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Technical efficiency in Moldavian industry *

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Abstract

In this paper we present a method for measuring the efficiency for any economical branch. We construct the econometric approach of production frontiers, using the DEA technique (Data envelopment analysis), based on the mathematical programming approach. We effectuate an analysis of some certain data concerning the efficiency or the inefficiency of the branches, using the Efficiency Measurement System Program (EMS).

Key words: efficiency measurement, Malmquist productivity index, production frontier, technical efficiency, allocative efficiency.

1 Introduction

The last decade of the century marked major political changes for Moldova. Such events as the political independence of Republic in 1991, the introduction of national currency in 1993 led to great perturbations in economics, based on a new creative mentality.

The first official document of consolidation of the new judicial, economical (including financial-bank) as well as the institutional instruments can be considered as the parliament Law adopted in 1990 "Concerning the Conception to adopt market economy in the Republic of Moldova". The economy of the Republic in this period is characterized by the accomplishing of some great reforms, that also characterize the economic changes, which occur now. In some economical branches

* We are very great full for the project with the acronym **"STEFAN CEL MARE"**, initiated by the European Community for the financiar sustaining of the research.

it can be noticed disappearances or dramatical jumps in the development, that identify achievements in reorganization and productivity reorientation.

2 Technique for efficiency measurement

The programming approach can be categorized according to the type of data available (cross-section or panel), and according to the type of variables available (quantities only, or quantities and prices). With quantities only, technical efficiency can be calculated, while with quantities and prices economic efficiency can be calculated and decomposed into its technical and allocative components, just as in the econometric approach.

2.1 Definition and measurement of Technical Efficiency

The technical efficiency of a productive unit is a comparison between observed and optimal values (defined in terms of production possibilities) of its outputs and inputs. This comparison can take the form of a ratio of observed to maximum potential output attainable from the given input, or the ratio of minimum potential to observed input required to produce the given output, or some combination of these two.

The most general definition of efficient production is provided by Koopmans: a producer is technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output. Debreu and Farrell introduced a measure of technical efficiency defined as one minus the maximum equiproportionate reduction in all inputs that still allows continued production of given outputs.

Suppose producers use input vector $x = (x_1, \dots, x_N) \in R_+^N$ to produce output vector $y = (y_1, \dots, y_M) \in R_+^M$. We refer to affine displacements of the input and output vectors by means of $\bar{x}_i = x_i + \alpha$,

$\alpha \geq 0$, and $\bar{y}_i = y_i + \beta$, $\beta \geq 0$, $i = 1, \ldots I$, so as to eliminate zero or negative values that may exist in x_i and y_i. Thus $\bar{x}_i \in R^N_{++}$, $\bar{y}_i \in R^M_{++}$, $i = 1, \ldots, I$. Further we consider $x_i = \bar{x}_i$, $y_i = \bar{y}_i$, $i = 1, \ldots, I$.

We can represent the production technology with an input set

$$L(y) = \{x : (y, x) \text{ is feasible}\},$$

and also with an output set

$$P(x) = \{y : (y, x) \text{ is feasible}\}.$$

The input distance function is

$$D_i(y, x) = \max\{\lambda : (x/\lambda) \in L(y)\},$$

and the output distance function is

$$D_o(y, x) = \min\{\theta : (y/\theta) \in P(x)\},$$

where D_i means D_{input}, D_o means D_{output}.

The corresponding Debreu-Farrell input-oriented and output-oriented measures of technical efficiency can be defined as:

$$DF_i(y, x) = 1/D_i(y, x) = \min\{\lambda : \lambda x \in L(y)\},$$

$$DF_o(x, y) = \frac{1}{D_o(x, y)} = \max\{\theta : \theta y \in P(x)\},$$

where DF_i means DF_{input} and DF_o means DF_{output}.

