Applying Sustainable Value Methodology for Hungarian Agriculture

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Abstract— **The Sustainable Value method is a promising approach for accessing sustainability performance of a given activity using the concept of opportunity cost and the performance of a given benchmark. In this study the performance of the Hungarian agriculture is studied. Using FADN data for the period of 2002-2006, the possible effect of the EU accession on agricultural production is examined. Structural, economic and human factors are considered in order to gain better understanding of the differences.**

Keywords— **sustainability, EU accession, assessment**

I. INTRODUCTION

The re-discovery and widespread popularity of sustainability in all fields are dated from the publication of the Brundtland Report in 1987 [1]. The concept has been challenged ever since, both from a theoretical and a practical point of view [2], however inclusion of sustainability in the objective of different economic activities – including agriculture – is hardly questionable.

A great number of definitions for the concept of "sustainability" can be found in the literature [3]. The key issues are what dimensions are considered and the standpoint from which sustainability is studied. Primarily it was viewed as a macro level concept closely related to sustainable development aiming to increase the well-being of everyone without exhausting the "resources basis" of economies [4]. The concept of sustainable development is based on two pillars: the equity principle (inter- and intra-generational equity) and the tri-dimensionality principle, the concept involving economic, ecological and social aspects [5]. Economists frequently tend to apply the capital theory approach when studying sustainability [6]. Capital is made of man-made capital, human capital, natural capital and social capital. It follows, according to the constant capital rule, that a development is sustainable, if it ensures constant capital stocks or at least constant capital services over time [7].

Turning to agriculture, sustainability has been increasingly appearing in recent policy arguments. In fact, sometimes in a less obvious way, sustainability becomings a key argument for subsidies. This can be in line with the free trade movement in the WTO, assuming that the compensation for positive externalities and/or public goods is done in a non-distorter fashion. Therefore policy makers are more and more interested in assessing sustainability performance of farming activity and land management in general.

When accessing the sustainability performance of the Hungarian agriculture there are some specific circumstances different from EU15 which are worth mentioning in brief. First, even almost 20 years after the end of centrally planed economic era and have been EU members already for 4 years now, the land market is still far from a well functioning (e.g. transparency, market access) one. As a consequence this form of capital doesn't behave as it is assumed by economic theory in general. Second, the structural characteristics of agriculture are not well established and still experiencing greater changes than at the western part of Europe. According to the 2005 Farm Structure Survey, the great number (~660 000) of individual farms are farming on 3,4 ha on average (skewed to small farms), while the 43 000 farm above 10 ha accounts for 74,4% of total land cultivated by individual farms (with average size of 39,2 ha). On the other side, about 7100 corporate farms with an average farm size of 485,7 ha, where the 3200 farms above 100 ha are farming 96,6% of total cultivated land by corporate farms [8]. The "new" farming population born during the privatization era – individual farmers in particular - is aging and often not well-trained. The needed concentration of family type farming in order to meet current challenges is slow if not stagnant. Third, there are much larger differences existing between frontrunners (dominated by corporate farms) and laggards (usually small size individual farms) in terms of efficiency compared to EU15 farms. Moreover, Hungarian agriculture can be characterised to be more extensive in general and (marketed) output is primarily produced by corporate farms compared to EU15.

According to the best of the author's knowledge, the sustainability performance of Hungarian agriculture is not assessed in any quantified way so far, particularly not in the light of EU accession. In this study the sustainable performance of the nine general types of farming is assessed according to the Community Typology Regulation [9], for the period of 2002-2006 and determinants of the sustainable performance are assessed. This was also motivated by the fact, that for sustainable value approach so far only intra-sectoral results have been available [10][11][12]. Chapter II. describes the data and methods used to perform this study and chapter III. demonstrates the results. Finally, in chapter IV. Discussion of the findings and general conclusions are given.

