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**How did Hungarian Crop Farms Perform Before Accession:
A Comparison of Technical Efficiency and Technology with France**

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Abstract

The paper investigates the difference in technical efficiency, productivity and technology between French and Hungarian cereal, oilseed and porteinseed (COP) farms during 2001-2004, using Data Envelopment Analysis with separate and common frontiers. Results indicate that Hungarian farmers showed lower scale efficiency and worse management practices than French farming on average. By contrast, under a common hypothetical technology, Hungarian farms would be by far the leaders, probably due to their scale economies and to their low use of variable inputs. This leadership might however not be sustainable as the Hungarian sample recorded technological regress, more and more substantial over the period. The EU subsidies that Hungarian farmers receive since enlargement might help them to reverse this trend.

Keywords: technical efficiency, productivity factor, COP farms, France, Hungary

How did Hungarian crop farms perform before accession:

A comparison of technical efficiency and technology with France

1. Introduction

The paper investigates the difference in technical efficiency, productivity and technology between French and Hungarian farms specialised in cereal, oilseed and porteinseed (COP) in the period 2001-2004. Technical efficiency, that is to say the ability of a farm to use the best existing technology in terms of quantities, is calculated firstly under separate frontiers, in order to assess the room for improvement within each country. Then, the measure is calculated with a common frontier, that is to say with a merged sample of both countries, in order to understand which country is lagging behind in terms of technology and thus might hinder productivity growth in the European Union (EU). Productivity change for both countries is also investigated and compared, as well as its components technical efficiency change and technological change.

Comparing two countries in terms of efficiency and technology has not been widely studied. In the EU, one can mention the study by Brümmer et al. (2002) about dairy farms in Germany, the Netherlands and Poland over the period 1991-1994. The authors use a parametric approach, namely the stochastic frontier analysis, which enables them to perform a test of poolability of the three samples. On the basis of the test's results, the authors reject the hypothesis of the possible merging of the three countries, and therefore provide results for country-specific efficiency and productivity change. Poland is found to have the lowest average technical efficiency and experienced a decrease in productivity change (with regards to its own frontier), while there was a growth in both EU-15 countries.

By contrast, in this paper the non-parametric approach Data Envelopment Analysis (DEA) is employed, giving the possibility to merge countries and investigate the technology gap

between them, without having to test for the poolability hypothesis. The method is that proposed by Charnes et al. (1981) in the case of two types of education programmes, and has for example been used by Oude Lansink et al. (2002) to compare organic and conventional farms' technology in Finland.

The performance of Hungarian farms has not received huge interest in the literature. A few papers investigated productivity or technical efficiency at a specific date during the transition (Hughes, 2000; Mathijs and Vranken, 2001; Davidova et al., 2002), and one considered the efficiency development over the period 2001-2005 (Bakucs et al., 2006). No research has however attempted to provide a comparison with another country. A comparison of France and Hungary, as it is done in this paper, is legitimate as France is one of the leader country in COP production in the EU-25. Regarding cereals only, for example, in 2003 France accounted for 23% of the EU-25 production with an average yield of 6.1 ton/ha (the respective figures were 3% and 3.0 ton/ha for Hungary; Eurostat figures). Not only France but also Hungary are highly self-sufficient and export a large part of their production, thus competing together on the European market. Whether Hungarian farms could improve their technology is therefore a crucial issue.

The paper is structured as follows. The next section explains the methodology used, while the third section presents the data. Results and conclusions are given in the fourth and fifth sections, respectively.