2.2 A DEA model

The "data envelopment analysis" (DEA) is a descriptive title for the mathematical programming approach to the measurement of efficiency relative to a production frontier. The frontier is calculated so that it envelops the data as tightly as possible, subject to various constraints (convexity, disposability, scale restriction) without imposing possibly misleading parametric structure on technology, choosing instead to let the data reveal the structure of technology. Since its setting up in 1978, with the study of Charnes, Cooper and Rhodes, the DEA methodology has been developed from a single linear programming model into a vast and still growing family of mathematical programming models.

In what follows we shall describe the most simple, most restrictive DEA model assuming convexity of the set of feasible input-output combinations, strong disposability of inputs and outputs and constant returns to scale.

Consider a set of I producers using vector $x \in R^N_{++}$ to produce output vector $y \in R^M_{++}$. Let x_0, y_0 be the input-output vector of the producer being evaluated and (x_i, y_i) the input-output vector of the i-th producer in the sample. The objective is to analyse the performance of comparing each producer to the best-observed practice in the sample. In order to do that, we search for a set of nonnegative weights which, when applied to each of producer's inputs and outputs, minimizes the ratio of weighted input to weighted output for the producer under evaluation, subject to the normalizing constraint that no producer in the sample has a ratio less than unity.

$$\min_{\zeta,\nu} \frac{\zeta^T x_0}{\mu^T y_0},$$

$$\frac{\zeta^T x_i}{\mu^T y_i} \geq 1, \quad i = 1, \ldots, 0, \ldots, I,$$

$$\mu, \zeta \geq 0,$$

where T means an operation of transposition.

The previous nonlinear ratio model can be converted into a linear programming problem via the change of variables:

$$u = t\mu, \quad v = t\zeta, \quad t = (\mu^T y_0)^{-1}.$$

The model becomes:

$$\min_{u,v} v^T x_0,$$

$$\begin{cases} u^T y_0 = 1 \\ v^T x_i > u^T y_i \\ u, v \geq 0 \end{cases}, \quad i = 1, \ldots, 0, \ldots, I,$$

and its dual is the linear programming "envelopment"

$$\max_{\theta,\lambda} \theta,$$

$$X\lambda \leq x_0,$$

$$\theta y_0 \leq Y\lambda,$$

$$\lambda \geq 0.$$

where X is an $N * I$ input matrix with columns x_i, Y is an $M * I$ output matrix with columns y_i and λ is an $I * 1$ intensity vector. The last DEA problem has to be solved I times, once for each producer, to obtain I optimal values of (θ, λ). The problem is output oriented, which means that the performance of a producer is evaluated in terms of his ability to radial expand his output vector, and to subject to the constraints imposed by the best observed practice. If radial expansion is possible for a producer, its optimal $\theta > 1$, while if radial expansion is not possible, its optimal $\theta = 1$. We may now observe that optimal $\theta = 1$ is necessary but not sufficient for a producer to be technically efficient in the sense of Koopmans, since $(\theta y_0, x_0)$ may contain slack in any of its $(N + M - 1)$ dimensions.

The input oriented version of the DEA problem can be handled analogously.

2.3 The Malmquist Productivity Index

The Malmquist productivity index can be used to construct indexes of output quantity, input quantity or productivity, as ratios of output or input distance functions.

This input (output) distance functions are reciprocals of the Debreu-Farrell input (output)-oriented measures of technical efficiency.

Let $x^t = (x_1^t, \ldots, x_N^t) \in R_+^N$ and $y^t = (y_1^t, \ldots, y_M^t) \in R_+^M$ denote respectively an input vector and an output vector in period t, $t = 1, \ldots, T$, where T means the time during the practic estimations.

The output oriented Malmquist productivity index can be defined using three different approaches for the same orientation:

* a backward-looking approach which evaluates the performances of the data from periods t and $t+1$ relative to technology (production possibilities) from period t

$$M_o^t(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)},$$

* a forward-looking approach which evaluates the performances of the data from periods t and $t+1$ relative to technology (production possibilities) from period $t+1$:

$$M_o^{t+1}(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)},$$

The economic interpretation is that it measures the relative change in either input-conserving or output-expanding efficiency between two periods with reference to the same frontier technology.

