Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 16, Issue 4, 2016
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASSESSING ALLOCATIVE AND ECONOMIC EFFICIENCY OF FARM AT REGIONAL LEVEL

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Abstract

The present paper aims to assess the allocative and economic efficiency at Romanian regional agriculture level for a certain level of input prices, by Data Envelopment Analysis approach. We utilize in our research the following FADN data from 2007 and 2013: inputs – labor (AWU- annual working unit), land (UAA-utilized agricultural area) and capital (euro – average farm capital); outputs – total output (euro) and farm net income (euro); input prices (rent paid, wages paid and depreciation). The main results of our research revealed for 2007-2013 period an increase in economic efficiency, but also indicate the allocative inefficiency (inefficient mix of inputs) us major cause for not reaching optimum levels in 2013 despite the improvement in technical efficiency (an increase in farm volume activities) .

Key words**:** *allocative efficiency, economic efficiency, farms*

INTRODUCTION

The concept of efficiency, calculated based on frontier production approach, was introduced in literature by Debreau [6] and Farell [7]. Starting with these studies the approach was utilized to assess the input mix and economic efficiency (through a combination between technical and allocative efficiency) and, in the following years, to assess the productivity and performance of firms. N'Gbo [12], Atkinson și Cornwell [1] and Briec *et al.* [3] focused on the identification of firms technical efficiency at a certain mix of inputs and outputs, Rodriguez-Alves*et al.* [13] studied the allocative efficiency by creating a connection between inputs and market prices and Coelli *et al.* [5] calculated the economic efficiency (or cost efficiency). All these papers have at base the Data Envelopment Analysis (DEA), a non-parametric method for the measurement of efficiency and productivity.

MATERIALS AND METHODS

DEA, under CRS assumption (constant return to scale), permits the calculation of technical efficiency (TE) and, under VRS assumption (variable return to scale) we can obtain the pure technical efficiency (PTE). The ratio between TE and PTE measures the potential productivity (scale efficiency, SE) which can be reached by a DMU at optimal level. Allocative efficiency (AE) reflects the ability of a DMU to utilize inputs in optimal proportion at a certain level of prices. In fact, AE shows, under optimal efficiency, the level of inputs at which a firm obtains the minimization of production costs. By multiplying the EA with ET we measure the economic efficiency or cost efficiency (EE). In this way cost efficiency it's reached only when a firm is technical and allocative efficient.

In agriculture, these indicators were studied to point out the efficiency and productivity of farms in many studies like the ones of Jan *et al* [8], Mary *et al* [11], Špička *and Smutka* [15], Špička [14], Kaneva [9] and Cesaro *et al.* [4]. In the spirit of our research we emphasize the paper of Bojnec *et al.* [2] in which the economic efficiency is calculated based on FADN data. The author established the following input prices inside the DEA model: rent paid, wages paid and depreciation. Starting of his research we applied the DEA method on the following FADN data [10]: Total labour input (SE010) (Annual Working Unit); Total utilised

agricultural area (SE025) (hectare); Average farm capital (SE510) (euro); Total output (SE131) (euro); Farm net income (SE420) (euro). The efficiency measurements were performed with DEAP program.

RESULTS AND DISCUSSIONS

The descriptive analysis of variables reveals at Romanian farm level an agricultural output of 11,223 ERuro and an obvious inequality between regions (from a minimum of 4,671 Euro in North-Est Region to a maximum of 20,973 Euro in Center Region) (Table 1). The average farm physical dimension oscillated between 5.44 ha in North-Est Region and 16,21 ha in West Region, reaching a value of 10.11 ha at country level. The average farm capital varied between a minimum of 8,866 Euro in North-Est Region and 53,615 Euro in West Region and a value of 25,883 Euro at national level.

