

Research of the impact of agricultural policies on the efficiency of farms

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Abstract

Common Agricultural Policy is one of the oldest as well as one of the most expensive policies of the European Union. Common Agricultural Policy accounted for circa 40 % of the European Union's budget. The aim of the presented paper is the analysis of agricultural policy impact on the agrarian subjects in Slovakia in the period 2007 – 2013. The source of the data is Information Sheets of the Ministry of Agriculture of the Slovak Republic. There is no significant technical inefficiency present when the production function model is applied with the subsidies as the part of the revenues. The subsidies might be considered as the input to motivate subjects and to increase the amount of the sales' revenues. However, production function model shows negative effect of the subsidies on the sales' revenues.

Keywords: agriculture, Common Agricultural Policy, efficiency, Slovakia

JEL klasifikácia: C51, O13, Q18

1. Introduction

The expansion of the European Union's (EU) economic and geographical size has led its budget to a steady increase characterized by phases of both reduction and accelerated growth, mainly due to the implementation of new policy actions.

The Common Agricultural Policy (CAP) is one of the oldest policies of the EU. Due to the CAP's long history, it is also a policy that has been reformed on many occasions, in particular during the past decade and a half. The CAP reforms reflect changes in the pursued goals of the CAP. The goals have evolved from food security in the beginning through competitiveness, sustainability and cohesion to policy efficiency with the CAP REFORM 2003. The CAP reforms together with growth of other EU policies have impact on the resources available to implementation of the CAP. The share of CAP expenditure on the EU budget has decreased very sharply over the past 25 years, from 73% in 1985 to 39% in 2013. This decrease has taken place despite the EU enlargements.

Expansion of the EU changed the situation in the CAP and created differences in the CAP subsidies. However, the European Commission acknowledged that the differences in support levels cannot be justified on a long term. On the other hand, a flat rate of direct payments is not a feasible solution in the environment consisting of states with different wage levels and input costs (Kosior, 2014).

The payments from the EU should have been leveled after 10 year period of the so called phasing-in. Therefore, today the question may be raised whether the phasing-in worked and if the CAP subsidies contributed to improve the efficiency of the agricultural subjects in Slovakia.

1.1 Empirical background

There are rich sources of empirical studies aimed at the efficiency of farms in connection to subsidies. Bielík and Hupková (2011) employed data envelopment analysis for the research of the efficiency for the years 1999-2007 and found decreasing trend in the overall efficiency. Same method, that is data envelopment analysis, was used by Kleinhanss, Murillo, San Juan and Sperlich (2005), who addressed the efficiency in connection to the CAP. Authors' research showed that direct payments tend to increase efficiency and that the less environmentally friendly and larger farms are more efficient. Sojková, Kropková and Kováč (2008) estimated efficiencies for Slovak farms using the SFA. Results for the years 2003-2005 did not prove any trend in efficiency. However, farms operating in the less favored areas had better efficiency results than farms from the production regions.

In general, payments decoupled from the production are assumed to be less market disturbing. Furthermore, such support ensures farmer's freedom in the output structure (Pokrivčák, & Ciaian, 2004). These facts should help improve efficiency of farms. However, subsidies can either improve efficiency if they provide incentive to innovation or decrease it if, as a certain income, reduce the motivation of farms. How much the subsidies affect the performance of producers is a question for empirical research (Zhu, Demeter, & Lansink, 2012)

The article is structured as follows. Section two discusses the concept used in this paper for the measurement of the efficiency, and used data. In section three there are results presented. Section four concludes.

2. Data and methodology

Research of this paper is aimed at the agricultural subjects of the Slovak Republic and the comparison of their efficiency in the years 2007 and 2013.

2.1 Data

Data on the farms is drawn from the Information Sheets of the Ministry of Agriculture and Rural Development of the Slovak Republic. Time comparability of the financial entries is secured by the price indices drawn from the EuroStat.

The main variables of our concern are total output, capital, labour, and subsidies of non-investment nature for the estimation of the production frontier model and the quantification of efficiency measures.

2.2 Methodology

Producers are efficient if they produce as much output as possible with the employed set of inputs and if the given output is produced at the minimum cost (Pesaran & Schmidt, 1997). The measure of efficiency can be decomposed into technical and allocative efficiencies (Coelli et. al, 2005). Technical efficiency is an ability of a decision making unit to produce maximum output with a given set of inputs. The decision making unit is allocatively efficient if it produces given output mix using cost-minimizing set of inputs (Farrell, 1957).

In general, there are two main approaches to efficiency measuring, namely data envelopment analysis (DEA) and stochastic frontier analysis (SFA). DEA is a non-parametric deterministic method, which allows for multiple input and output variables to be engaged in the model of the production frontier. However, any deviation from the frontier is assigned to inefficiency of the decision making unit. On the other hand, SFA is a parametric method which accounts for the random noise as the part of the deviation from the production frontier. When applying SFA the mathematical form of the production frontier has to be known or assumed.