II. DATA AND METHODS

A. The Sustainable Value approach

The Sustainable Value contrary to mainstream "burden-based" methods focusing on the value created, is based on a given stock of capital [13][14][15]. The theoretical basis stems from capital and opportunity costs theories. The core idea is to compare the value added created by a company to a given benchmark as a result of efficiency difference in its capital (economic, ecological and social) use [15]. Considering n different forms of capital, the Sustainable Value created by a given company can be calculated by equation 1 (adapted from Figge and Hahn [15]).

$$SV = \frac{1}{n} \underbrace{\sum_{i=1}^{n} x_i \underbrace{\left(\frac{y}{x_i} - \frac{y^*}{x_i^*} \right)}_{Value\ spread}}_{Value\ contribution} \qquad (1)$$

<u>with :</u>

SV = sustainable value

y = value added (output) of the firm

x_i = amount of capital i used by the firm

y* = value added (output) of the benchmark

x_i* = amount of capital i used by the benchmark

n = number of forms of capital considered

Three components need to pay attention. The value spread shows per unit of capital i, how much more or less value is created by the assessed entity. It is important to emphasize, that the definition of the benchmark is crucially important and should be carefully selected taking into account the research question that has to be answered [15]. The benchmark choice can significantly affects the SV results. Second, the value contribution is calculated by multiplying the value spread of capital i by the amount of capital i used by the company. The total Sustainable Value created by the entity is the sum of the value contribution of each form of capital considered. Third, in order to avoid overestimation caused by summing up the value created by each form of capital, we divide the sum obtained by a factor n (the number of resources considered to calculate the sustainable value). Sustainable Value indicates "whether the value added created by a firm exceeds the costs of its capital use" [15].

Sustainable efficiency[1] (SE) of capital use is determined by relating the value added (return) created by the firm to the opportunity cost (performance of the benchmark) of all forms of capital used (see Eq. 2). In other words the SV value is corrected for the size of the entity examined [15].

$$SE = \frac{y}{y - SV} \qquad (2)$$

If sustainable efficiency greater than one implies that the value added created by the company is exceeding the opportunity cost of its capital (the efficiency of the benchmark).

B. Assessment of the sustainable performance of different types of Hungarian farms for the period of 2002-2006

When performing sustainable value based assessment three aspects require particular attention [15] [16]: (1) the choice of the economic activity or entity to be analysed (2) the choice of the forms of

[1] Sustainable efficiency is sometimes quoted as Return-to-Cost-Ratio

capital to be taken into account (3) the choice of the benchmark.

ENTITIES ANALYSED AND DATA SOURCE

To be in line with the goal of giving an overall picture of the entire Hungarian agriculture the analysis is focusing to the nine general types of farming according to the Community Typology Regulation [9]. Weighting factors are used in order to receive the most possible overall picture about the sustainability performance of the different type of farms. The limitation of this is that only farms above 2 ESU are included in the sample, therefore only farms above this size in the population are represented. An other peculiar corollary is that the weights are calculated to image the latest available structure of the population captured by farm structure survey (2003 and 2005) or census (2000).

The data used for the current assessment are retrieved from the Hungarian Farm Accountancy Data Network which is managed by the Research Institute for Agricultural Economics. The sample includes 1893, 1895, 1917, 1940 and 1951 farms respectively for the period of 2002-2006, representing approximately 90 000 farms above 2 ESU. The descriptive statistics of this time series are presented in Table 1. (interval scaled variables) and Table 2 (categorical variables)[2].

FORMS OF CAPITAL

Seven forms of capital are considered: (1) land, (2) farm capital, (3) labour, (4) water use, (5) direct energy use, (6) indirect energy use and (5) subsidies.

The motivation for the choice of these capital forms is scarcity of the capital and the necessity for value creation [16]. Moreover, all three pillars of sustainability are needed to be represented. Conventional economic analysis suggests the inclusion of land, farm capital and labour. Land is a complex socio-environmental capital while labour can be considered as a socio-economic form of capital. Water and energy use are environmental forms of capital. Note, that indirect energy includes the use of pesticides and fertilizers as well.

[2] Since these values are rather stable over time, only values for year 2006 are presented

METHOD OF ASSESSMENT OF THE AMOUNT OF EACH FORM OF CAPITAL USED

Land use is measured in ha and labour in annual working unit (AWU). The remaining variables are measured in monetary terms, and converted to Euro at an exchange rate of 250 Forint/Euro for easier comparison with EU15 values. It might be argued, that environmental capital should be expressed in a unit closely follow the caused pressure, however as SV is a value oriented method this is not the case.

However, Resources are possible to classify into three groups: renewable[3], conditionally renewable[4] and exhaustible[5]. It is important to define this property for all resources are used or possibly used, since renewable resources are not scarce, therefore should not be included in the SVA. In case of conditionally renewable resources, there is a threshold about the rate of use[6]. In case of exhaustible resources we cannot really speak about strong sustainability, since the stock of capital is necessarily decreasing. One can conclude that only conditionally renewable resources concur with the claimed properties of SV.

