THE TECHNICAL EFFICIENCY OF YOUNG FARMERS IN THE CZECH REPUBLIC

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Abstract

The European Commission assumes that young managers bring innovations to the agricultural holdings and achieve better profitability, and therefore it supports their businesses by the subsidies. As the resources of the finances are public, it must be examined whether the aid is justified. Hence, the aim of the paper is to assess the technical efficiency of the young farmers and compare it to the technical efficiency of the holdings lead by "non-young" farmers.

Evaluated sample includes 82 observations for young farmers and 444 for others in the years 2007–2012. A Stochastic Frontier Analysis is used to estimate the production function in Cobb-Douglas form and to calculate the technical efficiency using Jondrow et al. (1982) method. Young farmers are found to be more efficient (from 67.6%) than other farmers (59.1%).The differences between the groups of farmers were tested using non-parametric Wilcoxon rank-sum test. The results show that young and other farmers do not statistically significantly differ in terms of the technical efficiency. Those findings do not support the assumptions on which the aid for which young farmers is provided. However, further research is needed in the area of innovation adoption by the farmers.

Key words: young farmer, Rural Development Programme, Stochastic Frontier Analysis

JEL Code: H71, H25

1 Introduction

The age structure of the Czech workers in agriculture is not favourable (see Šimpach (2012) or Šimpach and Pechrová (2014). Majority of farmers belong to the category between 50 and 54 years. Therefore, the steps are taken to encourage the young people to enter the agri-business. The financial support is provided for example from Rural Development Programme (RDP) for the period of 2007–2013 under measure *1.3.2 Setting up of young farmers business*. A person which is younger than 40 years is considered to be a young farmer. "The granting of

specific benefits to young farmers may facilitate both their initial establishment and the structural adjustment of their holdings after their initial setting up" (EC, 2005).

There were six calls for submission of the application for a grant (1st round in 2007, 3rd in 2008, 9th in 2010, 12th in 2011 and 16th in 2012) announced by the MoA. In total, there were 3 606 projects in a value over 3.9 bn. CZK registered, from which 1 286 projects in a value of 1.3 bn. CZK were re-paid so far (as of 30th September 2014). In total, 1105 young farmers were supported. One farmer had on average 1.1 bn. CZK at disposal. The programme will continue in new RDP for the period of 2014–2020, but in slightly different form.

As the young farmers are supported from public funds, it is desirable to examine, whether they are better managers and lead the companies to higher performance as it is assumed during subsidies' allocation. Davis et al. (2013) conducted a research in the area of the economics of New Entrant Scheme. They found out that young farmers had longer planning horizon and invest more to the growth of the holding that comparable group of older farmers.

According to Koutsou et al. (2014) the young farmers play „important role during creation and implementation of the modern rural development model". It seems that young farmers fulfil their role. However, Zagata and Sutherland (2015) also found "a major inconsistency between European policy documents, which conflate young farm holders with new entrants; Eurostat numbers, which focus on young sole holders; and the academic literature, which consistently demonstrates the importance of farming successors to farm business development."

„In measuring efficiency of producers, the focus is mostly on technical efficiency, which is often associated with managerial efficiency and estimated form the production/distance functions or the dual cost, revenue and profit functions" (Tsionas and Kumbhakar, 2006). Therefore, the aim of the paper is to examine whether the younger farmers and ensure the production with better technical efficiency than other farmers. The paper is structured as follows: firstly a methodology and used data are described. Then the results are provided and discussed. Last section concludes and draws suggestions for policy-making.

2 Methodology and data

Technical efficiency in this article is understood as defined by Pitt and Lee (1981) as "the maximum quantity of output attainable from given inputs". There have been two approaches developed for calculation of it – parametric and non-parametric. In both, a production frontier is constructed from the combinations of inputs and outputs where the production is technically efficient. The distance between the frontier and the actual input-output combinations of a particular farm measures the technical inefficiency of the production. The efficiency is normalized in the interval $\langle 0;1 \rangle$ taking value of 1 when the firm is 100 % efficient.

