own analysis

the selected model, which proved the existence of heteroscedasticity or autocorrelation. The Wooldridge test (AR_1 = –0.50, *p-value* = 0.0000) subsequently declared autocorrelation of the first order of the random element and the Breusch-Pagan test (*LMBP* = 423.84, *p-value* = 0.0000) showed the existence of heteroscedasticity. The following relationship no. 6 represents the functional transcription of the estimate of the production function taking into consideration autocorrelation and heteroscedasticity into the power form:

$$\hat{y}_{kt} = \underset{(0.5258)}{2{,}333}\, L_{kt}^{\underset{(0.0756)}{0.225}}\, WU_{kt}^{\underset{(0.0584)}{0.086}}\, K_{kt}^{\underset{(0.0526)}{0.114}}\, PP_{kt}^{\underset{(0.0404)}{-0.185}}\, SME_{kt}^{\underset{(0.0871)}{0.774}}\, OD_{kt}^{\underset{(0.0163)}{0.002}}. \quad (6)$$

The residual sum of squares of the said function reached the value of 523.19, which, in the standardization in regard to the total sum of squares, led to the value of the coefficient of determination being 41%, the statistical significance of which was verified by way of the F-test (*F* = 51.33, *p-value* = 0.0000).

As regards the intensity of the effects of individual production factors, the most significant may be considered the consumption of material and energy, where an increase in the said input by 1% causes a rise in production of 0.774% (ceteris paribus), with a probability of 99%. At the same level of significance, the effect of the production factor of land is also statistically conclusive, whose percentage increase implies a rise in production of 0.225%. The results of the comparison of the strength of effect of the said two factors corresponds to the specifics of plant production. In view of the general limited extent of the production factor of land, the consumption of material, such as, for example, seed, fertilizers, protective measures, and the consumption of energies may be considered a significant intensifying factor.

At a significance level of α = 0.01, the statistical significance of the parameter of direct payments was also proven. It was thus statistically verified that as a result of a one percent increase in direct payments, there is a fall in production of 0.185%. Hypothesis H_1 may thereby be considered verified. In the said regard, it must be noted that the primary goal of direct payments was to compensate a decrease in guaranteed prices on the market, which began to show after the year 1992 as a result of the McSharry reform. The purpose of such effort was to limit the overproduction of agricultural products and to lead to a certain decline in the intensity of agricultural production. The results of the analysis thus prove that direct payments still fulfill the goal stated above, as they lower the intensity of production.

Of the other parameters, the parameter of the variable of capital was verified as statistically significant at a significance level of α = 0.05. The effect of other subsidies on production was not statistically proven, and neither can the effect of the production factor of work surprisingly be considered statistically significant.

From the quantified production function, by way of the Lagrange method it is possible to derive the cost function, which, with the fixation of labor and other subsidies at an average level, is defined by way of the following relationship:

$$\hat{C}_{kt}(w_L, w_K, w_{SME}, y) = 1.7618\, PP_{kt}^{\,0.1664} w_{L,t}^{0.2020} w_{K,t}^{0.1023} w_{SME,t}^{0.6958} y_{kt}^{\,0.8994}. \quad (7)$$

The said function accepts the parameter of direct payments from the production function and does not enable its statistical verification, and thus the cost function model was also estimated, which was subsequently subjected to statistical as well as econometric verification. The said model was constructed in the form of a fixed effects model, because the Hausman test proved the presence of a correlation of farm specifics and explanatory variables of the model (*H* = 98.14, *p-value* = 0.0000). The farm specifics were thus modeled by way of the differentiation of the constant of the model for individual farms. The functional transcription set out in relationship no. 8 provides a general record of such constants as α_k. The difference in the intercept of individual farms is also shown by the Baltagi-Li LM test (*BLLM* = 361.43, *p-value* = 0.0000). In regard to econometric verification, only the presumption of the independence of random elements was breached in the examined model, while homoscedasticity was maintained. The proven positive autocorrelation (AR_1 = –0.17, *p-value* = 0.0054) was eliminated by way of Prais-Winsten transformation, whereby the resulting estimate states the following relationship:

$$\hat{C}_{kt} = \alpha_k W_{\underset{(0.0146)}{L,kt}}^{\,0.028}\, W_{\underset{(0.0190)}{WU,kt}}^{\,0.247}\, y_{\underset{(0.0102)}{k,t}}^{\,0.019}\, PP_{\underset{(0.0064)}{kt}}^{\,-0.004}\, OD_{\underset{(0.0057)}{kt}}^{\,0.003}\, W_{\underset{(0.1787)}{VF,kt}}^{\,0.827}. \quad (8)$$

