The determinants of adopting organic farming practices: a case study in the Czech Republic

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Abstract: The presented article focuses on an analysis of the phenomena appearing in the implementation of the transition from classic conventional technology in the production of agricultural food products to an ecological manner of farming. The main objective is an empirical analysis of the determinants of the implementation of ecological production technology, whereby not only is their definition focused on, but also the quantification of the level of their effect. The primary methodological tool for achieving the objective is a binary choice model, which was estimated in three variants – probit model, logit model and linear probability model. These estimations are conducted on the basis of the unbalanced panel data from 531 agricultural businesses – legal entities obtained over the time period 2004–2008. Results of the analyses indicate that the transition to and implementation of the organic production technology is negatively affected primarily by the higher age of the farmers and the high productivity of labour. On the other hand, the subsidies for the support of organic agriculture, as well as a high return on cost can be considered as the factors which positively influence the implementation of the organic technology. Given this fact, it is possible, through agricultural policy, to effectively influence the number of organically managing farmers, as well as the acreage of the organically managed land. And from the achieved outputs, the type of farm is subsequently characterised where a transition to organic farming may most likely be expected.

Key words: binary choice model, conventional production, organic agriculture, motivation factors, transition determinants

In the Czech Republic, organic agriculture is one of the fastest growing sectors of agricultural production. In the last decade, i.e. since the year 2000, the area of ecologically farmed land has increased by more than 140% (data from 2009), with the average growth year-on-year of over 9%. The number of organically farming agricultural entities increased almost five times, with the highest increase seen in 2008, when the number of organically farming entities increased by 32.2%.

The fast growth of organic farming brings with it a growth in the economic research of this alternative agricultural production system. In the Czech Republic alone, dozens of articles focusing on various aspects of the growth of organic agriculture have been published in scientific periodicals since 2000. As random examples, we could mention the research works of Jones et al. (2001), Hrabalová and Zanderová (2006), Jánský and Živělová (2007), Dimitri and Oberholtzer (2010), Zagata (2010a, b). Some of these publications (Jánský and Živělová 2007), and some foreign research studies too (e.g. Kumbhakar et al. 2009; Dimitri and Oberholtzer 2010), presume that the main determinant for the fast growth of organic agriculture in the Czech Republic are subsidies on the part of the state. However, some studies point out that subsidies are not the only motivator for the transition to the organic method of farming (Lohr and Salomonsson 2000; Darnhofer et al. 2005; Zagata 2010a). In the Czech Republic, the determinants of the growth of organic agriculture have, so far, been researched separately, primarily with the use of the sociological research techniques. The presented article thus has as its objective an empirical analysis of the determinants of the implementation of the organic production technology. Partial objectives are: (1) a definition of the factors that affect the transition to and the implementation of the organic farming system, (2) a quantification of the level of the effect of the said factors and (3) a characterisation of the farms where there is a high probability of a transition to the organic farming system.

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MATERIAL AND METHODS

The analysis of the determinants for the implementation of the organic production technology in the Czech Republic was based on the panel data on 531 agricultural businesses – legal entities obtained from the database of the Creditinfo Firemní monitor, created through the collection of mostly accounting data of business entities registered in the Czech Republic, and from the Collection of Documents of the Commercial Register. In the sample set, organic farms had the share of 27%, i.e. 143 entities, and conventional farms constituted 73% of the sample set. In terms of the time covered, the base data represented farming of the said agricultural businesses in the years 2004–2008. As regards specialisation, the sample set consisted of 93% businesses with predominantly mixed production (CZ-NACE 0150), 4% of entities in the sample set were focused primarily on plant production (CZ-NACE 0110 and 0120) and 3% primarily on livestock production (CZ-NACE 0140).

The base data detailed above was the basis for obtaining not only accounting data, but also other characteristics of the farming entities pertaining to gender and the genealogical characteristics of the business, the regional location of the farm and the duration of its existence.