We utilize a parametric approach – Stochastic Frontier Analysis (SFA). Production function is assumed to have Cobb-Douglas form (i.e. power function in linearized form; hence, the coefficients could be interpreted as elasticity). The amount of production y_{it} – where i (i =1, … n) denotes particular farm in time t was expressed in financial form (as sales) and deflated by the agricultural producers' prices (2005 = 100). The production was explained by 4 variables: consumed material and services ($x_{1,\,it}$) and capital – fixed tangible assets ($x_{2,\,it}$), both deflated by industrial producers' prices (2005 = 100), labour measured in number of workers ($x_{3,\,it}$), land in hectares ($x_{4,\,it}$) calculated as the division of Single area payment (SAPS) subsidies obtained by a company and SAPS rate in particular year. It was further corrected by the coefficient of land quality calculated as division of the administrative land price in particular region to the average administrative land price in the Czech Republic. The True fixed-effects model (TFE) suggested by Greene (2002) was estimated in the following form (1).

$$y_{it} = \alpha_i + \beta^T \mathbf{x}_{it} + v_{it} - u_{it}, \qquad (1)$$

whereα_i is the farm specific time invariant constant, $\boldsymbol{x}_{it}$ represents the matrix of explanatory variables and u_{it} is time variant inefficiency term, v_{it} is independently identically distributed $N(0;\sigma^2_{v_{it}})$ error term representing usual statistical noise. The distribution of u_{it} was assumed to be truncated normal $N^+(\mu_{u_{it}};\sigma^2_{u_{it}})$, hence we had to apply the maximum likelihood estimation method. Heterogeneity among farms (mean of u_{it}) was explained by a constant by the age of a farmer (z_{it}) as it is the factor which divides farms on two groups and where farms differs.. Heteroskedasticity (variance of u_{it}) was explained only by a constant.

The technical efficiency was estimated using Jondrow et al. (1982) method as $e^{(-E(u|e))}$. Then it was examined whether the age affects the standard deviation of technical inefficiency. Consequently it was tested by non-parametric (efficiency distribution is not normal) Wilcoxon

rank-sum test, whether the technical efficiency statistically significantly differs between farms managed by young and other farmers.

We utilized accountancy data of legal entities – agricultural holdings observed for years 2007 to 2012, i.e. from the beginning of RDP functioning until the latest available. A panel of 117 farms contained 526 observations in total (82 were for young farmers). There were on average 4.5 observations per one agricultural holding. Descriptive statistics of used variable are provided in Tab. 1.It can be seen that used resources differs between farms managed by young and other farmers. While young farmers produce on average more, they use less material, services and fixed assets. Also the number of employees is lower. Farms of other farmers are larger as they probably have longer time to expand their business than young farmers. Average acreage of the young farmers' farm is almost 900 hectares lower. Of course, the average age is higher in case of young farmers than in case of other farmers. Young farmers were 33 years old on average, while others were 54 years old.

Tab. 1: Descriptive statistics of a sample of agricultural holdings

Variable	Young farmers	Other farmers	All
Nr. of observations	82.00	444.00	526.00
y_{it}- Production (thous. CZK)	1 235 266.00	1 064 513.00	1 091 607.00
$x_{1,it}$ -Usage of material and services	903 696.90	1 991 805.00	1 819 153.00
$x_{2,it}$ - Usage of capital (tangible fixed assets)	4 412 492.00	10 900 000.00	9 894 939.00
$x_{3,it}$ - Nr. of employees	50.17	88.28	82.23
$x_{4,it}$ - Acreage (hectares)	1 837.00	2 703.07	2 565.65
z_{it} - Age	32.72	53.54	50.24

Source: Own elaboration

Accountancy data were gained from Albertina database of Bisnode Company. The SAPS rates were obtained from State Agricultural Interventional Fund. Agricultural and industrial producers' prices were taken from Czech Statistical Office and administrative land prices from a study of Pírková (2014). Age of farmers was looked up in business register (particularly year of birth of the main owner / manager was deducted from the observation's year). The calculations were done in econometric software Stata 11.2.

2 Results

The results of TFE estimation are displayed at Tab. 2. The model as a whole was statistically significant (Wald $\chi^2 = 5.63.10^{09}$ with prob.> $\chi^2 = 0.00$). Log likelihood equalled to -776.14.

All frontier parameters had expected sign (except for labour) and were statistically significant. The first coefficient reads that if the usage of capital increases by 1%, production increase by 0.06%. Similarly if the capital usage increases by 1%, production rises 0.07%. The highest elasticity is noted in case of land (increase of production by 0.13%). Labour did not have desirable sign which may indicate some problems with over-employment or productivity of this factor as its increase by 1% would cause decrease of production by 0.09%.

The mean of inefficiency function had none statistically significant parameters. Despite that the higher age of farmer increases the average inefficiency (and lower age decreases it), the effect is not verifiable. The value of the coefficient cannot be generalized on the whole population and the support to young farmers cannot be clearly advocated. Besides, the effect of both is rather mild.