From a statistical standpoint, the said model showed a high correspondence with the data, as the determination coefficient, verified by way of the F-test (*F* = 148.6, *p-value* = 0.0000), reached a value of 98%. However, only four of the six primarily estimated parameters may be considered statistically significant, those being the parameters of the variables of the price of labor (α = *0.01*), the price of land (α = *0.1*), production (α = *0.1*) and the price of other production factors (α = *0.01*). Of the said variables, the variable of other production factors showed the strongest effect on the total amount of costs of the farms, the one percent change of which causes, on average, a 0.827% rise in the costs under the condition of ceteris paribus. The said strength of effect comes close to the value derived from the production function, see relationship no. 7. On the contrary, there is a surprisingly low effect shown by the variable of the quantity of production, the one percent increase of which causes only a 0.019% increase in costs (ceteris paribus). In the said case, it may be more reasonable to consider the

effect of derivative value of 0.899%. A significant difference may also be seen between the derivative and quantified function as regards the effect of subsidies on the amount of costs of farms. While in the derivative function, direct payments imply a growth in costs, which supports the assertion of Zemplinerová (2006), in the quantified model their effect is not statistically conclusive, similarly as the effect of other subsidies. Hypothesis H_2 thus cannot be considered verified. The impact of subsidies on the amount of costs of agricultural producers engaging in plant production will likely depend on the ability of the management to control the amount of costs.

As subsidies in the form of direct payments, as well as, for example, agro-environmental support, are tied to hectares of farmed land, it is useful to examine their effect on the demand for land. The said model was quantified in the form of a random effects model (H = 0.09, *p-value* = 0.9955) and estimated by way of the generalized method of smallest squares after a Prais-Winsten transformation ($LMBP_j$ = 205.25, *p-value* = 0.0000, $LMBP$ = 0.02, *p-value* = 0.9998, AR_1 = –0.12, *p-value* = 0.0135), see relationship no. 9:

$$\hat{L}_{kt} = \underset{(0.1296)}{340.675} W_{L,kt}^{\underset{(0.0170)}{-0.025}} y_{k,t}^{\underset{(0.0130)}{0.040}} PP_{kt}^{\underset{(0.0082)}{0.024}} . \qquad (9)$$

The parameter of direct payments was, in the said model, verified as statistically significant, with a probability of 99%. The said subsidies thus lead to an increase in the area size of farmed land. Hypothesis H_3 was proven. However, the quantity in demand does not react to the change in direct payments flexibly, as a 1% increase in direct payments causes, on average, a 0.024% increase in the extent of farmed land, ceteris paribus. However, the strength of effect of direct payments is comparable to the strength of the price of agricultural land, where its increase by 1% causes, on average, a decline in demand of 0.025%. However, the said conclusions are only valid with a *p-value* = 0.14. The strongest effect on the quantity in demand is thus shown for the amount of production, with a probability of 99%. The demand for land may thus be termed generally inflexible, which relates to the mentioned limited extent of the given production factor. For the sake of completeness, it we note the coefficient of determination and its F-test: R^2 = 0.41, F = 103.35, *p-value* = 0.0000.

On the contrary, in the case of subsidies, and not even in the case of subsidies paid out through the Rural Development Program, a positive effect on employment, and thus primarily the demand for labor, cannot be presumed. The said assertion is based on the statistical development of the volume of subsidies paid out in the Czech Republic and the number of the labor force in agriculture. While the volume of subsidies has been growing steadily since 2004, the number of workers has constantly been declining. That, even on the company level, is evidenced by the model of demand for labor, which was specified by way of the fixed effects model (H = 17.73, *p-value* = 0.0014). The proven autocorrelation of the said model (AR_1 = –0.41, *p-value* = 0.0280) was addressed by Prais-Winsten transformation. The results of the estimate with a coefficient of determination of 98%, verified by the F-test (F = 114.14, *p-value* = 0.0000) state the following relationship:

$$\hat{WU}_{kt} = \alpha_k W_{WU,kt}^{\underset{(0.1033)}{-0.586}} y_{k,t}^{\underset{(0.0469)}{0.140}} PP_{kt}^{\underset{(0.0387)}{0.004}} OD_{kt}^{\underset{(0.0175)}{0.017}} . \qquad (10)$$

The assessment of the above hypothesis is based on the statistical verification of the estimated parameters. According to the t-test, the examined categories of subsidies do not achieve statistical significance, even at a significance level of α = 0.1. Hypothesis H_4 may be considered verified. The parameters of the remaining variables are statistically significant with a probability of 99%. A more flexible reaction of demand for labor to a change in the price of labor may be seen in the said function than was the reaction of demand for land to the change in its price. Farms react to a one percent increase in the price of labor with a decline in demand of, on average, 0.586% under the condition of ceteris paribus. The demand for labor also reacts more flexibly to a change in the volume of production. The said fact evidences a higher variability of application of the production factor of labor into the production process in plant production than is true in the case of the factor of land.

