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EFFICIENCY OF PEASANT FARMS IN THE REPUBLIC OF MOLDOVA: PERSPECTIVES OF DEVELOPMENT

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Abstract

The paper presents the evaluation method for the efficiency level of peasant farms in the Republic of Moldova. The proposed assessment method is defined by the Stochastic Frontier Analysis of half-normal Gaussian distribution. The economic-social characteristics of the households and the statistical performance of farms are presented. The functional relationship between the efficiency level of peasant farms and income from various categories of activities has been revealed.

Key words**:** *peasant farms, stochastic frontier analysis, regression analysis, efficiency*

INTRODUCTION

The Republic of Moldova is one of the countries with a transition agriculture. About 60% of the country's population are employed in the agricultural sector. The agrarian orientation of the country's economy is determined by chernozems soils, which occupy 75% of the territory, as well as favourable climate conditions (Cimpoieș, 2008) [1].

The agrarian sector of the Republic of Moldova suffered considerable changes in 1990's. The country's Parliament at that time, adopted the "Transition concept to the market economy" and a year later the implementation started. It stated that "we suppose to overcome a very difficult transition period as soon as possible, approximately in 1.5 - 2 years". It was adopted an impressive set of market laws in Moldova: on estate, the Land Code, on peasant (farmer) economy, on Land Tax, on state land management, land cadastre and monitoring of land, etc. In 1992 it was launched the reorganization of large collective farms; peasants started leaving collective and state owned smaller farms; they were provided with their own land and property; the first farms were registered. Finally, in 1997 the first signs of an agricultural reform appeared: there were reorganized 70 % collective farms; about 70 thousand farmers received their land titles. Then, in 1998, along with considerable debts, almost extinct production facilities and a broken system of labour relations, the realization of the National Program "Land" began without much publicity and almost without any participation of the Ministry of Agriculture; it was carried out under the influence and significant financial support from external donors. Having gained economic independence, the majority of agricultural enterprises engaged in business and started changing their status and form of operations.

Table 1. The number of economic agents involved in the agrarian sector of the Republic of Moldova, 2011

Economic agents	The agents number	Area, thousand ha	Average area, ha
Agricultural cooperatives	204	141	712.8
Join stock companies	158	46	455.38
Limited liability companies	1,986	654	388.01
State enterprises	89	14	192.34
Peasant farms	898,768	749	0.89

Source: National Bureau of Statistics

The core of the agricultural business was formed quite quickly, within 3-4 years.

Statistically, the results of the land reform are quite impressive and may be find in the Table 1.

Peasant farms (PF) area operate more than 46% of the total farmland. This legal form of organization cover 749 thousand ha, which is by 95 thousand ha more than the area of the limited liability companies. Agricultural cooperatives, on one side, own the area of 141 thousand ha, which represents respectively 8.8% from total area. Joint-stock companies cover more than 3.1% of farmland. The share of public enterprises in the farmland is the smallest part and represents less than 1%, with only 14 thousand ha.

In 2011 there were 898,768 PF in agriculture, which represents more than 99% of the total number. The structure of individual enterprises changed as follows:

- 89 state-owned enterprises;
- 158 joint stock companies;
- 204 agricultural cooperatives;
- 1,986 limited liability companies.

There is a significant increase in the number of PF, mainly related to the issue of certificates, which legally confirmed the right to own land and registered farms in accordance with the law. It should also be noted that land has been assigned to PF much earlier and the above mentioned registration has been funded by means of the World Bank project (Lerman, 2004) [17.

The average size of agricultural cooperatives exceeds the average size of a joint stock company by 257 ha and amounts to 455 ha. The size of a limited liability company is on average 388 ha, which is by 324 ha less than the size of leading joint stock companies. The average size of public enterprises is 192 ha and the average size of individual farms is the smallest among all enterprises and amounts to 0.89 ha.

MATERIALS AND METHODS

In our sample there are 723 economic agents in homogeneous farming settlements from nine districts and three areas of the Republic of Moldova were surveyed to assess the efficiency of individual farms (Figure 1). The household questionnaire has been designed in such a way that the answers reflect the three components of the efficiency of rural areas: economic, social, environmental, with the data format according to the Likert-type scale for ordinal data. The survey provides an opportunity to examine the status and structure of the households from certain regions of the country.