2. Methodology

2.1. Yearly technical efficiency

The non-parametric method DEA is preferred in this paper over the stochastic frontier method. The latter necessitates assumptions about the production function and the error term distribution, and therefore might comprise potential misspecifications. By contrast, DEA uses

linear programming to construct the efficient frontier with the best performing observations of the sample used, so that the frontier envelops all observations (see Charnes et al., 1978). The distance from a farm to the frontier provides a measure of its efficiency. DEA also enables to assess under which returns to scale each farm operates and to calculate their scale inefficiency. Calculating efficiency under the assumption of constant returns to scale (CRS) gives the total technical efficiency score, while assuming variable returns to scale (VRS) allows calculating one component of this total efficiency score, namely the pure technical efficiency. The latter captures the management practices, while the residual between total technical efficiency and pure technical efficiency shows whether the farm operates under optimal farm size. This residual is called scale efficiency. Efficiency scores are given between 0 and 1, 1 indicating a fully efficient farm (i.e. on the frontier) and a larger score showing a higher efficiency.

An output-orientated model is used, with one output – the value of total output in euros –, and four inputs – the utilised area in hectares, the labour used in Annual Working Units (AWU), the value of total assets in euros, and the value of intermediate consumption in euros. Values were deflated by relevant price indices.

Yearly efficiencies are calculated, that is to say a frontier is constructed for each year. In order to compare the performance between France and Hungary, firstly separate frontiers for each country are used. This can show how farms in each country perform with respect to their own country's technology. Then both countries are merged in a common sample and a common frontier is constructed. This allows to investigate which country has the most productive technology, by calculating a productivity factor for each farm, as the ratio between the efficiency calculated under the common frontier and the efficiency calculated under the respective country's frontier. Average productivity factors for French farms and Hungarian farms are then compared, the higher average indicating the superior technology.

2.2. Efficiency, technological and productivity changes

Productivity change is also calculated with DEA, using the concept of Malmquist indices (see Färe et al., 1992). These indices rely on comparing the distance of each farm to the frontier in year t with the distance to the frontier in year $t+1$. Malmquist indices of Total Factor Productivity (TFP) change can be decomposed into technical efficiency change and technological change. The former shows whether farms move closer or further from the frontier over time, while the latter captures the shift in technology. Moreover, technical efficiency change can itself be decomposed into pure technical efficiency change and scale efficiency change. An index of 1 indicates no change, while an index greater (less) than 1 reveals an increase (decrease) in the variable considered (efficiency, technology, productivity).

Productivity, efficiency and technological changes are firstly investigated for each country with respect to their own frontier. Secondly, the indices are calculated for the merged sample (France and Hungary together), that is to say as if the technology was common between both countries.

3. Data

FADN data are used for both countries. Farms with the type of farming dairy (TF13) were extracted in order to have a balanced panel between 2001 and 2004 in both countries. The French sample consists of 905 farms per year, while the figure is 278 for Hungary.

Table 1 presents the average output and inputs for both countries over the period studied. Hungarian farms are larger than French farms in terms of utilised land (247 against 145 ha), but produce only slightly more output. Hungarian farms are much more labour intensive (they use twice as much AWU as French farms), while French farms are more capital intensive. The

evolution over the period is not shown in the table. The main features of this evolution is that the French sample has experienced very slight changes in their output produced and their input use, while the Hungarian output has increased, the capital use has almost double, but the labour use has decreased.

Table 1: Description of the samples: Average values for the whole period 2001-2004

	France	Hungary
Total output (ths euros)	112.9	156.9
Utilised land (ha)	144.9	246.8
Labour (AWU)	1.57	3.91
Capital (ths euros)	190.6	137.5
Intermediate consumption (ths euros)	77.1	74.9
Number of observations	905	278

4. Results

4.1. Performance in each country (separate frontiers)

Table 2 presents the descriptive statistics for technical efficiency calculated with regard to the respective frontier. For the whole period 2001-2004, the average total technical efficiency (under CRS) is similar for both countries, with a short superiority for French farms (0.474 for France and 0.421 for Hungary). The low performance in terms of total technical efficiency for both countries mainly come from low pure technical efficiency (under VRS) (0.516 and 0.475), indicating that farms in both countries were very heterogeneous in terms of management practices. The scale efficiency is on average high in both countries (0.929 and 0.909), suggesting that farms operated close to their optimal size. In both countries, those