Data from the Creditinfo were also supplemented by the size in terms of the area of the farmed land, obtained from the LPIS database, the number of employees, specified as the proportion of wage costs of the individual entities and the average wage earned according to the Czech Statistics Office database within the region where the business in question was located, and the volume of the received subsidies from the State Agricultural Intervention Fund database. Out of the total volume of subsidies, monetary transfers were further singled out, as provided under the title of A1, Organic Agriculture, of the Horizontal Rural Development Plan in the years 2004–2006, and the subsidies under the title of II 1.3.1.1, Organic Farming, of the Rural Development Program in the years 2007–2008. The volume of subsidies obtained for the support of organic agriculture was set for each ecofarm as the product of the area of the relevant crop and the corresponding rate set out in the given subsidy programme. The areas of land farmed for the relevant crops were obtained for the individual farms from the lists of organic producers published by the Ministry of Agriculture of the Czech Republic. Subsidies obtained in the manner as stated represented the volume of subsidies for the support of organic agriculture that the farms could apply for. However, every ecofarm did not have to receive such subsidies, and thus the amount of subsidies for the support of organic agriculture was adjusted to take account of the amount of the agro-environmental subsidies drawn by the relevant farm according to the database of the State Agricultural Intervention Fund.

The analysis of the determinants that are the preconditions for the implementation of the organic farming system also required the addition of information on the location of the farm and whether it was in a less favoured area (LFA), based on the district of the location of the agricultural business and the list of municipalities and cadastral areas determined as the LFA, as prepared by the Ministry of Agriculture of the Czech Republic.

Processing the analysis also required the definition of several proportional indicators, characterising the

Table 1. Annual average of the selected indicator values of the selected collection

	Organic farming					Conventional farming				
	2004	2005	2006	2007	2008	2004	2005	2006	2007	2008
Land (ha)	907.44	829.75	797.81	828.12	948.18	1360.65	1293.56	1297.19	1330.56	1199.18
Average work units	17.16	16.51	16.71	42.29	103.44	76.93	71.97	66.69	64.87	45.95
Revenue from sale own products and services (ths. CZK/ha)	9.117	7.575	9.066	10.326	9.574	34.721	34.986	31.580	35.080	34.819
Profit (ths. CZK/ha)	1.917	1.518	2.211	3.141	3.059	2.509	1.297	1.409	3.894	2.107
Total subsidy (ths. CZK/ha)	7.166	9.385	10.001	11.149	12.570	3.225	5.924	6.439	7.195	6.670
Cost profitability (%)	12.28	10.15	3.66	9.89	14.08	4.61	7.32	2.92	14.82	28.09
Technical efficiency (%)	49.88	48.29	49.87	47.29	44.90	62.28	61.29	60.34	59.22	56.06
Labour productivity (ths. CZK/WU)	697.119	854.032	794.809	613.351	504.965	845.694	913.384	908.613	891.845	882.849

Source: Own calculation

business success level of the agricultural entities. The quantified factors were labour productivity, land productivity, return on costs and return on sales. Last but not least, the rate of technical effectiveness was also quantified, according to the method published by Kroupová (2010).

The data obtained in the manner as described above was further adjusted for the incomplete and remote observations. The resulting data set used for the estimates contained 1853 observations of 122 organic and 352 conventional agricultural businesses. As regards the number of the represented entities, the sample set of organic agricultural businesses constituted 50% of the basic set of all organic businesses – legal entities.

The basic characteristics of the acquired underlying data are presented in brief in Tables 1 and 2.

From the methodological viewpoint, the analysis of factors conditioning the implementation of the organic production technology was based on the binary choice model, a specific characteristic of which is a zero-one explained variable.

The said model was estimated in the form of the probit model, which is based on the presumption of a normal distribution of the concentration of the probability of occurrence of the phenomenon in question. According to Wooldridge (2002), the probit model of the choice of a relevant technology (organic technology in the case in question) may be defined by way of the following relationship:

$$P(I_{kt} = 1 | x_{kt}, u_k) = \Phi(x'_{kt}\beta + u_k) \quad (1)$$

$$\Phi(z) = \int_{-\infty}^{z} \phi(v)dv \quad (2)$$

$$\phi(z) = \frac{1}{\sqrt{2\pi}} e^{\frac{-z^2}{2}} \quad (3)$$

Table 2. Descriptive statistic of the used variables

	Mean	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
Woman (W)	0.576152	0.494301	–0.308119	1.0944	0	1
Age of farmer (OLF)	1.59946	0.702104	0.739312	2.31754	1	3
Mixed production (MP)	0.931707	0.252316	–3.42196	Dec–93	0	1
Average rate of org. farming subsidy (ASR) (10 ths. CZK/ha)	0.837286	0.201483	0.748711	1.56003	0.697625	1.1278
Size of farm (LF)	3.84173	1.30737	0.197977	2.14729	1	6
Age of farm (OF)	Jan–35	0.435617	–0.0339282	5.26756	1	3
Labour productivity (PWU) (mil. CZK/WU)	0.847585	0.411356	1.52678	8.79317	0.00649098	3.71434
Profitability of costs (RC)	0.0697541	0.122706	1.66994	15.0996	–0.695922	1.06475
South East region (SE)	0.192412	0.394302	1.56017	3.43358	0	1
South West region (SW)	0.254201	0.435529	1.12874	2.27351	0	1
North East region (NE)	0.184824	0.38826	1.62353	3.63531	0	1
North West region (NW)	0.0699187	0.255079	3.37214	Dec–08	0	1
Central Moravia region (CM)	0.164228	0.370582	1.81213	4.28328	0	1
Moravia-Silesia region (MS)	0.0634146	0.243773	Mar–19	13.8294	0	1
Lag revenue per hectare (RH_{t-1}) (ths. CZK/ha)	34.8175	231.762	36.1739	1327.72	0	8546.09
Lag subsidy per hectare (SH_{t-1}) (ths.CZK/ha)	6.14198	3.02763	1.26892	Jul–88	0	29.6977
Technical efficiency (TEF)	0.579899	0.180659	0.00155166	2.63956	0.115292	1
Land productivity (PL) (mil.CZK/ha)	43.3818	296.839	30.224	936.965	1.02598	9922.97
Profitability of revenue (RR)	0.176737	1.23081	–1.84936	203.205	–26	21.6667
Localization in LFA(LFA)	0.684553	0.46482	–0.794084	1.63003	0	1
Quality of land (Q)	0.416843	0.346618	2.68585	19.4835	0.000360756	3.79523

Source: Own calculation

$$z = (x'_{kt}\beta + u_k) \quad (4)$$

Where:

I_{kt} = binary explained variable, representing the choice of technology of a *k-th* entity in time "*t*", and achieving a value of 0 for the conventional technology and a value of 1 for the organic manner of farming

x_{kt} = the vector of actual factor values, affecting the choice of the organic way of farming, in a *k-th* entity in time "*t*" with a dimension of $[J \times N]$

β = the vector of regressive coefficients with a dimen sion of $[J \times 1]$, expressing the effect of explanatory variables on the probability of the occurrence of the given phenomenon

u_k = the farm specific of the *k-th* entity with the presumed normal distribution of $u_k \sim N(0, \sigma_u^2)$

Φ(.) = the standardized cumulative function of the normal distribution (CDF)

φ = the standard normal concentration of probability.

$j = 1, 2, \ldots J$, $n = 1, 2, \ldots N$, $k = 1, 2, \ldots K$, $t = 1, 2, \ldots T$

(Paap and Franses 2000; Wooldridge 2002; Green 2008)

According to Allison (1999), the probability model of the choice of the conventional technology may also be added, see relationship 5:

$$P(I_{kt} = 0 | x_{kt}, u_k) = 1 - \Phi(x'_{kt}\beta + u_k) \quad (5)$$

The specification of the above model of the probability of the implementation of the organic technology was based on assumptions that determine the behaviour of agricultural entities. Primarily, there was a consideration of the positive effect of subsidies to support organic agriculture on the implementation of the organic production technology (see Pietola and Lansink 2001; Jánský and Živělová 2007; Kumbhakar et al. 2009). The said subsidies were included in the model in several alternative forms – in the form of the total volume of subsidies obtained per hectare of the farmed land in time "*t* – 1" ($SH_{k,t-1}$), and in the form of the average amount of subsidy rates announced per hectare of agricultural land in time "*t*" ($ASR_{k,t}$).

Another factor taken into consideration was the price advantage of organic products (see Darnhofer et al. 2005 and Kerselaers et al. 2005) and the change in the income of farms associated with it. The said factor was modelled as the volume of proceeds that were achieved per hectare of farmed land in time "*t* – 1" ($RH_{k,t-1}$). Alternatively, the indicator of return on sales ($RR_{k,t}$) was used. However, the effect of the said indicator on the decision-making of the farmer regarding the transition to the organic technology may be considered to be rather negative, as organic products may be sold for a higher sales price, but the said increase in the proceeds does not fully compensate for the losses in production within the organic farming system in comparison to the conventional proceeds. The producer making decisions on the basis of the level of proceeds per hectare of the farmed land will probably prefer the conventional farming as opposed to the organic farming. The decision on the implementation of the organic production technology is also affected by the cost effectiveness; see Kerselaers et al. (2005). The said determinant was included in the model by the way of return on costs ($RC_{k,t}$).