Fig. 1. The distribution of settlements by the areas of the Republic of Moldova, where the survey has been conducted

The following variables have been taken into account: the size of a household, land use, types of the crops grown, the number and species of animals, agricultural machinery and equipment that are used, as well as the labour force engaged in agricultural activities on the farm. This information is crucial for determining the efficiency of PF and household plots.

As it has been mentioned above, the collection of various types of data contributes to the use of resources with the maximum benefit. However, this kind of survey has a number of drawbacks and it is important not to overlook them. A national representative survey would promote statistical significance and provide more conclusive evidence, which could serve as the basis for a strategy. However, such a survey would be larger and

more expensive. The extract used in this survey is representative and though it may point to some broader trends, it does not show any precise results for these or those groups of our society. The same concept is applied to both quantitative and qualitative aspects of the study. The disadvantages are particularly strongly noticed in the quantitative examination, since the quantitative analysis generally refers to objective information and cannot connect some peculiarities with the context as it is provided by the qualitative analysis. The quantitative survey results should be essentially seen as an aid to the main plot, which is based on the qualitative survey. The review of materials, qualitative and quantitative studies in this report assume to encourage more deployed debates about the impact of PF on the farmer's family welfare (Lerman, 2005) [8].

Another disadvantage of the sociological research is that a part of the information reported in questionnaires and interviews is distorted, either intentionally or unintentionally by respondents, and these distortions are often systematic. Respondents do not know or acknowledge much of the information that a sociologist needs. Therefore, questionnaire results should be cross-checked and supplemented by sociological observation and a performance study (Toma, 2015) [9].

We have chosen the parametric method Stochastic Frontier Analysis (SFA) to assess the efficiency of PF in this paper. Being technically a rating approach in identification of economic efficiency indices, SFA critically reflects the efficiency of PF on the basis of data inputs and outputs in agricultural activities. The boundary methods for determining the ranking of economic agents, which are characteristic to SFA, make it possible to determine the economic performance of agricultural activities. The purpose of this paper is to provide a critical and thorough review of the two main boundary practices. Parametric methods of assessment, which are used as a half-normal Gaussian distribution regarding Cobb Douglas production function, are a reliable tool to determine economic efficiency (Farrell, 1957) [5].

SFA model is often used to compare relative effectiveness of economic entities, because it is possible to monitor the dynamics of these indices. SFA assesses the "true" production boundary, rather than the average figure of all firms, since it takes full advantage of all the properties of the production function. The following may be distinguished as the advantages of this method: taking into account the influence of statistical noise on the resulting function, as well as the factors that are not included in the model for any reason. However, the method is complicated and requires a large extract of data, so that the analysis results may be considered statistically correct (Gorton, 2001) [6].

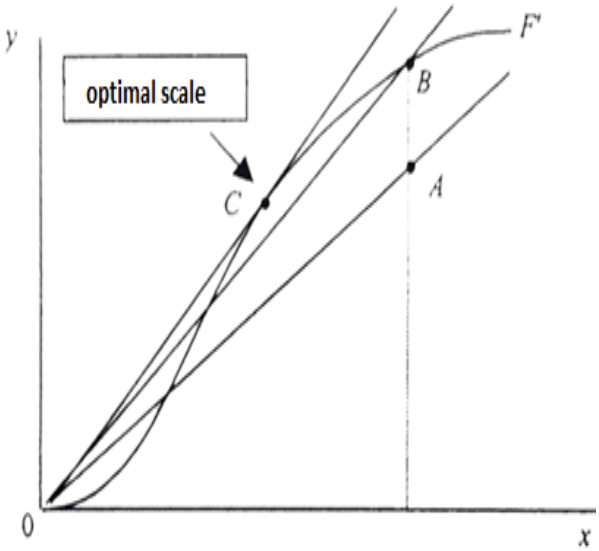

Fig. 2. Cobb Douglas production function used to assess the rating of PF

The standard function to determine the efficiency of PF can be presented in the following way:

$$Yi=X_i\beta+V_i+U_i, \text{ for } i= 1, ..., N, \quad (1)$$

where Y_i is the PF average income;

X_i – vectors of productive resources, which are used at PF to generate income;

β – a vector of unknown parameters;

V_i – a random variable, an error, it is assumed to be iid $N(0, \sigma_v^2)$;

U_i – a non-negative random variable, which characterizes the efficiency of a household iid $N(0, \sigma_u^2)$.