In this paper the Cobb-Douglas production function is estimated using variables listed in the previous section (see 2.1)

2.2.1 Stochastic Frontier Analysis

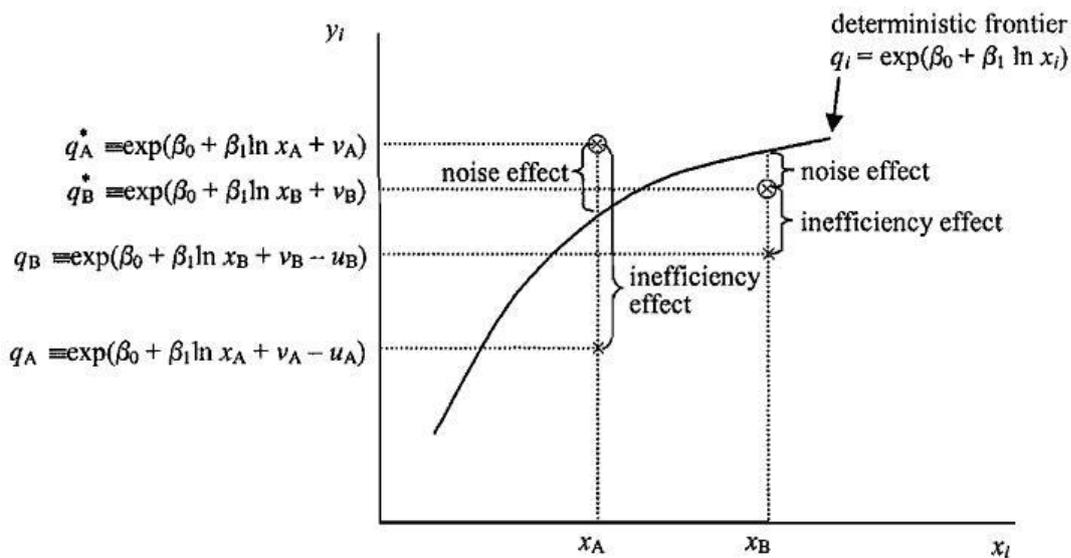
Statistical method applied in this paper for the estimation of efficiency measures is the SFA. Initially proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) the SFA allows for the estimation of the production function model given by the Equation 1:

$$\ln(y) = \alpha + \beta * \ln(x_i) + v_i - u_i \tag{1}$$

The SFA accounts for the fact that the quantity of *i*'s firm output is influenced not only by the efficiency of a subject but also by the noise effect (v_i). Deviation from the frontier is known as the compound error term, where the noise effect (v_i) represents impact of random external factors and can be positive or negative. (Greene, 2008)

Therefore, SFA model (Eq. 1) consists of three parts, namely deterministic frontier, noise effect and inefficiency (Fig. 1)

Figure 1: Three parts of the SFA



Source: Coelli, T. J., Rao, D. S. P., O'Donell, C. J., & Batesse G. E., 2005

Measure of *i*'s farm technical efficiency (TE) is computed as:

$$TE_i = \exp(-u_i) \tag{2}$$

This measure (Eq. 2) takes values 0 - 1 and represents quantity of *i*'s farm output relative to the output achievable if the inputs had been used efficiently. The SFA assumptions are:

- v_i is symmetrically distributed,
- v_i and u_i are independent and identically distributed variables,
- v_i is distributed independently of u_i and both error terms are uncorrelated with the explanatory variables,
- v_i and u_i are homoskedastic. (Coelli et al., 2005)

When the SFA is applied, the presence of systematic inefficiency (u_i) is tested. In the case it is not present, the error term is symmetrical, u_i equals to zero and the error terms equals only to v_i . In cases where u_i is more than zero, compound error is asymmetrical, negatively skewed,

indicating inefficiency of studied subjects. Schmidt and Lin (1984), and Coelli (1995) proposed a test for the presence of systematic technical inefficiency (for details see Kubhakar & Lovell, 2000).

Estimation of stochastic frontier and inefficiency measures is based on the assumption of distribution of u_i . The most widely used distributions applied are half-normal, gamma, exponential, and truncated normal distribution. In practical application it has to be tested whether the deviations from the frontier could be assigned solely to the statistical noise (v_i) or if the inefficiency is present (u_i). The stochastic frontier is estimated by the maximization of the likelihood function (Coelli et al., 2005).

For the purpose of this paper the statistical software STATA 13 is used.

3. Results and discussion

Information Sheets of the Ministry of Agriculture and Rural Development of the Slovak Republic provide data for the complete list of the agricultural subjects. It is necessary to create a balanced panel of data for the purpose of comparison between years 2007 and 2013. The panel needs to be adjusted as not all of the farms existed during the whole period and therefore had to be removed from the database. Further adjustment included removal of subjects without received subsidies and removal of outliers. As a result the panel consisting of 768 farms is obtained. Using the price indices from the EuroStat the data is synchronized for the prices of the year 2014 allowing for the time comparison.