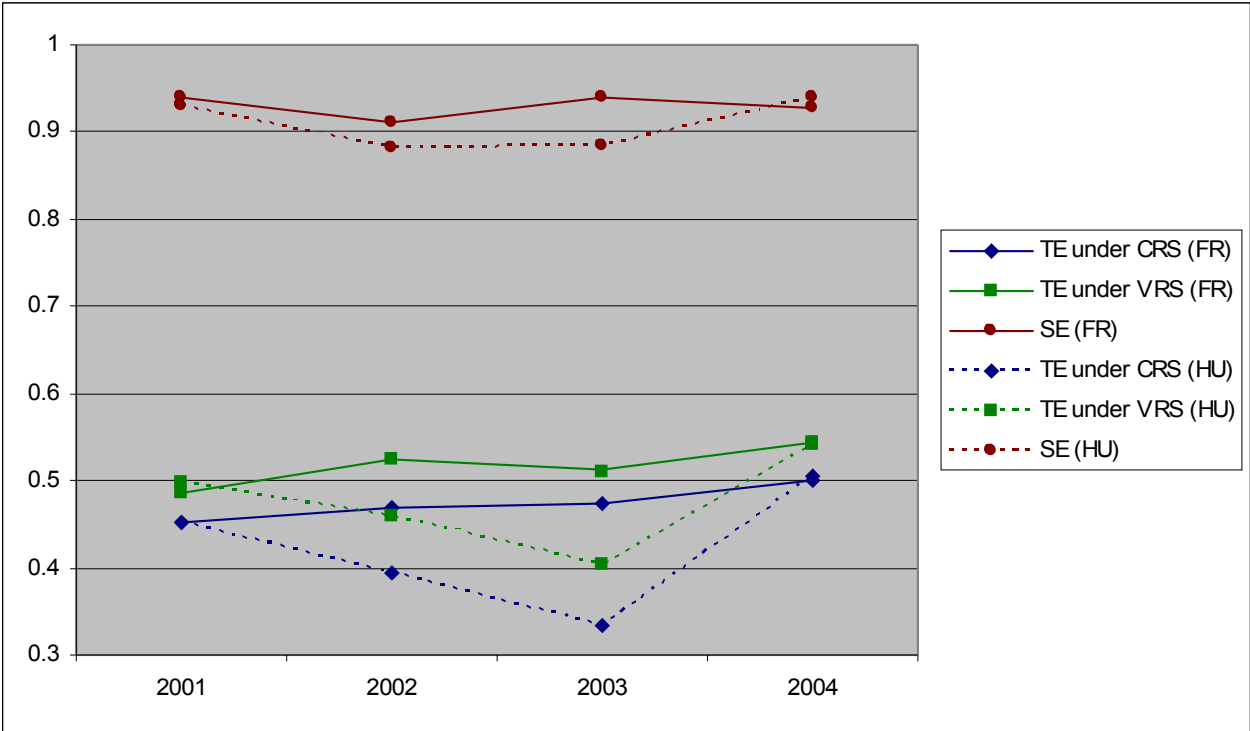
farms that were not fully scale efficient were equally split between too small farms (under IRS) and too large farms (under DRS).

Table 2: Yearly technical (TE) and scale efficiency as average for the whole period 2001-2004; separate frontiers

	France	Hungary
Number of observations	905	278
Average TE under CRS	0.474	0.421
Average TE under VRS	0.516	0.475
Average scale efficiency	0.929	0.909
Share of farms with score of 1:		
for TE under CRS (%)	1	4
for TE under VRS (%)	3	8
for scale efficiency (%)	8	6
Share of farms under:		
CRS (%)	10	9
IRS (%)	47	49
DRS (%)	43	42

As Figure 1 shows, comparing the technical efficiency statistics between each year reveals that, while the homogeneity of the French sample remained approximately the same over the period, farms in the Hungarian sample became less clustered to the efficient frontier in 2003, since the average technical efficiencies (total, pure and scale) decreased. This suggests that there has been a worsening in the farming practices in Hungary between 2001 and 2003. However, farms increased their efficiency again in 2004, catching up with the French sample.