The key element in determining the PF efficiency is the evaluation of the non-observed value U_i. Therefore, we need to get the expectation U_i, conditional on the observed value ($V_i + U_i$). The expressions that are necessary to assess technical efficiency are defined by Coelli (Coelli et al., 2005) [3].

RESULTS AND DISCUSSIONS

The Republic of Moldova has significant natural, production and human resources to manufacture agricultural products. Hilly landscapes of the Republic, as well as favourable climatic conditions make it possible to develop agriculture and animal husbandry.

Table 2. The structure of expenses and costs needed to purchase goods and services for the production of agricultural products in the studied farms, %

	HF		PF	
	2014	2015	2014	2015
Total costs and expenses for purchased goods and service as well as taxes of which:	100	100	100	100
wages for employees	3.7	4.5	9.7	13.5
seeds, seedlings and planting material	6.6	7.7	7.0	5.2
forage	24.6	32.2	9.5	8.8
agricultural works (tillage, sowing, harvesting, etc.)	15.7	13.5	29.7	24.1
young livestock and poultry	27.1	26.7	16.8	12.0
diesel and gasoline	3.8	0.4	4.0	5.0
transportation services	3.4	2.2	4.7	4.0
inorganic fertilizers and crop protection agents	2.2	1.5	5.0	11.8
land and other taxes, social insurance	2.5	1.5	3.0	2.8
other costs and expenses	10.4	9.8	10.6	12.8

Source: National Bureau of Statistics

PF's grow mainly industrial crops (40%), vegetables (20%), etc. The average size of farm plots, cultivated by individual farms, is 0.89 ha, which is by 1.26 ha less than the value presented in our sample that equals 2,15 ha. Our sample data show that the total area that is cultivated is 1,327 ha, 228 ha of which belong to household personal subsidiary plots. This means that 83% of the land is owned by PF and 17% - by household farms (HF) respectively.

In 2015 the average size of land owned by HF in the Republic of Moldova amounted to 0.40 ha per farm, while the figure equals 0.33 ha in our sample. There is a number of expenses for obtaining of goods and services needed to produce agricultural products in both PF and HF.

Table 2 presents the structure of costs that is observed in the country's households.

We have selected the following indicators as variables of the Cobb- Douglas production function:

- Y - PF's income, thousand lei;
- X_1 – the area of cultivated land that is owned by a PF (including household plots);
- X_2 – expenses of a PF's to manufacture products.

Table 3. The PF efficiency depending on the farms area and its costs

No	Income, thousand lei	Area, ha	Consumption, thousand lei	TE
1	67,000	3.05	24,300	0.5733
2	25,000	2.41	10,300	0.3760
3	15,000	2.9	200	0.5423
4	40,000	2.48	36,500	0.4040
5	5,000	2.24	4,450	0.1364
6	18,000	1.99	3,950	0.3596
7	77,300	2.19	2,950	0.7261
8	83,000	0.38	1,200	0.7607
9	9,200	2.56	900	0.3050
10	53000	2.8	3,890	0.6413
11	68,000	2.23	7,758	0.6501
12	24,000	1.97	14,100	0.3417
13	56,000	1.41	6,550	0.6107
14	3,500	1.65	3,400	0.1088
15	28,700	4.63	8,000	0.4379

The production function in the form of translog can be presented in the following way:

$$\ln(Y_i)=\beta_0+\beta_1\ln(X_{1i})+\beta_2\ln(X_{2i})+V_i+U_i \quad (2)$$

The software used to calculate the technical efficiency is FRONTIER Version 4.1, developed at New England University, Australia (Coelli, 1996) [4].

We assessed the PF efficiency based on the assumption that U_i is distributed iid $N(0, \sigma_u^2)$.

We processed 723 PF in 2015 and obtained the following results:

(i)elasticity values for the factors that are included in the model are presented in Table 3.

(ii)values of PF technical efficiency for the considered factors are presented in Table 4.