Tab. 2: TFE estimates, truncated-normal distribution of u_{it}

	Coef. (Std. err.)		Coef. (Std. err.)
Frontier		μ_u – inefficiency mean function	
β_1 ($x_{1,it}$)	0.0602 ($6.43.10^{-06}$)***	δ_0 (constant)	-152.4753(133.592)
β_2($x_{2,it}$)	0.0707 ($7.68.10^{-06}$)***	δ_1 (z_{it})	0.2815 (0.6150)
β_3($x_{3,it}$)	-0.8852 ($1.48.10^{-05}$)***	σ_u – inefficiency variance function	
β_4($x_{4,it}$)	0.1250 ($7.46.10^{-06}$)***	ω_0 (constant)	4.8029 (0.8722)***
σ_v – stochastic term variance function		Note: statistical significance is labelled: *** at $\alpha = 0.01$, ** at $\alpha = 0.05$ and * at $\alpha = 0.1$	
γ_0 (constant)	-31.7864 (57.3944)		

Source: own elaboration

Consequently, the technical efficiency of the agricultural holdings was estimated. The results show (see Tab. 3) that there is 39.6% production gap as the farms are efficient only from 60.4% on average. Young farmers (from 67.6%) were more efficient than other farmers (from 59.1%). This finding is in line with previous obtained from TFE model (see Tab. 2).

The efficiency was tested whether the distribution of it is normal. As expected Shapiro-Wilk test revealed that the probability that null hypothesis holds is 0% (7.097^{***}). Hence, the hypothesis is rejected and further testing is done by nonparametric tests. The differences between the groups were tested using Wilcoxon rank-sum test. The null hypothesis was not rejected at $\alpha = 0.05$. Hence, there are no statistical differences between young and other farmers regarding the technical efficiency. Of course, the probability that

other farmers will be more efficient that young ones is low as other farmers are actually less efficient.

Tab. 3: Two-sample Wilcoxon rank-sum (Mann-Whitney) test

Farmer	Efficiency	H0: $\mu_1 = \mu_0$	H0: $\mu_1 < \mu_0$
Young (1)	0.6759	z =-1.740 (p = 0.0819)	p = 0.440
Other (0)	0.5907		
All	0.6040	---	---

Source: own elaboration

This finding has certain implications in practise. It shows that the assumptions that the performance of the holding depends on the age of the managers might be too strong. Our findings are in line with those of Hengzhou and Tong (2013) who examined the effect of age on efficiency of family farms in China. Their result was "ambiguous, depending on whether older farmers are more experienced or more likely to stick to farming traditions and less likely to adopt new technologies." Galanapoulos et al. (2011) give an argument for the transition of the agricultural holding to younger farmers stating that: "the old age of the farmers and the lack of successors is often the main reason for poor adoption levels of novel production techniques and improved management systems."

In our case the other farmers use on average more (or more expensive) tangible fixed assets than young farmers. However, we cannot assess the age or innovativeness of the technologies. Therefore, more detailed study based not solely on accountancy data will be needed. Besides, the managerial competences of the farmers should be examined too. For example Christina et al. (2013) found that the employees of particular age cohort favourably perceive the managers of the same generation. Therefore, it is not important what age the manager is as long as the employees are of the same age group, because they perceive him or her more competent. This also influences the performance of the agricultural holding as a whole. It is obvious that further research is needed.

Conclusion

The objective of the paper was to assess the technical efficiency of the farmers in the Czech Republic and to find out whether young farmers are more technically efficient than others. Evaluated sample was an unbalanced panel with 82 observations for young farmers and 444 for others in the years 2007–2012. Using SFA a TFE model is constructed. The mean of the

inefficiency term is explained by farmer's age, so its effect on inefficiency could have been assessed. The coefficient for age was not statistically significant. Despite that higher age of the manager affect the efficiency of the farm negatively, the results are not robust. Selecting another sample of farms might bring different outcomes. Consequently the technical efficiency of each farm was estimated. Young farmers were found to be more efficient (from 67.6%) than other farmers (59.1%). However, the differences are negligible. Wilcoxon rank-sum test revealed that young and other farmers do not statistically significantly differ in terms of the technical efficiency. Those findings do not clearly support the assumptions on which the aid for which young farmers is provided. However, further research is needed in the area of innovation adoption by the farmers. Using other than solely accountancy data is recommended.

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