A value larger than 1 for $M_o(y^{t+1}, x^{t+1}, y^t, x^t)$ indicates positive productivity growth from period t observation to the period $t+1$ technology, while a value less than 1 indicates a productivity decline.

In the same manner can be defined an input-oriented Malmquist productivity index. Improvement in productivity occur whenever $M_i(y^{t+1}, x^{t+1}, x^t, y^t) < 1$.

The Malmquist productivity index can be decomposed into an index of technical change and an index of technical efficiency change. For the Malmquist index we obtain:

Forward:

$$M_o^{t+1}(x^t, y^t, x^{t+1}, y^{t+1}) = \left[\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right]\left[\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}\right] =$$

$$= \Delta T(x^t, y^t)\Delta TE(x^t, y^t, x^{t+1}, y^{t+1}).$$

Backward:

$$M_o^t(x^t, y^t, x^{t+1}, y^{t+1}) =$$

$$= \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} =$$

$$= \Delta T(x^{t+1}, y^{t+1}) \Delta TE(x^t, y^t, x^{t+1}, y^{t+1}).$$

* $\Delta T(x^t, y^t)$ is the index of technical change between periods t and $t+1$ with respect to the data from period t, i.e. the shift to frontier technology between periods;

* $\Delta TE(x^t, y^t, x^{t+1}, y^{t+1})$ is an index of technical efficiency change between periods t and $t+1$.

3 The Data.

We have chosen two inputs and two outputs. As inputs we decided to use Investments, **Employees**, and as outputs – the **Volume of Industrial Production and the Volume of Export.** (We would like to mention that in export tables we've included the intermediary export. As a result for some branches the volume of export is the biggest production volume).

We have performed two kinds of analyses, a static analysis and a dynamic analysis on a data[1] set for 17 economical branches of Moldova in the 1993 – 1998 period. To compare the industrial branches among them we have transformed the data of Investments, Volume of Industrial Production and Volume of Export in dollars, then we have converted the data according to 1993 price.

For this operation we have used the following formula:

$$\sum_i q_i p_i^b = \frac{\sum q_i p_i^t}{\left(1 + \frac{int^{b+1}}{100}\right) \cdots \left(1 + \frac{int^t}{100}\right)}.$$

[1]According to the data used in this paper we want to mention the following: no one can say that the results of privatization, at its final stage, might not be later reviewed.

Here:

q_i – denotes the investments, industrial productions and export, respectively and is expressed in physical units, corresponding to year t,

p_i^b – denotes the price of the reference year,

p_i^t – denotes the price of year t,

int^t – denotes the level of inflation in the year t, relatively to the year $(t-1)$,

int^{b+1} – denotes the level of inflation in the year $(b+1)$, relatively to the year b (reference year).

The data concerning the value rate of exchange and the yearly inflation level have been collected from the yearly Reports of the National Bank of Moldova and are used at estimation of inputs and outputs .

Investments represent expenditures for construction, installations and assembly works, for equipment and transport means of acquisition and other expenditures for the creation of the new fixed assets, for the developing, modernizing, and rebuilding the existing ones.

The distribution of investments among branches of industry has been performed taking into account their destination within economic and social-cultural units according to the classification of the national economy branches.

Indices of the investment dynamics have been calculated on comparable price bases.

Industrial production represents the value sum of delivered finite works (services) with industrial character, semi-manufactured products stock and unfinished production.

Export represents one of the most important characteristics of a country, which shows us clearly its economic development. Export represents our commercial relationships with the foreign countries, where to sell a part of goods.

The **Employees** indicator measures the average number of employees in different industrial branches (the minimum unit being one thousand people).

4 Technical efficiency analysis

The distance functions are equivalent to Farrell's measure of technical efficiency. It follows that the distance function completely describes technology, and simultaneously provides a very useful measure of deviations from frontier performance or technical efficiency. The choice between weak and strong disposability is important for explaining the origin of inefficiency.