Table 4. Program listing of the results for data processed with FRONTIER 4.1

```
Output from the program FRONTIER (Version 4.1c)
instruction file = a1.ins
data file =        a1.dta
 Error Components Frontier (see B&C 1992)
 The model is a production function
 The dependent variable is logged
the ols estimates are :
              coefficient     standard-error    t-ratio
  beta 0        0.83300257E+01  0.22169232E+00  0.37574714E+02
  beta 1       -0.40088151E-01  0.30587295E-01 -0.13106145E+01
  beta 2        0.29058829E+00  0.26598503E-01  0.10924987E+02
  sigma-squared  0.62695563E+00
log likelihood function =  -0.85561248E+03
the estimates after the grid search were :
  beta 0        0.90853413E+01
  beta 1       -0.40088151E-01
  beta 2        0.29058829E+00
  sigma-squared  0.11948558E+01
  gamma         0.75000000E+00
   mu is restricted to be zero
   eta is restricted to be zero
 iteration =     0  func evals =     20  llf = -0.84318895E+03
    0.90853413E+01-0.40088151E-01 0.29058829E+00 0.11948558E+01 0.75000000E+00
 gradient step
 iteration =     5  func evals =     41  llf = -0.84300023E+03
    0.91846804E+01-0.52968496E-01 0.28581368E+00 0.11939930E+01 0.75640680E+00
 iteration =     7  func evals =     64  llf = -0.84300022E+03
    0.91847589E+01-0.52927444E-01 0.28579559E+00 0.11941489E+01 0.75638573E+00
the final mle estimates are :
              coefficient     standard-error    t-ratio
  beta 0        0.91847589E+01  0.21966737E+00  0.41812122E+02
  beta 1       -0.52927444E-01  0.28424891E-01 -0.18620104E+01
  beta 2        0.28579559E+00  0.24610115E-01  0.11612932E+02
  sigma-squared  0.11941489E+01  0.11370922E+00  0.10501777E+02
  gamma         0.75638573E+00  0.53935089E-01  0.14024001E+02
   mu is restricted to be zero
   eta is restricted to be zero
log likelihood function =  -0.84300022E+03
LR test of the one-sided error =   0.25224523E+02
with number of restrictions = 1
 [note that this statistic has a mixed chi-square distribution]
number of iterations =      7
(maximum number of iterations set at :   100)
number of cross-sections =    723
number of time periods =      1
total number of observations =    723
thus there are:      0  obsns not in the panel
covariance matrix :
  0.48253753E-01 -0.24965445E-02 -0.38993311E-02  0.80678564E-02  0.42382898E-02
 -0.24965445E-02  0.80797444E-03 -0.19770534E-03 -0.22130500E-03 -0.13625490E-03
 -0.38993311E-02 -0.19770534E-03  0.60565774E-03 -0.11488226E-03 -0.71486441E-04
  0.80678564E-02 -0.22130500E-03 -0.11488226E-03  0.12929786E-01  0.50832781E-02
  0.42382898E-02 -0.13625490E-03 -0.71486441E-04  0.50832781E-02  0.29089938E-02
```

Constant beta 0 from the formula 2 takes value 0.918. While beta 1, which is responsible for the area, is set to -0.052. This suggests that the PF area negatively affects the level of efficiency. For example, if we raise the cultivated area of a household by

1%, its revenues are reduced by 0,052%. This statement is consistent with the data from previous studies (Cimpoies, 2013) [2].

As for constant beta 2, which is responsible for the costs of the household, the positive value of 0.285 suggests that the use of additional resources increases the efficiency of PF. For example, if we increase costs by 1%, the revenues of PF are increased by 0.285.

The average value of technical efficiency for this sample is 0.538, which corresponds to the expected performance of farms. For example, the farm 499 has an efficiency of 0.8745, which is the maximum value for this sample, and the ratio of the cultivated land of 0,65 ha and the amount of costs (23.2 thousand lei) are most favourable. The farm 390, which has 0.91 ha and costs amount to 2.4 thousand lei with a minimum efficiency in the sample (0.044), shows the worst ratio of the area and amount of expenses.

The stochastic component of the Cobb-Douglas production function TE (technical efficiency) was chosen as a characteristic feature that describes the efficiency of PF and HF. Both production inputs and market competition are considered in his index.

$$TE = e^{(-0,762 + 0,056\sqrt{X_1})} \quad (3)$$

As a result of processing, according to exponential model, the functional relationship between the efficiency of PF and the area of an individual quota is shown in Figure 3.