In accordance with Pietola and Lansink (2001), labour productivity ($PWU_{k,t}$) and land productivity ($PL_{k,t}$) were also included in the probit model, with a presumed negative effect on the implementation of the organic manner of farming. Kumbhakar et al. (2009) also define technical effectiveness ($TEF_{k,t}$) as a factor for the transition to the organic farming, with a presumed positive effect, and the experience of the farmer, which was modelled through the use of proxy variables of the duration of the existence of the agricultural business ($OF_{k,t}$) and the age of the farmer ($OLF_{k,t}$). It may be assumed that the organic production technology will tend to be implemented by younger farmers and businesses with a shorter tradition.

According to De Koeijer et al. (1995), the type of farm is also a significant factor. According to the results of the research by the said authors, specialised farms have a lesser tendency to implement organic technologies. The said factor was included in the model by way of a dummy variable expressing the mixed production of the farm ($MP_{k,t}$). In the said regard, Pietola and Lansink (2001) add an indicator of the size of the agricultural business with an assumed negative effect on the implementation of the organic technology, which was included in the model of the probability of the implementation of the organic production technology by way of a proxy variable ($LF_{k,t}$).

Kerselaers et al. (2005) also add geographic and climatic conditions as the pre-conditions for the transition to and the implementation of the organic production technology. The said indicator was modelled by way of a dummy variable of the location of the farm in a less favourable production area ($LFA_{k,t}$), or alternatively, a proxy variable characterising the quality of natural conditions by way of the official price of agricultural land ($Q_{k,t}$) was utilised. Besides the factors stated above, the effect of the regional location of the farm was also modelled by the way of dummy variables for five Regions of Cohesiveness (South West ($SW_{k,t}$), South East ($SE_{k,t}$), North East ($NE_{k,t}$), North West ($NW_{k,t}$), Central Moravia ($CM_{k,t}$), Moravia-Silesia ($MS_{k,t}$)), and the gender effect, by the way of a dummy variable ($W_{k,t}$) representing the prevailing position of women in the managing positions of the given agricultural business.

The choice of the appropriate regressors entering the final form of the model was based on the iterative top-down selection procedure (Bai and Person 1998), where the statistical significance of the parameter of the given regressor according to the Likelihood Ratio test (Gujarati 2003) was chosen as the selective criterion. Information criteria were also utilised for the assessment of the appropriate selection of explanatory variables, specifically the Akaike information criterion (ACI) (Hansen 2007). Multicolinearity was also tested in specifying the model, by way of the Farraf-Glauber test and VIF statistics (Lin et al. 2011).

The utilisation of panel data also required the adjustment of the model into a form of random effects, because of the existence of the inter-business heterogeneity as evidenced by the analysis of variance. The resulting model is as follows:

$$P(I_{kt} = 1|x_{jkt}, u_k) = \Phi(\alpha + \beta_{ASR}ASR_{kt} + \beta_{RC}RC_{k,t} + \\ +\beta_{PWU}PWU_{k,t} + \beta_{OF}OF_{k,t} + \beta_{OLF}OLF_{k,t} + \\ +\beta_{MP}MP_{kt} + \beta_{W}W_{k,t} + \beta_{SE}SE_{k,t} + \beta_{NE}NE_{k,t} + \\ +\beta_{NW}NW_{k,t} + \beta_{CM}CM_{k,t} + \beta_{MS}MS_{k,t} + e_{kt} + u_k) \quad (6)$$

Where:

e_{kt} = random element of the model with $e_{kt} \sim N(0,1)$

$j = 1, 2, \ldots J, t = 1, 2, \ldots T, k = 1, 2, \ldots K$

An estimate of the parameters of the said model was, under the assumption of a standardized normal distribution of the random element of the model $e_{kt} \sim N(0,1)$ and a normal distribution of farm specifics $u_k \sim N(0, \sigma_u^2)$, carried out by the way of the likelihood maximum method with a subsequent log-probability function (Bagnoli and Bergstrom 2005):

$$\log L = \sum_{k=1}^{K} \log \int_{-\infty}^{+\infty} \left[\prod_{t=1}^{T_k} \Phi(\beta' x_{kt} + \sigma_u u_k)^{y_{kt}} \right. \\ \left. [1 - \Phi(\beta' x_{kt} + \sigma_u u_k)]^{1-y_{kt}} \right] \phi(u_k) du_k \quad (7)$$

Where:

σ_u = decisive deviation of farm specifics (Green 2007)

The congruity of the obtained estimates with the empirical data was quantified by the way of the McFadden's Pseudo R^2 and tested by the way of the χ^2 test (Veal and Zimmermann 1994).