For the study of the technical efficiency of industrial branches we used a DEA model with two inputs and two outputs, assuming constant returns to scale and free disposability of inputs and outputs. We performed EMS for input and output orientations in order to construct the Mulmquist productivity index. The forward looking approach of Malmquist index, input and output oriented is

$$M_i^{t+1}(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D_i^{t+1}(y^{t+1}, x^{t+1})}{D_i^{t+1}(y^t, x^t)},$$

$$M_o^{t+1}(x^t, y^t, x^{t+1}, y^{t+1}) = \frac{D_o^{t+1}(y^{t+1}, x^{t+1})}{D_o^{t+1}(y^t, x^t)}.$$

This approach evaluates the performances of the data form period t and $t+1$ relative to technology (production possibilities) from period $t+1$.

4.1 Forward input-oriented analysis

Scores of Branches that have been efficient at least for two years

Table 1[2]

Branches	1993	1994	1995	1996	1997	1998
Bakery prod.	**1125,23**	**580,24**	**559,43**	**440,41**	**266,08**	**349,02**
Wood, furnit.	**1156,39**	**4585,99**	**1226,67**	16,42	8,34	10,48
Tobacco.	79,8	**170,31**	93,64	**321,06**	**284,28**	**236,71**
Soap,det.,cosm	**184,36**	75,45	**239,78**	**158,91**	**109,82**	29,49
Mach.,equipm.	17,68	42,24	42,63	68,09	**528,92**	**349,49**
Pharm.,chemical	**104,68**	**168,87**	95,79	**106,29**	**118,22**	**125,5**
Records, TV	**110,19**	**160,75**	**167,62**	**341,13**	**170,64**	**256,11**

Analyzing the scores[3] and Table 1 we can conclude:

1. there were two efficient branches in the Republic during the period 1993 to 1998: *Production of bakery products and the Technical industry (equipment to record and reproduce of TV); the Production of bakery products* has undergone a fall in its efficiency during 1994-1997; *the Technical industry* has always been growing efficiently except 1997;

2. *the Pharmaceutic preparations, medical and chemical substances* have been efficient every year, except 1995;

3. there are seven branches, with a negative efficiency during 1993-1998; three branches were efficient just one year;

4. a dramatic decline in *Production of wood, products including furniture* during 1995-1998 has been registered;

5. a considerable growth in the branch of *Machines and equipment's production* has been registered in 1997.

[2]**Observations:** In the following tables the names of the economic branches were shortened for to respect the construction of the tables, but we think that won't make it harder for the reader to understand the complete names of the branches.

[3]Appendix 1

Malmquist productivity indexes.

Table 2

Branches	'93 - '94	'94 - '95	'95 - '96	'96 - '97	'97 - '98
Bakery prod.	0,3145	0,2367	0,2981	0,3559	0,5136
Wood, furnit	0,0534	0,2126	65,691	2,5191	1,3177
Paper, art.	1,9389	0,9715	0,9834	1,6959	1,2236
Rub. plast. art.	0,7044	0,1509	1,3979	0,9087	1,5182
Leather, trunks	0,8212	0,8214	0,8127	0,8164	4,4901
Food, drinks	0,6606	0,8549	1,0460	0,8850	2,9641
Tobacco	0,4913	1,0778	0,3333	0,4420	0,8772
Textile	0,4266	1,1772	0,8025	1,1683	0,7482
Clothes, fur.	0,7569	1,0366	0,7759	1,4486	2,0147
Soap, det., cosm.	2,0968	0,2723	0,7350	4,6702	4,3424
Mineral prod.	1,2092	1,0409	1,0296	0,7320	1,1076
Cement, lime	1,7721	1,2690	0,3610	3,2490	1,3558
Mach., equipm.	0,5563	0,8723	0,7313	0,1439	0,3637
Foot- wear	2,8567	2,1424	1,0314	0,6998	1,3069
Pharm., chemical	0,6621	1,0698	0,7167	0,7929	1,2112
Records, TV.	0,5305	0,5980	0,2150	9,2192	0,4184
Ind. Wines	1,4541	0,6521	0,9946	0,7129	1,1706