OUTPUT PARAMETER AND BENCHMARK CHOICE

For return assessment the value added of each farm is chosen. To be in accord with the stated aim of the study, weighted benchmark is used, believed to be “much closer to how resources are really used” [10]. Using an unweighted average benchmark “would imply that every farm (regardless of size) gets the same share, in case resources put on the market, which is rather unrealistic“ [10].

[3] Renewable resources are resources that, after exploitation, can return to their previous stock levels by natural processes of growth or replenishment [17].
[4] Conditionally renewable resources are those whose exploitation eventually reaches a level beyond which regeneration will become impossible [17].
[5] Exhaustible natural resources - such as mineral resources - cannot be regenerated after exploitation [17].
[6] Even though SV assumes strong sustainability (stock of capital remains the same for each capital form), the resource use might be greater than the threshold.

Table 1: Main descriptive statistics of the variables used for SV and SE calculations

Variable		Mean								Standard deviation							
	Farm type	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Labour use [AWU]	2002	5.4	2.8	5.4	13.6	12.1	6.0	39.8	17.4	13.8	2.7	11.6	26.1	29.0	15.4	82.1	35.2
	2003	5.1	3.6	5.9	13.9	11.0	8.9	41.8	19.4	12.9	4.3	10.1	26.9	26.4	22.6	79.0	43.2
	2004	4.6	13.6	5.3	9.7	8.6	8.2	41.9	15.7	11.4	2.6	8.7	20.8	22.9	30.8	90.3	38.8
	2005	4.0	3.1	4.2	9.0	6.7	6.9	38.6	13.5	9.6	4.1	7.2	20.6	16.8	38.5	89.3	29.6
	2006	4.2	3.2	4.0	9.1	6.6	8.5	12.9	12.2	9.7	3.6	6.9	21.4	19.9	38.8	33.6	27.3
UAA [ha]	2002	285.7	14.0	68.0	248.7	81.5	206.2	645.8	514.0	537.2	16.4	272.9	458.7	263.1	571.8	1345.8	1024.2
	2003	273.9	59.8	46.0	230.6	41.5	267.4	765.3	507.5	528.2	193.8	68.9	391.6	149.8	727.4	1609.2	1044.8
	2004	260.4	15.5	49.5	201.5	33.9	213.3	836.1	461.6	518.5	20.5	91.3	341.5	120.3	605.5	1941.2	1023.1
	2005	241.1	39.3	39.1	204.4	26.2	183.0	684.3	403.0	446.0	119.5	58.9	351.6	74.6	875.0	1683.1	800.8
	2006	243.2	24.3	34.6	221.0	25.5	246.4	237.4	397.0	441.4	70.5	50.6	423.3	97.9	947.2	527.9	774.9
Farm capital [1000 €]	2002	13.1	3.9	15.5	17.9	20.3	13.5	49.6	23.1	24.9	3.4	56.5	32.2	42.1	35.6	103.0	48.2
	2003	14.6	8.3	16.3	21.8	21.5	18.6	61.5	32.0	26.7	19.3	53.2	37.8	42.9	42.2	145.1	73.4