Table 1. Descriptive statistics at farm level, on regions, 2007-2013 periods

Region		Input 1	Input 2	Input 3	Output 1	Output 2	Cost Input 1	Cost Input 2	Cost Input 3
		Total labour (AWU)	Total utilized agricultural area (hectare)	Average farm capital (euro)	Total output (euro)	Farm net income (euro)	Wages paid	Rent paid	Depreciation
Center	Minim	1.14	9.11	24,273.10	10,791.50	2,779.10	182.20	754.20	797.50
	Maxim	2.24	11.31	40,014.80	20,973.40	7,199.00	402.00	2,685.50	1,376.10
	Average	**1.47**	**10.07**	**30,820.04**	**13,840.34**	**4,678.57**	**264.47**	**1,200.10**	**1,065.07**
	Std.	0.384	0.820	5,106.887	3,341.442	1,621.263	81.623	681.031	215.798
North Est	Minim	0.97	5.44	8,865.60	4,670.50	1,757.20	76.00	223.30	390.50
	Maxim	2.37	8.32	19,422.20	9,553.20	3,879.80	306.00	303.60	1,085.20
	Average	**1.42**	**7.19**	**16,955.01**	**7,623.34**	**3,013.03**	**211.60**	**265.83**	**791.06**
	Std.	0.491	1.113	40,65.486	2,058.992	877.519	99.964	26.960	251.398
North West	Minim	1.42	7.00	14,949.30	8,380.50	3,248.00	90.10	411.80	601.00
	Maxim	2.16	9.66	33,302.00	12,168.00	7,561.00	277.30	1,173.60	959.50
	Average	**1.73**	**8.55**	**26,966.61**	**10,776.84**	**5,043.70**	**184.14**	**718.56**	**736.17**
	Std.	0.250	0.943	6,481.308	1,496.630	1,419.304	74.017	245.385	154.887
South	Minim	1.28	8.87	18,309.60	7,670.10	1,696.20	217.70	424.60	712.00
	Maxim	2.05	11.42	40,561.00	14,920.00	4,811.00	924.00	1,013.80	2,101.10
	Average	**1.50**	**10.58**	**29,718.31**	**11,470.91**	**3,200.84**	**563.56**	**668.03**	**1,668.26**
	Std.	0.260	1.157	9,926.538	3,006.865	1,225.355	270.892	209.593	563.484
South Est	Minim	1.31	11.88	12,328.40	7,254.40	325.20	334.50	632.00	810.80
	Maxim	2.01	14.95	29,586.00	16,442.00	8,852.00	1,100.20	2,045.30	1,125.20
	Average	**1.55**	**13.81**	**24,463.97**	**12,455.57**	**5,115.97**	**713.94**	**955.64**	**947.87**
	Std.	0.228	1.345	5,934.984	3,899.370	3,038.705	329.981	488.180	124.549
South West	Minim	1.29	6.29	10,180.40	6,194.70	2,214.70	80.60	401.10	436.90
	Maxim	2.13	8.28	26,361.00	10,454.70	5,673.50	242.80	607.10	1,274.00
	Average	**1.59**	**6.91**	**15,819.16**	**8,407.71**	**3,901.19**	**158.60**	**481.90**	**876.86**
	Std.	0.319	0.858	5,996.404	1,898.581	1,401.734	54.110	68.166	331.957
West	Minim	1.05	9.69	27,001.90	8,147.90	2,276.10	325.90	588.80	910.60
	Maxim	1.86	16.21	53,614.90	18,427.20	9,893.40	928.80	746.00	1,512.60
	Average	**1.41**	**13.68**	**36,441.89**	**13,986.39**	**6,483.80**	**604.13**	**684.20**	**1,248.44**
	Std.	0.355	2.784	9,364.874	4,779.419	3,374.245	244.854	51.363	218.784
Total	Minim	0.97	5.44	8,865.60	4,670.50	325.20	76.00	223.30	390.50
	Maxim	2.37	16.21	53,614.90	20,973.40	9,893.40	1,100.20	2,685.50	2,101.10
	Average	**1.52**	**10.11**	**25,883.57**	**11,223.02**	**4,491.01**	**385.78**	**710.61**	**1,047.68**
	Std.	0.333	2.964	9,569.336	3,736.307	2,232.741	284.084	427.009	411.891

Source: Own calculation.

Starting from these variables we estimated that, in 2007, the allocative efficiency was 86.1%, with a minimum of 50.1% in West Region and a maximum of 100% in North-Est, North-West and South-West Regions (Tabel 2). This means that a Romanian farm can have a cost saving of 13.9% at an optimum level of allocative efficiency. Also the results indicate that in West Region, the most inefficient region, the cost saving would've been of 37.8% if the farms would have reached the production frontier.

The combined effect of technical and allocative factors reveals a medium level of economic efficiency (74.1%) with a minimum of 41.3% in West Region and a maximum of 100% in North-West and South-West Regions. At national level we obtained 25.9%

cost savings, but in West Region (the most economic inefficient region) the economic efficiency would have increased with 46.8% if the farms would have been operated at optimum level.

If we compare the results at regional level we observe that only the North-West and South-West Regions have maximum cost savings, being technical and allocative efficient. The Centre and West Regions present an inefficiency regarding the costs due especially to an inefficient mix of inputs (low allocative efficiency). These two regions overcome the minimum costs with 32.5% and 58.7%. In South, South-Est and North-Est Regions the cost inefficiency is due to the low technical efficiency (46.8%, 24.4% and respectively 18.5%). Actually the South Region was the most technical inefficient region and the West Region the most allocative inefficient region.