From Table 2 of Malmquist Productivity indixes we can conclude:

1. the efficient branch of *Bakery production* is productive during the entire period 1993-1998, but decline in productivity startly 1995;

2. the *Machines and equipment's production and metaltreatment* branch is also productive during the entire period 1993-1998, but there is a decline in productivity in the period 1996-1997;

3. the situation is catastrophical for *Production of wood, wood products including furniture* in 1995-1996 period;

4. the productivity of the *Technical industry (equipment for record and reproduce of TV)* was unlucky with its considerable decline in 1996-1997 period, that was not true in 1997-1998, when the productivity clearly went up;

5. there was also noticed a drop in the productivity index in *Winemaking industry* in 1994-1995, later on followed by considerable rise in 1996-1998, combined with a degree of efficiency;

6. The dynamic evolution of Malmquist index for values close to 1 shows that the *Food-processing industry and drinks, Manufacture of tobacco articles* have been efficient.

Decomposition of Malmquist index for efficient branches

Table 3

Branches	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998
	ΔT	ΔT	ΔT	ΔT	ΔT
Bakery prod.	0,1621	0,2279	0,2347	0,2150	0,6737
Wood, furnit.	0,2118	0,0568	0,8793	1,2795	1,6558
Tobacco.	1,0487	0,5926	1,1427	0,3914	0,7304
Soap,det.,cosm	0,8581	0,8331	0,5061	3,2275	1,1660
Mach.,equipm.	1,3291	0,8804	1,1681	1,1182	0,2403
Pharm.,chemical	1,0681	0,6195	0,7952	0,8819	1,2858
Records, TV	0,7739	0,6236	0,4377	4,6116	0,6280

Table 4

Branches	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998
	ΔTE	ΔTE	ΔTE	ΔTE	ΔTE
Bakery prod.	1,9392	1,0371	1,2702	1,6551	0,7623
Wood,furnit	0,2521	3,7385	74,7076	1,9688	0,7958
Tobacco.	0,4685	1,8187	0,2916	1,1293	1,2009
Soap,det.,cosm	2,4434	0,3229	1,4522	1,447	3,7239
Mach.,equipm.	0,4185	0,9908	0,6260	0,1287	1,5131
Pharm.,chemical	0,6194	1,7629	0,9012	0,8990	0,9419
Records, TV	0,1854	0,9590	0,4913	1,9991	0,6818

According to the Tables 3 and 4 of Malmquist productivity indexes decomposition we state:

- the sudden change of productivity index in 1995-1996 in *Wood production including furniture* is due to the decrease of the efficiency technique index change (ΔTE); the decline in efficiency for the *Technical industry* in 1996 -1997 has happened because of the index of technical change (ΔT);

- the value of all indices of technical change (ΔT) is growing during 1994-1995, these indices contributed to the rise of productivity and at the same time to the rise of the efficiency degree.

4.2 Forward output-oriented analysis.

Scores of branches that have been efficient at least for two years.

Table 5

Branches	93	94	95	96	97	98
Bakery prod.	**8,89**	**17,23**	**17,88**	**22,71**	**37,58**	**28,65**
Wood, furnit.	**8,65**	**2,18**	**8,15**	609,04	1199,36	954,17
Tobacco.	125,31	**58,72**	106,8	**31,15**	**35,18**	**42,24**
Soap,det.,cosm	**54,24**	132,54	**43,33**	**62,93**	**91,05**	339,11
Mach.,equipm.	565,66	236,75	234,55	146,87	**18,91**	**28,61**
Pharm.,chemical	**95,53**	**59,22**	104,4	**94,08**	**84,59**	**79,68**
Records, TV.	**90,76**	**62,21**	**59,66**	**29,31**	**58,6**	**39,05**

Malmquist productivity index – output oriented approach.