Figure 1: Evolution of yearly technical (TE) and scale (SE) efficiency over the period 2001-2004 for France (FR) and Hungary (HU); separate frontiers



Calculating the productivity change with Malmquist indices allow to investigate this issue more in depth. Table 3 displays the results regarding these calculations. In both samples about half of the farms has experienced a productivity progress (TFP indices strictly greater than 1 for 51% of the French farms and 55% of the Hungarian farms). However, the average productivity progress is extremely low, it is even a stagnation for French farms and a very slight progress of 0.5% for Hungarian farms. In both samples farms have improved their efficiency (pure technical efficiency growth of 3.8% in France and 2.7% in Hungary), kept a similar scale efficiency (average indices about 1), but have experienced a technological regress (of 3.3% in France and 2.7% in Hungary). It is usual to see opposite patterns between technological change and efficiency change, as a technological regress often makes it easier for initially inefficient farmers to adopt the new technique and use it efficiently (e.g. Brümmer et al., 2002; Balcombe et al., 2005). This seems to be the case for both countries: as the existing technology has not been improved over the period, most of the farmers have

eventually adapted their practices to it. The evolution of technological change over the period (not shown in Table 3) gives a pessimistic picture of crop farming in the EU, as both countries experience increasing technological regress. This is especially the case for Hungarian farms, whose technological regress was -30% in the last period 2003-2004.

Table 3: Change over time of technical efficiency (TE), technology and Total Factor Productivity (TFP) as average for the whole period 2001-2004; separate frontiers

	France	Hungary
Number of observations	905	278
Average total TE change	1.034	1.032
Average pure TE change	1.038	1.027
Average scale efficiency change	0.996	1.005
Average technological change	0.967	0.973
Average TFP change	1.000	1.005
Share of farms with total TE change:		
=1 (stagnation) (%)	0	1
>1 (increase) (%)	64	62
<1 (decrease) (%)	36	37
Share of farms with technological change:		
=1 (stagnation) (%)	0	2
>1 (increase) (%)	4	19
<1 (decrease) (%)	96	79
Share of farms with TFP change:		
=1 (stagnation) (%)	1	0
>1 (increase) (%)	51	55
<1 (decrease) (%)	48	45

4.2. Comparison of the countries' technologies (common frontier)

As the interest is in the comparison of the performance of each country, the results using a common frontier are not presented for the pooled sample, but for each country only. Table 4 shows the descriptive statistics of the technical efficiency of France and Hungary, when a common frontier is used. The results for the pooled sample are given in Appendix.

Table 4: Yearly technical efficiency (TE) as average for the whole period 2001-2004; common frontier; results for both countries

	France	Hungary
Number of observations	905	278
Average TE under CRS	0.400	0.412
Average TE under VRS	0.424	0.465
Average scale efficiency	0.949	0.911
Share of farms with score of 1:		
for TE under CRS (%)	1	4
for TE under VRS (%)	1	8
for scale efficiency (%)	5	5
Share of farms under:		
CRS (%)	8	8
IRS (%)	34	47
DRS (%)	58	45
Average productivity factors		
under CRS	0.845	0.982
under VRS	0.830	0.979

Table 4 reveals that Hungarian farms display higher average pure technical efficiency but lower average scale efficiency than French farms over the period studied, resulting in very similar average total technical efficiency (0.400 for French farms and 0.412 for Hungarian

farms). This suggests that more Hungarian farms are closer to the efficient common frontier than French farms in terms of management practices, while French farms seem to perform slightly better in terms of scale efficiency. Thus, it indicates that, if it is assumed that French and Hungarian farms have access to the same technology, Hungarian farmers would have better management practices, while French farms would be more able to adjust their operational size. Not shown in the table is the evolution of technical efficiency over the period, but the main point to note about this evolution is that it is similar to the evolution of technical efficiency calculated with separate frontiers, except that French farms also experienced a decrease in efficiency decrease in 2003 under the common frontier.