The analysis shows that the factor elasticity is equal to 0.76. If we increase the household area by 1%, the volume of agricultural production increases by 0.76%. This indicates an increase in the cultivated area of an PF and, consequently, an increase in yields and agricultural production, which leads to greater profits.

Usually HF is not oriented to participate in business relationships, as the main purpose of its activity is to provide themselves and their families with products, and only the surplus can be put up for sale. Consequently, the efficiency, according to the presented data, slightly depends on the exogenous factors. The elasticity coefficient is not high, but there are some farmers with a decent amount of land, who are able to compete with large households.

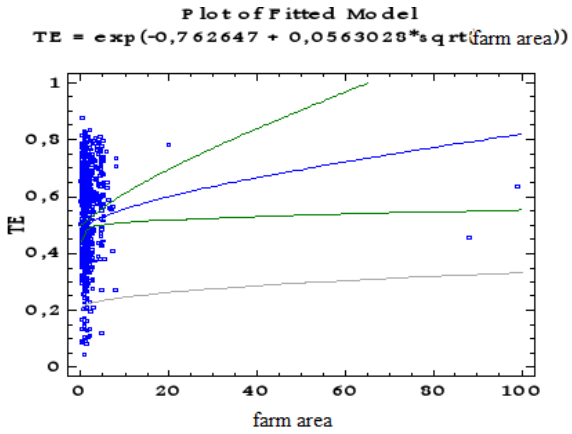

Fig. 3. Functional relationship of the PF area and TE

The model, which reflects the dependence of the efficiency of PF on the HF area, is as follows:

$$TE = \sqrt{0,304 + 0,019 * X_1} \quad (4)$$

In accordance with the studied sample, the total area of HF is 228 ha, which is 17% less than the area of PF that is equal to 1,327 ha.

Based on the data, presented in Figure 5, the factor elasticity is 0.0107. The elasticity ratio shows that the efficiency of HF increases by 0.0107%, if the plot area increases by 1%. Thus, the expanding of the production scale has a positive effect. Therefore, we may conclude about increased levels of the family income.

Traditional branches of the livestock industry are developed in the country too: cattle, pig and poultry breeding. Sheep, fur and fish farming, horse breeding, as well as bee-keeping have an insignificant share in the agricultural production. In years 2000-2015 the rural development is described by a steady productivity increase of agricultural animals and production volumes (Toma, 2014) [10].

The share of animal husbandry in the corporate sector is insignificant due to the emergence of a number of serious problems: lack of initial capital; they have no access to credits and loans due to the lack of collateral property. They also need significant expenses

to design farm buildings and to connect them to utility networks, paying out initial instalments for lease payments, etc.

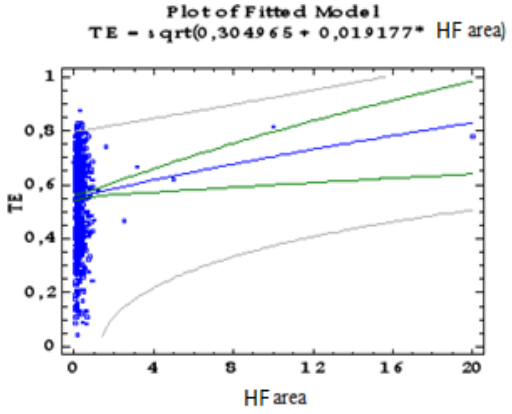

Fig. 4. Functional relationship of the HF area and TE

Based on the information mentioned above, we can conclude that crop production is dominant in agricultural production as compared to animal breeding. Overall agricultural production has fluctuated dramatically over the years at peasant farms.