Table 6

Branches	'93 - '94	'94 - '95	'95 - '96	'96 - '97	'97 - '98
Bakery prod.	3,1804	4,2276	3,3531	2,8094	1,9469
Wood, furnit	18,7201	4,7030	0,0152	0,3968	0,7589
Paper, art.	0,5157	1,0293	1,0167	0,5897	0,8171
Rub.plast.art.	1,4195	6,6238	0,4170	1,1003	0,6585
Leather,trunks	1,2179	1,2175	1,2303	1,2248	0,2227
Food, drinks	1,5137	1,1697	0,9559	1,1298	0,3373
Tobacco	2,0349	0,9277	3	2,2617	1,1401
Textile	2,3438	0,8494	1,2459	0,8558	1,3364
Clothes,fur.	1,3210	0,9648	1,2883	0,6903	0,4963
Soap,det.,cosm.	0,4769	3,6715	1,3604	0,2141	0,2302
Mineral prod.	0,8268	0,9605	0,9709	1,3660	0,9028
Cement, lime	0,5647	0,7883	2,7713	0,3077	0,7980
Mach.,equipm.	1,7974	1,1464	1,3673	6,9455	2,7497
Foot-wear	0,3501	0,4674	0,9680	1,4280	0,7656
Pharm.,chemical	1,5103	0,9156	1,3953	1,2610	0,8255
Records,TV.	1,8849	1,6719	4,6499	0,1085	2,3895
Ind.Wines	0,6877	1,5333	1,0055	1,4025	0,8541

Analyzing the scores[4] of efficiency, Table 5 and 6, we state:

1. there are two economical branches efficient (the same as the previous analysis) during the entire period 1993-1998;

2. there are seven branches with no efficiency (as in the input oriented analysis) during 1993-1998; three branches were efficient just one year. From the Table 6 of Malmquist productivity index we detect the same declines and growths for all economical branches (as the input oriented analysis), consequently the same positive or negative frontier shifts.

Decomposition of Malmquist index for efficient branches.

Table 7

Branches	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998
	ΔT	ΔT	ΔT	ΔT	ΔT
Bakery prod.	6,1642	4,3871	4,2589	4,6490	1,4843
Wood,furnit.	4,7179	17,5825	1,1374	0,7815	0,6038
Tobacco.	0,9535	1,6873	0,875	2,5544	1,3689
Soap,det.,cosm	1,1653	1,2003	1,9757	0,3098	0,8576
Mach.,equipm.	0,7523	1,1358	0,8561	0,8942	4,1602
Pharm.,chemical	0,9362	1,6141	1,2573	1,1338	0,7776
Records,TV	1,2919	1,6034	2,2844	0,2169	1,5923

Table 8

Branches	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998
	ΔTE	ΔTE	ΔTE	ΔTE	ΔTE
Bakery prod.	0,5159	0,9636	0,7873	0,6043	1,3169
Wood,furnit.	3,9678	0,2520	0,0133	0,5078	1,2569
Tobacco.	2,1340	0,5498	3,4285	0,8854	0,8328
Soap,det.,cosm	0,4092	3,0588	0,6885	0,6911	0,2684
Mach.,equipm.	2,3892	1,0093	1,5969	7,7667	0,6609
Pharm.,chemical	1,6131	0,5672	1,1096	1,1121	1,0616
Records,TV	1,4589	1,0427	2,0354	0,5001	1,5006

[4] Appendix 2

From the decomposition of Malmquist productivity indexes we conclude that the same factors ($\Delta TE, \Delta T$) (as in the input oriented analysis) provide the declines or growths in productivity, consequently in efficiency for every branch.