	2004	10.8	3.5	11.6	17.3	12.5	11.5	58.8	22.2	20.5	3.2	33.4	33.5	26.1	33.0	144.2	53.9
	2005	18.1	10.6	20.4	24.2	18.4	20.7	69.4	34.1	31.1	29.3	51.1	44.9	37.1	93.8	167.4	64.9
	2006	18.6	8.2	20.1	24.4	18.6	26.3	27.2	32.0	28.0	16.8	53.0	45.0	40.7	101.3	58.3	60.8
Water use [1000 €]	2002	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.2	0.2	0.9	0.4	0.2
	2003	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.4	1.1	0.3	0.2	0.2	1.0	0.7	0.4
	2004	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.3	0.0	0.1	0.2	0.2	0.1	0.7	0.4
	2005	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.1	0.3	0.2	0.1	0.1	1.0
	2006	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.3	0.1	0.1	0.2	0.2	0.1	0.4	0.3
Direct energy use [1000 €]	2002	2.0	0.4	0.7	2.5	2.1	2.0	7.5	4.3	4.0	0.4	1.2	5.4	5.3	6.7	15.9	9.8
	2003	1.9	1.4	0.7	2.7	2.1	2.1	7.5	4.4	3.8	4.6	1.3	5.7	5.7	5.4	17.0	10.6
	2004	2.2	0.6	0.8	2.8	2.0	2.6	10.2	4.6	5.2	0.7	1.5	6.6	5.8	9.5	24.5	12.3
	2005	2.5	1.2	0.7	2.9	1.8	2.8	10.7	4.8	5.0	3.1	2.1	6.9	4.4	16.4	26.3	11.2
	2006	0.7	0.2	0.3	0.6	0.3	0.6	0.3	0.7	2.3	0.6	1.4	2.3	1.5	1.9	0.9	1.5
Indirect energy use [1000 €]	2002	3.9	0.7	1.2	5.1	14.9	3.6	23.4	10.9	8.9	0.8	2.1	11.4	29.4	10.8	51.2	24.8
	2003	3.9	2.4	1.2	5.9	18.0	5.0	26.6	14.3	10.3	7.2	1.9	11.3	33.8	13.0	54.0	32.7
	2004	4.0	1.0	1.4	4.2	17.1	5.5	43.6	12.1	9.8	0.9	3.7	8.3	34.2	22.1	117.6	30.1
	2005	3.6	1.5	0.9	5.0	13.3	4.6	22.9	10.3	8.3	4.5	1.4	12.1	23.6	30.8	52.9	23.9
	2006	3.6	1.2	0.9	5.3	13.3	6.4	10.4	10.4	7.5	1.7	1.6	13.5	29.7	36.6	26.4	24.2
Subsidies [1000 €]	2002	1.6	0.1	1.2	3.2	3.1	1.6	7.8	3.8	3.5	0.3	6.0	6.8	10.8	5.5	21.2	9.0
	2003	1.3	0.3	0.3	2.8	3.2	1.8	9.1	4.2	3.2	1.6	0.8	5.5	10.8	5.0	24.7	11.2
	2004	2.8	0.2	0.6	2.8	2.1	2.8	12.6	5.7	5.9	0.3	1.2	5.3	5.5	9.1	30.9	13.5
	2005	2.8	0.4	0.4	2.7	1.4	2.4	10.4	5.1	5.3	1.7	0.8	5.4	3.2	12.5	27.1	10.7
	2006	3.2	0.3	0.7	4.3	1.8	3.9	4.2	6.4	6.1	0.7	1.3	9.4	4.8	17.7	10.1	13.3
Value added [1000 €]	2002	2.5	1.5	2.3	4.9	5.1	2.0	5.4	6.6	12.3	2.4	14.8	12.3	17.3	7.3	24.5	17.2
	2003	2.6	1.6	1.0	3.7	0.8	2.5	-1.4	5.6	8.2	6.5	9.7	8.5	18.1	8.7	27.4	20.9
	2004	4.2	1.4	2.7	4.0	3.9	3.5	19.2	9.3	13.6	1.9	10.0	12.1	28.2	11.8	42.4	29.5
	2005	2.5	2.5	3.8	5.8	6.6	3.2	25.8	7.6	10.1	8.8	20.5	20.8	21.8	16.5	59.5	19.3
	2006	3.0	2.2	2.6	5.6	3.7	5.6	13.0	8.1	7.7	4.0	16.8	14.7	14.4	27.9	34.7	19.9