The statistical significance of the model as a whole, based on testing of the zero hypothesis, presuming that all regressive coefficients achieve a zero value, was examined by the way of the Likelihood Ratio test (LR-test). The LR-test was also utilized to test the adequacy of the specification of the model in the form of a random effects model. In the case in question, it was limited by the log-probability function, a function representing the estimate of the model without consideration of inter-farm variability, whereby it supplemented statistics "ρ" (Wooldridge 2002). The LR-test was also utilized for testing the statistical significance of the estimated parameters.

The marginal effects of the individual explanatory variables on the explained variable were quantified according to the Green's procedure (Green 2008):

$$\Delta\hat{P}(I_{kt} = 1|x_{kt}) \approx [g(\bar{x}\hat{\beta})\hat{\beta}_j]\Delta x_j \quad (8)$$

$$g(z) = \frac{d\Phi(z)}{dz} \quad (9)$$

For dummy variables, the marginal effects were quantified according to Wooldridge (2002):

$$\Delta\hat{P} = Prob[I_{kt} = 1|dummy = 1] - Prob[I_{kt} = \\ = 1|dummy = 0] \quad (10)$$

For the purposes of comparison, the model specified above was further estimated in the form of the logit model, which is defined by Wooldridge (2002) by way of the following relationship:

$$P(I_{kt} = 1|x_{kt}, u_k) = \Lambda(z) \quad (11)$$

$$\Lambda(z) = \frac{e^z}{1 + e^z} \quad (12)$$

The said model was estimated with the maximum likelihood method and tested by way of the LR-test. The partial effects of the said model were quantified according to the relationship 8, with only an adjustment of the relationship 9 for the logit model.

In order to make a comparison, the linear probability model (LPM) was also added, which was estimated by the way of the generalised smallest squares method because of the existence of heteroscedasticity. The statistical significance of the estimated parameters of the LPM was tested by way of the *t*-test. The congruity of the estimated model with the data was, in the case of the LPM, quantified by the coefficient of multiple determination, which was tested by the way of the *F*-test.

The above estimates of the probit model and the linear probability model, including verification, were conducted using the LIMDEP econometric software, version 9.0.

RESULTS

The results of the estimate of the binary choice model are set out in Table 3 for all considered variants of the model (probit, logit and LPM). The primarily analysed probit model shows a statistical significance of all estimated parameters. The LR-test showed a statistical significance at the significance level of $\alpha = 0.01$ for fourteen estimated parameters, while the parameter of the variable characterising the location of the farm in the Southwest region ($SW_{k,t}$) achieved the statistical significance with a probability of 95%. The estimate of the parameter ρ, defined as the proportion of the dispersion of farm specifics and overall dispersion of the random element of the model, proved, at a level of 0.531 with the probability of 95%, the statistical significance of the inter-company specifics and thus confirmed the suitability of the specification of the model in the form of random effects. The LR-test also allowed for the rejection of the hypothesis of zero values of all estimated parameters, at the significance level of $\alpha = 0.01$. The McFadden's Pseudo R^2 only quantified a 27.46% congruity of the estimated model with data, verified at the significance level of $\alpha = 0.01$; nevertheless, in terms of the quality of the estimate obtained by way of the maximum likelihood method, the statistical significance of the estimated parameters may be considered more significant (similarly – Wooldridge 2002). As regards the prediction capability, the model may be considered adequate, as it correctly quantified the value of the explained variable for 85.64% of observations. However, the model is slightly more sensitive with regard to zero values of the explained variable, which it predicted correctly for 86.84% of observations, while it predicted the implementation of the organic production technology correctly for 75.51% of observations.

The logit model was characterised by a similar statistical significance of the estimated parameters; only the parameter of the dummy variable, expressing the location of the farm in the Southwest region ($SW_{k,t}$), was not proven as statistically significant even at the significance level of $\alpha = 0.10$. The statistical significance of the inter-company specifics was proven in a similar manner to the probit model by way of the ρ coefficient, which was, in the case in question, quantified at the level of 0.7818 and proven as statistically significant with the probability of 99%. The McFadden's Pseudo R^2 quantified a 32.59% congruity of the estimated model with the data, with a 99% probability. The prediction capability (Giovanis 2010) of the logit model may also be compared to the probit model. Overall, the values for 85.85 % of observations were quantified correctly. The model slightly inclines toward the prediction of zero values, which were predicted correctly for 87.324% of observations, while the implementation of the organic technology was predicted correctly for only 74.53% of the observations.