Table 2. The technical, allocative and economic efficiency in 2007 (at regional level)

	2007		
	Technical efficiency (TE)	**Allocative efficiency (AE)**	**Economic efficiency (EE)**
C	1.000	0.675	0.675
NE	0.816	1.000	0.815
NW	1.000	1.000	1.000
S	0.622	0.854	0.532
SE	0.757	0.999	0.756
SW	1.000	1.000	1.000
W	0.824	0.501	0.413
Average	**0.860**	**0.861**	**0.741**
Minimum	0.622	0.675	0.532
Maximum	1.000	1.000	1.000
Cost savings – C	0.0	32.5	32.5
Cost savings – NE	18.4	0.0	18.5
Cost savings – NW	0.0	0.0	0.0
Cost savings – S	37.8	14.6	46.8
Cost savings – SE	24.3	0.1	24.4
Cost savings – SW	0.0	0.0	0.0
Cost savings – W	17.6	49.9	58.7
Cost savings average	**14.0 %**	**13.9 %**	**25.9 %**
Cost savings for the most technically inefficient region	**37.8 %**	**32.5 %**	**46.8 %**

Source: Own calculation with Win4Deap 2

In 2013 the allocative efficiency was 81.6%, with a minimum of 68.2% in South Region and a maximum of 100% in South-est Region (Tabel 3). This means that a Romanian farm can have a cost saving of 18.4% at an optimum level of allocative efficiency. Also the results indicate that in South Region, the most inefficient region, the cost saving would've been of 31.8% if the farms would have reached the production frontier.

Table 3. The technical, allocative and economic efficiency in 2013 (at regional level)

	2013		
	Technical efficiency (TE)	**Allocative efficiency (AE)**	**Economic efficiency (EE)**
C	1.000	0.863	0.863
NE	0.975	0.883	0.861
NW	1.000	0.759	0.759
S	0.971	0.682	0.662
SE	1.000	1.000	1.000
SW	1.000	0.710	0.710
W	1.000	0.819	0.819
Average	**0.992**	**0.816**	**0.810**
Minimum	0.971	0.682	0.662
Maximum	1.000	1.000	1.000
Cost savings – C	0.0	13.7	13.7
Cost savings – NE	2.5	11.7	13.9
Cost savings – NW	0.0	24.1	24.1
Cost savings – S	2.9	31.8	33.8
Cost savings – SE	0.0	0.0	0.0
Cost savings – SW	0.0	29.0	29.0
Cost savings – W	0.0	18.1	18.1
Cost savings average	**0.8 %**	**18.4 %**	**19.0 %**
Cost savings for the most technically inefficient region	**2.9 %**	**31.8 %**	**33.8 %**

Source: Own calculation.

The combined effect of technical and allocative factors reveals a medium level of economic efficiency (81.0%) with a minimum of 66.2% in South Region and a maximum of 100% in North-West and South-Est Region. At national level we obtained 19.0% cost savings, but in South Region (the most economic inefficient region) the economic efficiency would have increased with 33.8% if the farms would have been operated at optimum level. Actually only the South-Est Region had maximum cost savings, being technical and allocative efficient.

If we compare the results at regional level we observe that, after the changes from 2007-2013 periods, almost all the regions became technical efficient, but in 2013 the allocative inefficiency (wrong mix of inputs) remain a major problem of Romanian farms and the main cause of economic inefficiency.

CONCLUSIONS

Based on 2007 data, we concluded that the allocative inefficiency was comprised between 32.5% and 0% with an average of 13.9% and the technical inefficiency was

comprised between 37.8% and 0% with an average of 14.0%. So the major source of economic inefficiency was the technical one. Also in South, South-Est and North-Est Regions labor and land inputs were oversized compared with the outcomes, while in West Region the major cause of inefficiency is allocative (wrong mix of inputs). However an economic efficiency over 70% suggests that, except for South and West Regions, farms were productive at a cost close to minimum and the level of technology from 2007.

In 2013, given that the allocative was comprised between 31,8% şi 0% (with an average of 18.4%) and the technical inefficiency was comprised between 2.9% and 0% (with an average of 0.8%) we can conclude that the main source of economic inefficiency was the allocative one. Also except for South Region, all the regions had productive agriculture at a cost close to minimum and the level of technology from 2013.

Our research based on DEA permits a comparison between the two analyzed years in terms of structural changes. However the results permit us to conclude that the small increase in size of Romanian farms from 2007-2013 periods doesn't influence the level of efficiency, the major cause of inefficiency being the allocative factors (wrong mix of inputs).

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