Table 2: Descriptive statistics of categorical variables (weighted)

Variable	%
Legal status	
- individual	93,7%
- corporate	6,3%
Proportion of farms with any organic farming	1,6%
Farm type	
- Specialist field crops	39,9%
- Specialist horticulture	7,0%
- Specialist permanent crops	15,2%
- Specialist grazing livestock	5,6%
- Specialist granivores	4,2%
- Mixed cropping	12,5%
- Mixed livestock holdings	3,3%
- Mixed crops-livestock	12,3%
- Non-classifiable holdings	0%
Farm size	
- Class I. (smaller than 2 ESU)	0%
- Class II. (between 2 and 4 ESU)	40,4%
- Class III. (between 4 and 6 ESU)	21,0%
- Class IV. (between 6 and 8 ESU)	8,8%
- Class V. (between 8 and 12 ESU)	9,6%
- Class VI. (between 12 and 16 ESU)	4,9%
- Class VII. (between 16 and 40 ESU)	9,4%
- Class VIII. (between 40 and 100 ESU)	3,5%
- Class IX. (between 100 and 250 ESU)	1,3%
- Class X. (above 250 ESU)	1,1%
Proportion of farms with any environmental schemes	0,1%

C. Assessing the determinants of the sustainable efficiency

Different techniques applied to reveal what determines of sustainable efficiency, following methods described in detail in [10] and [11]. The approximated probability distribution function using Gaussian kernel is performed for the SE value of each farm type for the period of 2002-2006. The correlation between years for each farm type is performed with the goal of accessing the relationship between years. Finally a multiple linear regression analysis is performed for specialist field crops farms with different determinants expected to effect SE (structural and social characteristics), for the period 2002-2006. The used specification of the model is the following:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it}$$

with:

y_{it} SE of farm i in year t
x_{it} the independent variable
ε_i the stochastic error

This model is estimated with the Ordinary Least Squares procedure which minimises the sum of squared residuals to estimate the ß parameters of interest. By performing a regression with the classical linear regression model, well known assumptions have to be met [18]. The independent variables presented in Table 3 are considered for the specification of the model.

Table 3: Regressors considered for the specification of the model

Category	Variable
Structural characteristics of the farm	Legal status 0: individual farmproof of ecological performance 1: organic farming
	Any organic farming activity 0: no 1: yes
	Farm size *(as defined in Table 2.)* 1: class I. 2: class II. 3: class III. 4: class IV. 5: class V. 6: class VI. 7: class VII. 8: class VIII. 9: class IX. 10: class X.
	Region where the farm situated 1: Central Hungary 2: Central Transdanubia 3: Western Transdanubia 4: Southern Transdanubia 5: Northern Hungary 6: Northern Great Plain 7: Southern Great Plain
	Land quality (in golden crown)
Social characteristics of the farmer	Age of the farmer in years

III. RESULTS

First the approximated probability distribution of each farm type for the period of 2002-2006 is presented through Figure 1-8. As mentioned before, we are interested the SE above and below the performance of the benchmark. In order to focus this, the segment of SE values between -1 and 3 is figured.

Fig. 1: Distribution of the sustainable efficiency scores of specialist field crops farms

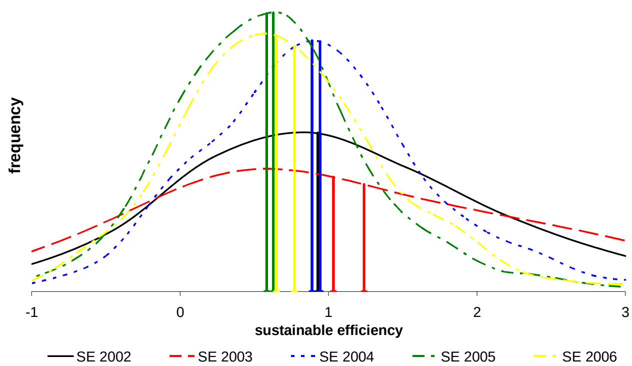


Fig. 2: Distribution of the sustainable efficiency scores of specialist horticulture farms

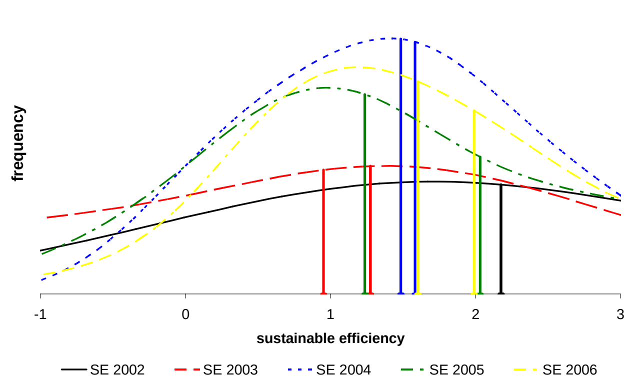


Fig. 3: Distribution of the sustainable efficiency scores of specialist permanent crops farms

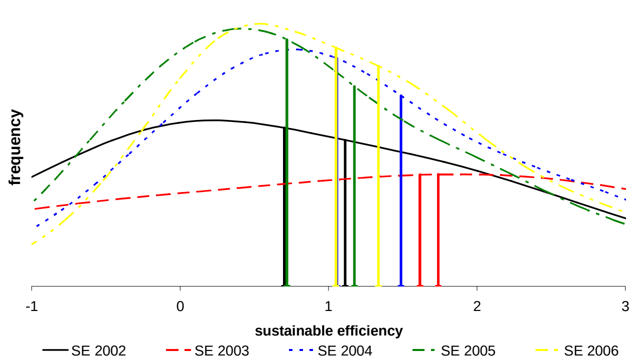


Fig. 4: Distribution of the sustainable efficiency scores of specialist grazing livestock farms