In contrast to the models stated above, the linear probability model showed a much lower statistical conclusiveness of the estimated parameters. In addition to the parameter of the variable $SW_{k,t}$, , which did not achieve statistical significance even within the logit model; the constant was also statistically inconclusive. The parameter of the variable characterising gender of the farmer ($W_{k,t}$) was shown to be statistically significant only at the significance level of $\alpha = 0.05$. In the LPM, similarly as in the previous models, the statistical significance of the inter-company specifics was shown ($\rho = 0.7928$), at a significance level of $\alpha = 0.01$. The determination coefficient once again failed to reach a satisfactory value, as it only quantified 25.97% congruity of the estimated model with the data, statistically significant with the probability of 99%. However, the LPM correctly predicted the values of the explained variable for 83.65% of the observations. However, in comparison with the previous models, it had even more of the inclination toward the prediction of zero values, which it predicted correctly for 97.78% of the observations. However, it was only able to correctly predict the implementation of the organic technology for 27.67% of the observations.

As regards the direction of the effects of explanatory variables on the probability of the implementation of the organic production technology, the probit and logit model show congruity; the LPM model only differs in the variable of $SW_{k,t}$, the parameter of which is not, however, statistically significant in the said model.

The transition to and implementation of the organic production technology is negatively affected primarily by the increasing age of the farmer and a high productivity of the production factor of labour. Furthermore, large farms do not have a tendency to make the transition to the organic production technology. On the other hand, the probability of the implementation of the organic production technology grows as a result of the growing rate of subsidies for the support of organic agriculture and thereby the generally conditioned growing return on costs. There is also more of a tendency toward the implementation of the organic production technology in farms that have women predominating in managerial positions. In the above scientific studies, the possible reasons include, for example, a greater social empathy in women, the maternal role of woman and her attempt at the healthiest possible care for the child, etc. The transition to the organic production technology may also be presumed more probable for the farms located in the regions of the Czech Republic other than in the Central Bohemia, which was used as the basis.

Furthermore, the achieved outputs may be considered to show a positive effect of the age of the farm, and, in contrast, a negative effect of the age of the farmer as well as a negative effect of the specialisation of the farm on transition to the organic system. The positive effect of the age of the farm may be interpreted as the effect of "learning by doing", which usually brings a greater support for nature through more ecological technologies with the increasing experience in one's own practice and thus the support of the organic principles. The effect of age may be interpreted as expected, with the sociological studies stated above showing that a lower age level is associated with a higher rate of the modern knowledge regarding organic farming systems, which was not supported in the Czech Republic prior to 1990 and basically it was not applied, thus contributing to the tendency of support for the ecological principles primarily by younger farmers. Both considered effects may then be potentially connected in a possible conclusion that over the assessed period, there was a rejuvenation of farmers on the existing (historically functioning) farms, which would, in view of the previous and current age structure of workers in agriculture, be a highly positive phenomenon. The negative effect of specialisation may be explained by the fact that a stronger specialisation is a method of increasing the profitability of a conventional manner of farming and the farms in question thus then have less motivation to make the transition to organic farming.