Figure 2: Evolution of productivity factors over the period 2001-2004 for France (FR) and Hungary (HU)

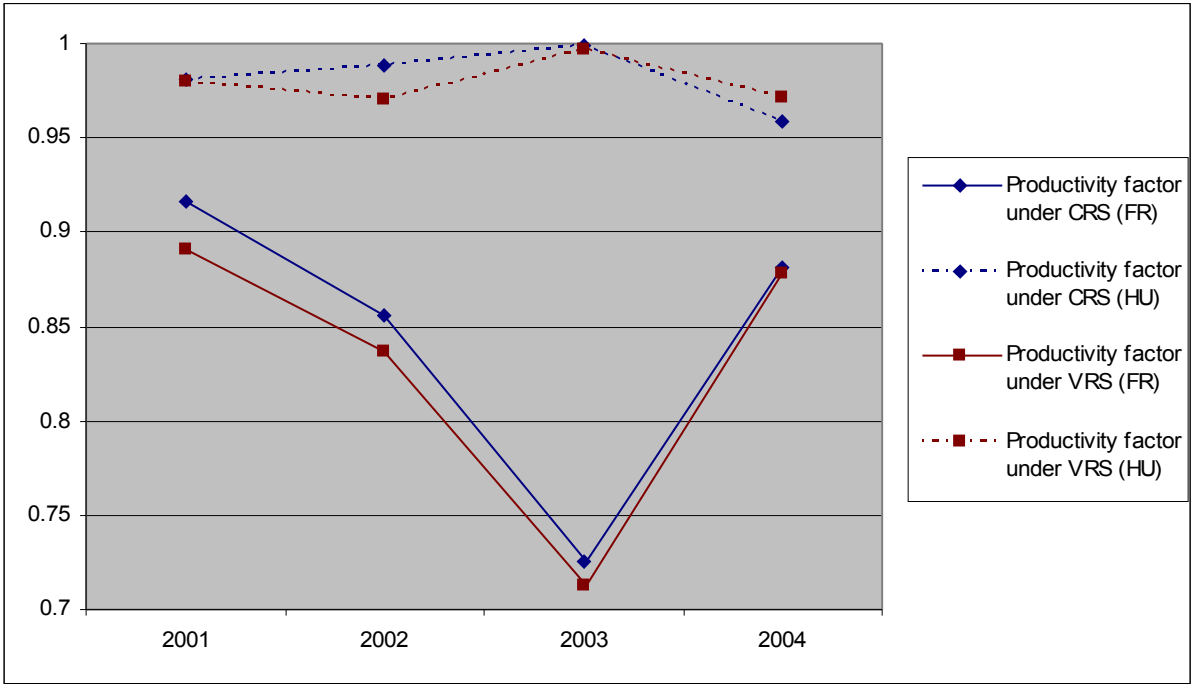


Table 4 also gives the productivity factors, calculated under CRS and VRS. The average productivity factor over the whole period is greater for Hungarian farms (0.982 and 0.979

under CRS and VRS respectively) than for French farms (0.845 and 0.830). This suggests that Hungarian farms had on average a more performing technology than French farms. As shown by Figure 2 picturing the evolution of the productivity factors over the period, the discrepancy between both countries is clear-cut for the whole period: the average productivity factor of the Hungarian sample is greater than the French sample's one in each year.