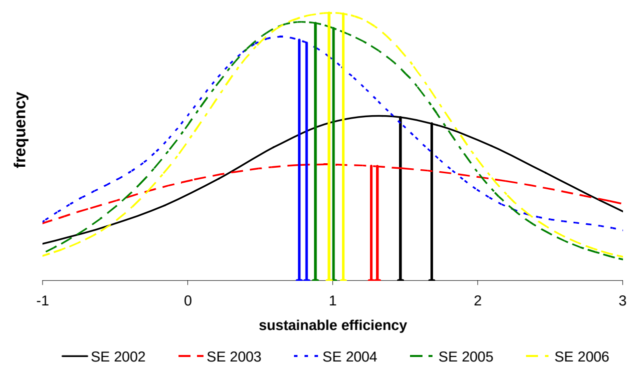


Fig. 5: Distribution of the sustainable efficiency scores of specialist granivores farms

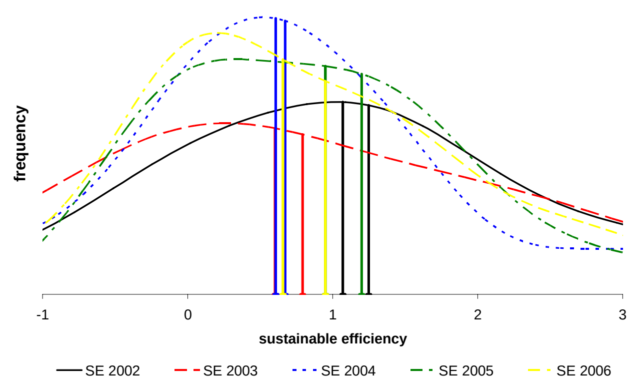


Fig. 6: Distribution of the sustainable efficiency scores of mixed cropping farms

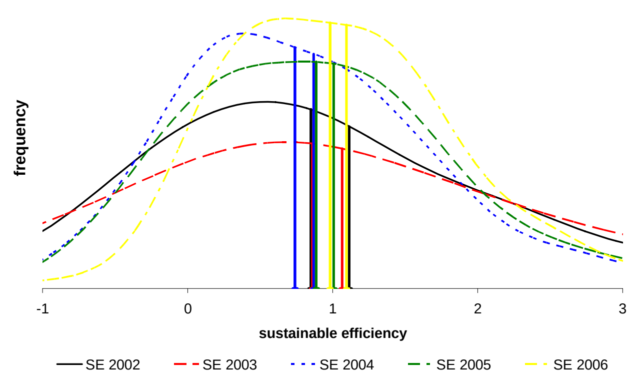


Fig. 7: Distribution of the sustainable efficiency scores of mixed livestock holding farms

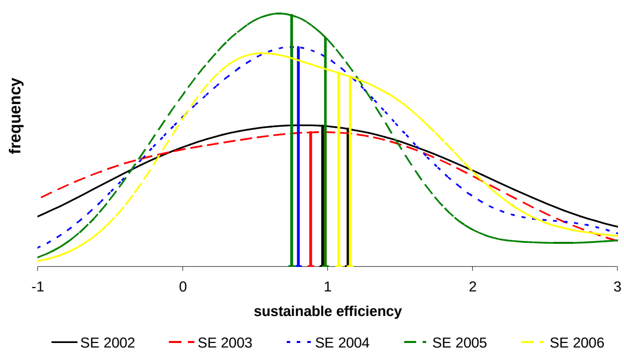
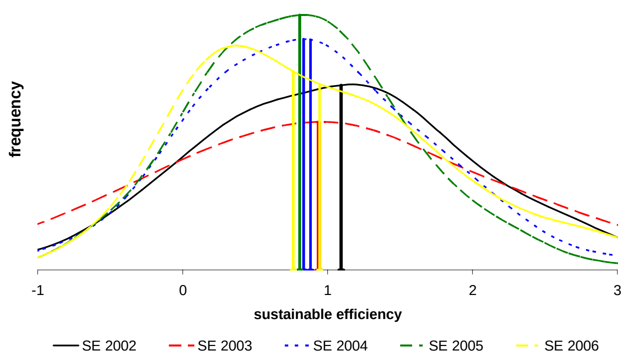


Fig. 8: Distribution of the sustainable efficiency scores of mixed crops-livestock farms



The distribution of each year for all farm types is tested, and found based on Kolmogorov statistics, that non of the distributions are normal, therefore Sperman's rho non-parametric correlation is used. This is presented through Table 4-11.