Subsidies provided to agricultural producers are a significant source of profit, without which a number of agricultural producers would show a stable loss. The effect of both examined categories of subsidies on the profit of agricultural producers is quantified by the following model of random effects (H = 8.11, *p-value* = 0.0875):

$$P_{kt} = \underset{(0.8171)}{17.530} ICV_t^{\underset{(1.4452)}{8.1762}} ICVF_t^{\underset{(4.0027)}{-18.044}} PP_{kt}^{\underset{(0.1137)}{0.303}} OD_{kt}^{\underset{(0.1137)}{-0.019}} . \qquad (11)$$

The said model represents the profit function after the elimination of autocorrelation and heteroscedasticity ($LMBP_j$ = 243.76, *p-value* = 0.0000, $LMBP$ = 214.53, *p-value* = 0.0000, AR_1 = –0.40, *p-value* = 0.0000). The estimated parameters, with the exception of other subsidies, achieve a statistical significance therein with a probability of 99%. The parameter of other subsidies is not statistically significant. The explains, at a rate of 76%, the change in a dependent variable in the case of changes of non-dependent variables, which is proven by the F-test achieving the following values: F = 358.98, *p-value* = 0.0000. As regards the strength of effect, we see a distinct negative effect of changes in prices of inputs into the production process. An increase in the said prices by 1% causes a decline in profit of 18.04%, which is associated with a low substitution ability for individual inputs. On the

contrary, a percentage increase in the prices of agricultural products implies a 8.18% increase in profit. Direct payments also positively affect the profit of agricultural producers engaging in plant production, but the reaction of profit to their changes is not equally as flexible as in the case of prices. An increase in subsidies of 1% increases profit by 0.303%, ceteris paribus. However, hypothesis H_5 is accepted on the basis of the above.

DISCUSSION AND CONCLUSION

On the basis of the results of the analysis conducted, it may be stated that direct payments have a negative effect on the production of agricultural businesses, but, on the other hand, they stimulate demand for agricultural land and increase the profit of agricultural producers. According to the results of the estimated model, a percentage increase in direct payments lowers production by 0.185%. A similar direction of the effects of direct payments on production is also evidenced by Kroupová and Malý (2010), who, however, in their research focusing primarily on ecological agriculture, quantified a lower strength of effect of direct payments, at a level of 0.101%. That may be considered a consequence of production specialization, as a lower effect of direct payments may be presumed on the production of mixed farms, which ecologically focused farms are, as opposed to farms specializing in plant production. The conducted research thus proved that direct payments do not motivate agricultural businesses toward increased production, as opposed to price support, which was the dominant instrument of CAP until 1992. Price support also led to the focus of agricultural businesses on a certain commodity, while the SAPS payment does not allow for even the partial tying of payments to production. The effect of other subsidies on production was not statistically proven.

Direct payments also increase the demand for the production factor of land, but the said demand appears to be non-flexible, and thus the effect of direct payments on its extent is also very small.

As regards the impact of subsidies on financial results, it was clearly proven that direct payments have a significant effect on the amount of profit, which is also evidenced by the research of Hrabalová and Zander (2006).

Further, it was also statistically proven that subsidies do not stimulate the growth of employment in plant production. The demand for labor reacts flexibly to a change in the price of work as well as to a change in the volume of production, but not to a change in the volume of subsidies paid out.

SUMMARY

The article quantifies the impact of subsidies provided within CAP on selected plant production business in the Czech Republic, especially on their production, costs, profit. It also determine the effects of subsidy policy on demand for production factor of labour and land. The results of the article are confronted and discussed with the anticipated effects of political instruments. The results also enables to verify following hypotheses.

First, subsidies (especially directs payments) implicate a fall in plant production. To answer the question the production function model by Cobb-Douglas function was constructed. The model statistically verifies that one percent increase in direct payments means a fall in production of 0.185%. The analysis also proves that the directs payments lower the intensity of production.

Second, the subsidies cause waste of resources, which leads to a rice in demand for land. The verification is based on quantification of the cost function by Lagrange method. The results of constructed model do not verify the hypotheses. The impacts of subsidies on the level of costs in analyzed businesses will likely depend on the ability of the management to control the amount of costs.