Table 3. Results of the estimations

	Probit			Logit			LPM	
	coeff.	std. err.	partial effects	coeff.	std. err.	partial effects	coeff.	std.err.
Const.	(–2.4951)***	0.5322	(–0.5246)***	(–4.4508)***	0.8759	(–0.4639)***	(0.0479)	0.0779
$W_{k,t}$	0.2414***	0.0588	0.0507***	0.3943***	0.1511	0.0403***	0.0328**	0.0169
$OLF_{k,t}$	(–0.1802)***	0.0394	(–0.0379)***	(–0.2876)***	0.1045	(–0.0299)***	(–0.0352)***	0.0116
$MP_{k,t}$	(–0.4716)***	0.0802	(–0.0992)***	(–0.8050)***	0.2331	(–0.1085)***	(–0.1142)***	0.0325
$ASR_{k,t}$	0.5632***	0.2669	0.1184**	1.000***	0.3355	0.1042***	0.1129***	0.0404
$LF_{k,t}$	(–0.2615)***	0.0245	(–0.0548)***	(–0.4660)***	0.0631	(–0.0486)***	(–0.0506)***	0.0066
$OF_{k,t}$	0.8586***	0.0704	0.1805***	1.5987***	0.1792	0.1666***	0.192***	0.0195
$PWU_{k,t}$	(–0.5001)***	0.0478	(–0.1051)***	(–1.0648)***	0.1832	(–0.1110)***	(–0.1492)***	0.0201
$RC_{k,t}$	2.2792***	0.2591	0.4792***	4.2109***	0.5549	0.4388***	0.6669***	0.0670
$SE_{k,t}$	1.2720***	0.4115	0.2674***	2.2461***	0.6444	0.3710***	0.1288***	0.0358
$NE_{k,t}$	0.9845***	0.4108	0.2070***	1.7380***	0.6532	0.2674**	0.0725****	0.0358
$NW_{k,t}$	1.5739***	0.4153	0.3309***	2.7385***	0.6660	0.5315***	0.2424***	0.0437
$SW_{k,t}$	0.6434**	0.0274	0.1353*	1.0484	0.6532	0.1335	(–0.0036)	0.0346
$CM_{k,t}$	1.4620***	0.4118	0.3074***	2.5852***	0.6431	0.4571***	0.1798***	0.0365
$MS_{k,t}$	1.4595***	0.4134	0.3068***	2.5705***	0.6647	0.4959***	0.1822***	0.0444
LR [14]	62.9328***			598.2182***				
Log-likelihood function	(–634.1955)			(–618.5610)				
(Pseudo) R^2	0.2746***			0.3259***			0.2597***	
AIC	0.7378			0.6868				
Correct prediction	85.637%			85.854%			83.648%	
Positive predictive value	75.510%			74.528%			27.671%	
Negative predictive value	86.841%			87.324%			97.775%	

Source: Own calculation

For a comparison of the strength of the effect of these variables in the individual models, a conversion was conducted as proposed by Wooldridge (2002). Of the examined variables, a significant congruity in the strength of the effect on the implementation of the organic production technology was seen in the variables of mixed production and the age of the farmer, and this was so in all examined models. On the other hand, the greatest differences were declared between the parameters of the index models and the LPM for the variable of the location of the farm in the Southwest region. A comparison of the probit and logit models shows a congruity in the strength of effect of the explanatory variables on the explained variable.

Within the probit model, the most significant dummy variable affecting the implementation of the organic production technology may be considered the location of the farm in the Northwest region. The said location increases the probability of the implementation of the organic production technology by 0.3309, and by whole 0.5315 in the logit model. Currently, 13.01% of the organic agriculture businesses in the Czech Republic are located in the said region. The said region is also characterised by the highest rate of the organically farmed land in the Czech Republic (24.56%). From the regional viewpoint, the location of the farm in the Central Moravia region is also significant, which increases the probability of the implementation of the organic production technology by 0.3074. A total of 17.63% of organically farming agricultural businesses in the Czech Republic are located in the said region. In terms of the probit and logit model, the Moravia-Silesia region may be added to the said regional definition of organic farms, as the said dummy variable increases the probability of the implementation of the organic agricultural production by 0.3068 (by 0.4959 in the logit model). A total of 9.45% of ecological farms are located in the said region of the Czech Republic, on 11.52% of the organically farmed land. The location of the farm in the Southwest region together with the specialisation of production and a woman in the managerial position thus increases the probability of the implementation of the organic production technology by 0.3816 according to the probit model and by 0.5718 according to the logit model.

Among proxy variables, the age of the farm has the most significant effect, where, surprisingly, the tradition of the agricultural business shows more of a tendency toward the implementation of the organic production technology. Of the other variables, the greatest effect may be seen in the case of return on costs. For example, a growth in return on costs by 1% increases the probability of the implementation of the organic production technology by 0.4792. Other variables tend to have a much smaller effect on the probability of the implementation of ecological production technology. For example, an increase in subsidy rates by CZK 1000 per hectare increases the probability of the implementation of ecological production technology by 0.0118.

Under the current level of rates for the support of ecological agriculture, the most probable transition to ecological production technology may thus be presumed in the case of small farms (up to 99 ha), located in the Southwest region managed by a young female manager (up to 40 years of age) with low labour productivity.