5 Conclusions

Studying the results of a forward-looking approach we can notice that the both analyses, input and output oriented, concerne:

a) the same economic branches while surveying the efficiency and inefficiency (through the scores of efficiency);

b) the same periods of growth and decline in productivity (through the Malmquist indices);

c) the same dramatic drop in the economic development for the same branches (Wood Production).

Practical results confirm again the theoretical results on maintaining the relations of equiproportionality between inputs and outputs in economic efficiency studies.

In conclusion we can affirm, that the DEA technique is efficient concerning the study of the efficiency of any economic branch or sector. Evaluating the Malmquist-type coefficients, the DEA models permit to compare the actual efficiency of every branch with the optimal efficiency and show the dependence between the observed values of inputs and outputs. We believe that such analysis is very useful for the evaluation of the actual economic situation, and makes a real appreciation of the development or stagnation factors. Finally, it led to some theoretic solutions for the growth of economical indexes in the conditions of market economy.

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Scores of branches for input oriented analysis (%)

Appendix 1.

Branches	1993Y	1994Y	1995Y	1996Y	1997Y	1998Y
Bakery prod.	1125,23	580,24	559,43	440,41	266,08	30,00
Wood,furnit.	1156,39	4585,99	1226,67	16,42	8,34	10,48
Paper,art.	128,47	66,96	62,59	72,08	58,31	47,84
Rub.plast.art.	30,15	57,41	193,40	60,49	55,80	53,29
Leather,trunks	17,80	25,84	19,99	29,38	32,30	13,22
Food,drinks	53,96	87,54	58,86	77,38	66,65	42,09
Tobacco.	79,80	170,31	93,64	321,06	284,28	236,71
Textile.	46,68	73,59	45,92	56,23	94,39	134,78
Clothes,fur.	16,77	23,49	14,74	21,56	23,45	13,59
Soap,det.,cosm	184,36	75,45	230,78	158,91	109,82	29,49
Mineral prod.	61,05	46,30	27,34	25,26	36,72	63,99
Cement,lime	8,66	6,54	3,94	9,14	10,36	8,29
Mach.,equipm.	17,68	42,24	42,63	68,09	528,82	349,49
Foot-wear.	18,03	7,89	3,79	4,14	8,33	6,94
Pharm.,chemical	104,68	168,87	95,79	106,29	118,22	125,50
Records,TV.	110,19	160,75	167,62	341,13	170,64	256,11
Ind.Wines	61,06	46,13	48,84	48,46	66,20	92,00

Scores of branches for output oriented analysis (%)

Appendix 2.

Branches	1993Y	1994Y	1995Y	1996Y	1997Y	1998Y
Bakery prod.	8,89	17,23	17,88	22,71	37,58	28,65
Wood,furnit.	8,65	2,18	8,15	609,04	1199,36	954,17
Paper,art.	77,84	149,34	159,77	138,73	171,49	209,04
Rub.plast.art.	331,63	174,18	51,71	165,31	179,21	187,67
Leather,trunks	561,90	386,96	500,20	340,33	309,56	756,21
Food,drinks	185,33	114,23	169,90	129,24	150,04	237,57
Tobacco.	125,31	58,72	106,80	31,15	35,18	42,24
Textile.	214,23	135,89	217,76	177,85	105,95	74,19
Clothes,fur.	596,36	425,71	678,36	463,84	426,37	735,90
Soap,det.,cosm	54,24	132,54	43,33	62,93	91,05	339,11
Mineral prod.	163,79	216,00	365,77	395,94	272,34	156,28
Cement,lime	1155,13	1528,20	2536,94	1094,59	965,32	1205,70
Mach.,equipm.	565,66	236,75	234,55	146,87	18,91	28,61
Foot-wear.	554,51	1266,66	2635,33	2417,40	1200,41	1440,09
Pharm.,chemic.	95,53	59,22	104,40	94,08	84,59	79,68
Records,TV.	90,76	62,21	59,66	29,31	58,60	39,05
Ind.Wines	163,78	216,77	204,74	206,35	151,06	108,70