Table 4: Correlation between SE values of specialist field crops farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	-,021	,001	,030	-,013
SE 2003		1,000	-,008	-,060	,026
SE 2004			1,000	,046	-,041
SE 2005				1,000	,006
SE 2006					1,000

Table 5: Correlation between SE values of specialist horticulture farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	-,004	-,134	-,125	-,192
SE 2003		1,000	,066	,254	-,018
SE 2004			1,000	,153	-,167
SE 2005				1,000	,022
SE 2006					1,000

Table 6: Correlation between SE values of specialist permanent crops farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	-,042	,109	,028	,115
SE 2003		1,000	,092	-,036	-,109
SE 2004			1,000	,019	,036
SE 2005				1,000	-,009
SE 2006					1,000

Table 7: Correlation between SE values of specialist grazing livestock farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	-,004	-,221(*)	-,046	,155
SE 2003		1,000	,029	,139	-,165
SE 2004			1,000	-,007	-,090
SE 2005				1,000	-,104
SE 2006					1,000

* Correlation is significant at the 0.05 level (2-tailed).

Table 8: Correlation between SE values of specialist granivores farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	,029	-,210(*)	,046	-,049
SE 2003		1,000	,217(*)	-,041	,047
SE 2004			1,000	-,012	-,004
SE 2005				1,000	-,093
SE 2006					1,000

* Correlation is significant at the 0.05 level (2-tailed).

Table 9: Correlation between SE values of mixed cropping farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	,060	,011	,027	,056
SE 2003		1,000	,079	,001	,032
SE 2004			1,000	,004	-,034
SE 2005				1,000	,101
SE 2006					1,000

Table 10: Correlation between SE values of mixed livestock holding farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	,004	-,224	-,081	,376
SE 2003		1,000	-,486(*)	,042	-,242
SE 2004			1,000	,045	-,196
SE 2005				1,000	-,333
SE 2006					1,000

* Correlation is significant at the 0.05 level (2-tailed).

Table 11: Correlation between SE values of mixed crops-livestock farms

	SE 2002	SE 2002	SE 2002	SE 2002	SE 2002
SE 2002	1,000	-,026	-,004	,066	-,084
SE 2003		1,000	-,093	-,114	,090
SE 2004			1,000	,142(*)	,027
SE 2005				1,000	,041
SE 2006					1,000

* Correlation is significant at the 0.05 level (2-tailed).

Table 12: OLS estimation of the model with robust standard errors

Variable	Coefficient	t	P>|t|	[95% Conf. Intervall]	
Constant	234,214	7,759	,000	175,039	293,390
Legal	-,242	-4,049	,000	-,359	-,125
Organic	-,085	-,903	,367	-,268	,099
Size	,088	7,518	,000	,065	,111
Region	,009	,877	,380	-,011	,029
Land quality	,026	9,136	,000	,021	,032
Age	-4,05E-005	-,319	,750	,000	,000

Number of observations = 4800
F(7, 4792) = 28,323
Prob > F = 0,0000
R-Squared = 0,040

The results of OLS estimation is presented in Table 12. All VIF values used to test for collinearity are below 1,345, therefore no further step is needed to control for multicollinearity.

IV. DISCUSSION AND CONCLUSIONS

The results of the distributions of different farm types show differences both between years for a particular farm type and between farm types in general. Interestingly, for all farm types the distribution of SE values are more scattered before 2004. That is SE is converging for its mean in a given year, which date coincide with the EU accession. Further more SE values of mixed crop farms looks pretty stable, while permanent crop farms have the most scattered pattern. Mixed farms also show rather stable SE values.

Somewhat surprising (see [10]), that there is very weak and almost always insignificant correlation between the years for each of the farm types. This suggests, that in case of Hungary there is great variation of SE between the years considered for all farm types.

The model estimated with the given variables does not explain the determinants of the variance of sustainable values. Therefore further investigation is needed to find out these determinants.

The results presented here should be taken as a first step, since there are many points where improvement could be done. For example the use of different benchmarks or panel data might discover further insights of sustainability.

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