In connection with the binary choice models quantified above, the selected scenarios were subsequently simulated, allowing for a broader characterisation of the behaviour of the examined entities and their motivation to make the transition to an organic farming system. The following scenarios were analysed successively. **Scenario 1** – Growth in subsidy rates for the support of organic agriculture by 10%. The result of the simulated estimate of the Probit model is an increase in the number of organic farming entities by 3%, which corresponds to the presumed intensity of growth as well as other similar research studies (for example, Jánský and Živělová 2007; Kumbhakar et al. 2008). Subsequently, there was an analysis of **Scenario 2** – Growth of the subsidy rates for the support of organic farming by 20%, the output of which is an increase in the number of organic agriculture entities by 5%. In the overall context, there was also a subsequent examination of **Scenario 3** – Growth in subsidy rates for the support of organic agriculture by 50%, in which case there was a potential increase in the number of organic agriculture entities by 10%. The above values show a relatively lower rate of growth in the number of organic entities as compared to the corresponding rate of growth of subsidy rates; the fact that strong increases in rates are not a sufficient stimulus for the transition of more businesses to an organic farming system, and that there are thus probably other significant motivating factors. The subsequently modelled scenarios focus on simulations of a change in the return on costs. **Scenario 4** – An increase in the return on costs by 1%. According to the results of the Probit model estimate, the said situation led to an increase in the number of organic entities by 3%. **Scenario 5** – An increase in the return on costs by 2% would then likely cause an increase in the number of organic entities by 13%. The presented outputs may be considered very substantial, as a one percent increase in return on costs in the examined sample of businesses would cause more than a four-fold increase in the rate of growth in the number of organic entities, meaning operations resulting in growth of return on costs may thus be considered a very strong motivating tool. The last examined simulation was **Scenario 6** – The farmer growing older (moving into the 40–60 age category), which would, according to the obtained estimates, cause a fall in the number of organic entities by 29%. The said value is relatively surprising in terms of its size and shows that older farmers do not have the willingness to make the transition to organic farming principles. However, according to the general assumptions as well as similarly conducted research studies (see below), the negative effect of the age of farmers is a relevant finding, as it is very probable that younger farmers have had more opportunities to get acquainted with the organic farming technology in a professional manner as well as the opportunities to achieve a positive economic effect, and the increasing age thus decreases the number of organic entities.

DISCUSSION

The transition to and the implementation of the organic production technology is negatively affected primarily by the rising age of farmers and the high productivity of the production factor of labour (similar findings by Pietola and Lansink 2001). In addition, large farms do not have a tendency to make the transition to the organic production technology. This is also demonstrated in the research of Pietola and Lansink (2001). On the other hand, the probability of the implementation of the organic production technology grows as a result of growing subsidies for the support of organic agriculture (similar findings by Jánský and Živělová 2007; Kumbhakar et al. 2008). However, the effect of the subsidy rates is relatively low and with the increasing level of the rate, the rate of growth of the organic farming entities goes down. Other factors appear to be decisive; primarily the achievement of a positive economic effect, where the growing return on costs markedly increases the number of organic entities. Similar results were achieved, for example, by Darnhofer et al. (2003) and Zagata (2010a).

Last but not least, it may be stated that there is more of the tendency to implement the organic production technology in farms where women predominate in management positions, and the transition to an organic system may also be presumed more likely for farms located in other regions of the Czech Republic than in the Central Bohemia, which was used as the basis.

Under the influence of the experience acquired over the long-term, the age of the farm was expressed positively, and the age of the farmer was, in contrast (related to the modern knowledge of organic farming systems being presented only relatively recently and thus tending to be more accessible to younger farmers), expressed negatively. Both effects are in accordance with similar studies; see, for example, Kumbhakar et al. (2009) and Tiffin (2011). Specialised production has a negative effect on the transition to organic farming principles, which is also evidenced by the research done by De Koeijer et al. (1995), the output of which is the conclusion that mixed farms have greater preconditions for the transition to the organic production technology.

CONCLUSION

Organic agriculture is one of the fastest growing sectors of Czech agricultural production what illustrates the dynamic growth in the number of organically farming entities. Some research studies presume that the main determinant of the development of organic agriculture is the growing rate of specific subsidy. However, the results of estimated binary choice models declare that the effect of the subsidy rate on the probability of the implementation of organic farming is relatively low and for example much lower than the effect of growing return on cost. Simulated scenarios declare that 10% growth in the subsidy rate cause increase in the number of organic farms by 3%, while the same change can be caused by 1% increase in the return on costs.

On the other hand, the probability of implementation of organic farming is negatively affected by higher age of the farmers, higher size of farm and the high productivity of labour.

Finally, it can be said that the Czech farms with the greatest potential of transition to the organic production technology are presumed small farms (up to 99 ha), located in the Southwest region, managed by a young female manager (up to 40 years of age) with low labour productivity.

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