Table 5: Change over time of technical efficiency (TE), technology and Total Factor Productivity (TFP) as average for the whole period 2001-2004; common frontier; results for both countries

	France	Hungary
Number of observations	905	278
Average total TE change	1.021	1.024
Average pure TE change	1.034	1.024
Average scale efficiency change	0.987	1.000
Average technological change	0.977	0.985
Average TFP change	0.997	1.009
Share of farms with total TE change:		
=1 (stagnation) (%)	1	1
>1 (increase) (%)	59	61
<1 (decrease) (%)	40	37
Share of farms with technological change:		
=1 (stagnation) (%)	1	2
>1 (increase) (%)	22	33
<1 (decrease) (%)	77	65
Share of farms with TFP change:		
=1 (stagnation) (%)	0	0
>1 (increase) (%)	50	56
<1 (decrease) (%)	50	43

The results regarding the Malmquist indices for each country under a common frontier, presented in Table 5, give a similar picture as the one given by the Malmquist indices calculated under separate frontiers (Table 3). Table 5 indicates that French farms' TFP has stagnated while Hungarian farms recorded a slight productivity decrease (by 0.9%), that both countries experienced technological regress but improvement in efficiency. Such similarities between the findings under common and separate frontiers suggest that, despite a technology gap between France and Hungary, French farms have been able to improve their efficiency and to limit their productivity decline under the hypothetical common frontier, as much as they would have done with respect to their own technology.

The French sample is considerably larger than the Hungarian sample. To control for a potential sample size bias in the results, all analyses have been redone with a French sample of 278 farms only, drawn randomly from the original 905 farms. Output and input characteristics of this 278-farm sample are similar to those of the 905-farm sample. As for the results, they are in general confirmed. The only major difference is that the average technical efficiencies for French farms under the separate frontier are greater for this small sample than for the 905-farm sample, which is expected (smaller samples show larger average efficiency).

5. Conclusions

The paper has investigated the performance of French and Hungarian COP farms, with respect to their own technology frontier, and has compared their technology. The analysis was performed during the period 2001-2004, when Hungary was at the end of its transition period and preparing for EU accession, while French farms were not subject to reduced support in the form of area payments within Agenda 2000.

Regarding the performance related to their own frontier, Hungarian COP farming showed lower scale efficiency and worse management practices than French farming on average. The average technical efficiency of Hungarian farms decreased sharply in 2003 but increased back to the initial level in 2004. This suggests that a large part of farmers in this country were not able to adapt their practices to the policy changes required for preparation to EU accession, but that the new environment brought by enlargement was favourable to efficiency. Both samples did not record and TFP improvement, and showed similar average technological regress, more and more substantial over the period, particularly for Hungarian farms.

Looking at the results with a common frontier showed that Hungarian farms were by far leading the technology over the whole period. It could have been expected, by contrast, that Hungarian farms would lag far behind French farms, as they might not have had the access to modern technology during the transition period, either because this technology was not available or because most farms were financially constrained (as shown by Fertő et al., 2006, for a panel of Hungarian farms in 2000-2004). This paper seems to reveal that Hungarian farms might indeed not have had access to technological improvement, as their technological regress has been significant for each year of the period study. However, despite such bad performance, Hungary remained the leading technology over the whole period, probably due to their scale economies and to their low use of variable inputs. It is hoped that the accession of Hungary to the EU in 2004 will allow Hungary to reverse the trend of technological regress, as it enables its farmers to receive European subsidies, in the form of Single Area Payments. Although this support is lower than what the French farmers receive at the same time due to the phasing-in, it is higher than pre-accession support. As for French farms, they might need to reduce their input use (e.g. variable factors) on farm if they want to keep up with Hungary's competition.

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Appendix

Table 6: Yearly technical efficiency (TE) as average for the whole period 2001-2004; common frontier; result for the pooled sample (France + Hungary)

	Pooled sample
Number of observations	1183
Average TE under CRS	0.403
Average TE under VRS	0.434
Average scale efficiency	0.940

Table 7: Change over time of technical efficiency (TE), technology and Total Factor Productivity (TFP) as average for the whole period 2001-2004; common frontier; results for the pooled sample (France + Hungary)

	Pooled sample
Number of observations	1183
Average total TE change	1.021
Average pure TE change	1.032
Average scale efficiency change	0.990
Average technological change	0.979
Average TFP change	0.999