Third, subsidies tied to the size of the area of farmed land implicate a rise in demand for land. The verification is derived from the quantification of the demand function for land in the form of a random effects model. The results verifies stated hypothesis. Nevertheless the quantity in demand do not react flexibly on the change in directs payments.

Fourth, subsidies do not initiate a rise in employment in plant production. The verification is derived from the quantification of the demand function for labour in the form of a fixed effects model. According to the t-test the hypothesis is verified. A more flexible reaction of demand for labor to a change in the price of labor may be seen in the said function than was the reaction of demand for land to the change in its price.

Fifth, agriculture producers engaging in plant production are, as regards profit, highly depended on subsidy support. The hypothesis is verified by quantification of profit function. Direct payments also positively affect the profit of agricultural producers engaging in plant production, but the reaction of profit to their changes is not equally as flexible as in the case of prices.

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REFERENCES

BALTAGI, B. H., JUNG, B. CH., SONG, S. H., 2008: *Testing for Heteroskedasticity and Serial Correlation in a Random Effects Panel Data Model.* In Working Paper No. 111. New York: Center for Policy Research. 51 pp. ISSN 1525-3066.

BLAAS, G., 2009: *Health Check a výhledy SZP po roce 2013*. [online]. [Accessed 20100510]. Praha: ÚZEI. URL: <http://www.uzei.cz/left-menu/publikacni-cinnost/bulletin-uzei/2009/bu0904.pdf >.

CIPRA, T., 2008: *Finanční ekonometrie.* Praha: Ekopress. 538 pp. ISBN 978-80-86929-43-9.

DRUKKER, D. M., 2003: Testing for Serial Correlation in Linear Panel-data Models. *The Stata Journal*, 3, 2: 168–177. ISSN 1536-8734.

GREEN, W. H., 2007: *Limdep Version 9.0 – Reference Guide*. [online]. [Accessed 20100112]. New York: Econometric Software. URL: < http://pages.stern.nyu.edu/~wgreene/DiscreteChoice/Software/LIMDEP-Short-Student-Manual.pdf >.

DOUCHA, T., FOLTÝN, I., 2008: Czech agriculture after the accession to the European Union – impacts on the development of its multifunctionality. *Agricultural Economics,* 54, 4: 150–157. ISSN 0139-570X.

GREEN, W. H., 2008: Econometric Analysis. New Persey: Pearson Prentice Hall. 1187 pp. ISBN 978-0-13-513740-6.

HRABALOVÁ, A., ZANDER, K., 2006: Organic Beef Farming in the Czech Republic: Structure, Development and Economic Performance. *Agricultural Economics,* 52, 2: 89–100. ISSN 0139-570X.

HSIAO, CH., 2003: *Analysis of Panel Data*. New York: Cambridge University Press. 366 pp. ISBN 978-0-521-52271-7.

CHRASTINOVÁ, Z., BURIÁNOVÁ, V., 2009: Economic development in Slovak agriculture. *Agricultural Economics,* 55, 2: 67–76. ISSN 0139-570X.

JAKSON, S. L., 2009: *Research Methods and Statistics*. Belmont: Wadsworth. 430 pp. ISBN 978-0-495-51001-7.

KROUPOVÁ, Z., MALÝ, M., 2010: Analýza nástrojů zemědělské dotační politiky – aplikace produkčních funkcí. *Politická ekonomie,* 6: 778–798. ISSN 0032-3233.

Ministerstvo zemědělství ČR, 2010: *Program rozvoje venkova České republiky na období let 2007–2013*. [online]. [Accessed 20100302]. URL: <http://eagri.cz/public/eagri/file/40890/PRV__leden2010.pdf >.

ŠPIČKA, J., BOUDNÝ, J., JANOTOVÁ, B., 2009: The role of subsidies in managing the operating risk of agricultural enterprises. *Agricultural Economics,* 55, 4: 169–179. ISSN 0139-570X.

ŠTOLBOVÁ, M., HLAVSA, T., 2008: The impact of the LFA payments on the FADN farms in the Czech Republic. *Agricultural Economics,* 54, 10: 489–497. ISSN 0139-570X.

VARIAN, H. R., 1992: *Microeconomic Analysis.* New York: W.W.Norton & Copany, Inc. 506 pp. ISBN 0-393-95735-7.

WOOLDRIDGE, J. M., 2002: *Econometric Analysis of Cross Section and Panel Data*. Cambridge: Massachusetts Institute of Technology. 752 pp. ISBN 0-262-23219-7.

ZEMPLINEROVÁ, A., 2006: Efekty státní podpory podniků. *Politická ekonomie,* 2: 204–213. ISSN 0032-3233.

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