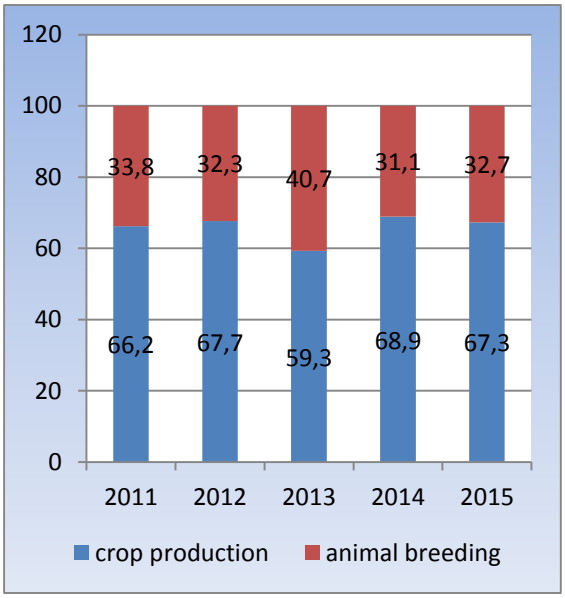

Fig. 5. The structure of agricultural production per branch at a PF, 2011-2015
Source: National Bureau of Statistics

As for individual farm products, the production of some of them tend to increase (grain, cattle and poultry for slaughter, milk), others tend to change slightly (vegetables, eggs).

CONCLUSIONS

We have analysed the efficiency of PF in the Republic of Moldova using the stochastic frontier method and we can conclude the following provisions: the average TE value for the sample is 0,538, which corresponds to the efficiency of PF that is most often found in the sample.
The contribution of various factors that influence the development of PF, is the following:
-the increase of the volume of mechanized operations by 1 lei leads to an increase in the efficiency of PF by 0.10655 TE units. This indicates a high factor elasticity of mechanized operations;
-the factor elasticity of land rent is low and amounts to 0.019 TE units with an increase in the cost of rent by 1 lei. The correlation coefficient between the cost of rent and the efficiency of PF is 0.17, which indicates a connection of low intensity between the factors;
-the factor elasticity of animals purchase is low and amounts to 0.0395 TE units with an increase in costs for the purchase of animals by 1 lei. The correlation coefficient between the expenses needed to purchase animals and the efficiency of PF is 0.053, indicating a low intensity connection between the factors;
-expenses on transportation services amount to 573 thousand lei, which is 13% of the total costs. The factor elasticity of transportation services is low and equals to 0.0498 TE units.
This method of determining the efficiency of PF may be useful to research competitiveness optimization in the rural areas.

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REFERENCES

[1] Cimpoieș, D., 2008, Land policy, structural change and agricultural performance in Moldova. Bulletin of the Armenia Agricultural Academy. State Agrarian

University of Armenia, Armenia, No. 3 (11):118-120.
[2]Cimpoieș, D., Saravia-Matus S., 2013, Methodological background and feasibility assessments of WAW international typology of agricultural holdings, typology and indicators to Characterizae Agricultural Holdings for Improved Policy Formulation, Editors: World Agricultural Watch, France.
[3]Coelli, T., Rao, D. S. P., Battese, G. (2005): An Introduction to Efficiency and Productivity Analysis, Kluwer, Boston.
[4]Coelli T., 1996 Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation, Working Papers in Econometrics and Applied Statistic, No. 96/07, Department of Econometrics, University of New England, Armidale, pp. 31.
[5]Farrell, M.J., 1957, The measurement of productive efficiency. Journal of the Royal Statistical Society , Series A, Vol. 120, p. 253-281.
[6]Gorton, M., Davidova, S. 2001, Farm Productivity and Efficiency in rge CEF Applicant Countries: a synthesis of results. Work Package 5, Working Paper 2/7. Research Group of Agricultural Economics and Business Management, Imperial College at Wye, University of London.
[7]Lerman, Z., Csaki, C., Feder, G. 2004, Agriculture in Transition: Land Policies and Evolving Farm Structures in Post-Soviet Countries. Lexington Books. Oxford, 2004. 254 pp.
[8]Lerman, Z., Cimpoies, D., 2005, Land Consolidation as a Factor for Successful Development of Agriculture in Moldova. Discussion Paper No. 10.05. The Hebrew University of Jerusalem. The Center for Agricultural Economic Research.
[9]Toma, E., Dobre, C., Dona, I., Cofas, E., 2015, DEA Applicability in Assessment of Agriculture Efficiency on Areas with Similar Geographically Patterns, Agriculture and Agricultural Science Procedia, 6, p. 704-711.
[10]Toma, E., Vlad, I., 2014, Structure and shares in the Romanian international trade, Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol.14 (1), p.381-386.