3.1 Impact of the non-investment subsidies on the technical efficiency

Estimation of the efficiency measures is based on the SFA with the exponential distribution of the u_i (see 2.2.1) in STATA 13. Production frontier is specified according to Cobb-Douglas function. Total revenues variable is used as the output, capital and labour as inputs. It has to be noted that the amount of non-investment subsidies is part of the total revenues. Based on the Information Sheets and accounting in Slovak Republic, non-investment subsidies are recorded as the part of the revenues. Efficiency measures are estimated for the year 2007 and 2013. Comparison of the results for these years should show if the farms are getting closer to the frontier and therefore becoming more efficient.

However, when the functional form from the previous paragraph is used, test for the presence of inefficiency shows that the deviations from the frontier should be attributed solely to the statistical noise. Therefore, no statistically significant inefficiency is identified. Former applies both to the year 2007 and 2013 (Tab. 1, M1 2007 & M1 2013).

Given that the studied subsidies are recorded as revenues in the books, second model is specified where only sales' revenues (difference of total revenues and non-investment subsidies) are used as the output variable. Input variables remain the same as in the first case. Applying such model gives results showing statistically significant inefficiency (Tab. 1, M2 2007 & M2 2013). This suggests that subsidies have positive impact on the performance of the farms. When the financial aid is not included in the model, agricultural subjects are technically inefficient contrary to the results of model incorporating subsidies (Tab. 1).

As mentioned earlier, non-investment subsidies are part of the revenues. However, this financial aid could be considered as the amount of funds that should be transformed into better performance and improved sales' revenues. For this purpose the third model is specified, both for the years 2007 and 2013 (Tab. 1, M3 2007 & M3 2013). The third model employs subsidies as the input variable, together with capital and labor. Sales' revenues are considered as the output variable. The third model once again shows statistically significant

inefficiency. However, subsidies' variable is estimated to have negative coefficient. This suggests that the financial aid does not serve as the motivator corresponding to the higher sales' revenues (Tab. 1).

Table 1: Production frontier and efficiencies of farms in 2007 and 2013

	Const	Labor	Capit	Subsid	/lnsig2v	/lnsig2u	Ineff. Test	Average eff.	Eff. st. dev.
M1 2007	2.411 ***	0.251 ***	0.619 ***	-	-2.068 ***	-3.709 ***	0.075 *	0.865	0.052
M1 2013	1.537 ***	0.210 ***	0.700 ***	-	-1.763 ***	-10.456 ***	1.000	0.996	0.000
M2 2007	1.672 ***	0.208 ***	0.705 ***	-	-2.015 ***	-1.545 ***	0.000 ***	0.684	0.176
M2 2013	0.208	0.188 ***	0.813 ***	-	-1.489 ***	-1.969 ***	0.000 ***	0.728	0.129
M3 2007	1.917 ***	0.229 ***	0.755 ***	-0.099 ***	-1.972 ***	-1.636 ***	0.000 ***	0.694	0.168
M3 2013	0.517	0.209 ***	0.855 ***	-0.095 ***	-1.451 ***	-2.087 ***	0.000 ***	0.739	0.120

Source: own work, STATA 13

To sum up the results, non-financial subsidies appear to have positive impact on the overall efficiency of agricultural subjects. Model which included subsidies as part of the revenues (Tab. 1, M1 2007 & M1 2013) tested negatively for the presence of the systematic inefficiency. On the other hand, subsidies, as the input to improve sales' revenue, are estimated to have small negative impact (compared to capital and labor coefficients). Therefore, non-investment financial support does not serve as the motivator for better performance (Tab. 1, M3 2007 & M3 2013). Considering the time development the average efficiency is estimated to be better in 2013, regardless of the model specification (Tab. 1; M1, M2, M3 2007 & 2013).

4. Conclusion

The CAP is still evolving political framework of the EU. The challenge for the CAP was flattening of the financial support among the countries. Tool for such flattening was 10 year period of phasing-in. However, subsidies in central and eastern European countries are not the same as in the old member states of the EU. Differences among countries together with the amount of the finances for the CAP create pressure for the effective allocation of the sources that does not distort the market and supports improvement of the farms' efficiency and competitiveness.

The aim of this paper is to assess the impact of the non-investment subsidies on the efficiency of agricultural subjects with the focus on the years 2007 and 2013.

Employing the SFA, the Cobb-Douglas production function is estimated for the years 2007 and 2013. When modelling the output including subsidies (that means as they are kept in books) there is no statistically significant inefficiency present. On the other hand, frontier for the sales' revenues shows significant inefficiency. Therefore, non-investment financial support has positive effect on the average efficiency of Slovak farms. Furthermore,

the average efficiency is better in the 2013, compared to the 2007. Former statement holds for the three model specifications presented in this paper. Such result suggests positive effect of the phasing-in period despite the fact that the financial support is not levelled across countries.

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