

Evaluation of Individual and Aggregate Credit Institutions Management's Performance

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***Abstract.** Data Envelopment Analysis method allows both the measurement of the relative efficiency of an homogenous group of credit institutions, and the identification of those banking activity's components generating a state of inefficiency. The present study focuses on this last issue, by proposing an interpretation of inefficiency signals and by strengthening the major role played by the credit institution's executive board in designing a viable, coherent business strategy and in defining its risk profile.*

DEA method places all the efficient credit institutions on the efficiency frontier, without allowing their differentiation. In order to exceed this limit, we have analysed and compared two ranking techniques. The results obtained suggest that the hierarchy generated by the two techniques hasn't changed significantly for almost 60% of our sample of credit institutions.

Key words: Data Envelopment Analysis; management's performance; inefficiency; superefficiency score; virtual ideal institution.

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JEL Codes: G21, G32.

REL Codes: 11C, 11E.

Introduction

In the last decade, Data Envelopment Analysis (DEA) has become an analysis tool employed on a large extent in evaluating the relative efficiency of a homogenous set of decision making units. The field of action of this method increased considerable, allowing for performance evaluation of both qualitative, intangible issues of economic environment, such as public services, and for a large spectrum of entities⁽¹⁾.

DEA method proposes a quantitative dimension of relative efficiency, but doesn't allow the ranking of efficient units. In other words, there isn't enough to know which are the best performing entities, but also what is their ranking. The economic literature comprises several techniques for reaching this desideratum:

- *Cone-ratio model*, created by Charnes in 1990, and *assurance region model*, developed by Thompson in 1990, both of them imposing additional restrictions in the process of solving an optimization problem.
- “*Superefficiency*” concept, introduced by Andersen and Petersen in 1993, which ranks only the efficient units; the inefficient ones are ranked according to their efficiency score, obtained by simply running a DEA model.
- *The approach based on the frequency of appearance*⁽²⁾ of efficient units in the reference set, generated for each of the inefficient units. The more number of occurrences, the most important is a particular credit

institution relative to the others lying on the efficient frontier, and, therefore, it will be placed at the beginning of the classification. This method cannot be applied to inefficient units.

- *Relative closeness index RC*, build by introducing in the analysed sample two virtual decision making units, namely ideal DMU and non-ideal DMU. By combining the efficiency scores estimated under the assumption of the best performance, and, respectively, of the lowest efficiency, we will obtain a ranking of all entities.

We have structured the present study in two parts. First part represents an interpretation of the estimates obtained by applying DEA technique, focusing not only on the identification of efficient credit institutions from the point of view of management's quality, but also on aspects that lead to inefficiency of the current activity. We argue that a special focus on potential sources of vulnerability prevails on the basic concept of efficiency and allows the elaboration of corective actions.

In the second part, in order to surpass one of the limits of DEA technique, namely the ascription of an efficiency score equal to one for each efficient unit, we have applied and analysed comparatively two ranking methods, having as purpose a more clear distinction between credit institutions performance. The study was conducted for a sample of five credit institutions, representatives for the Romanian banking system.

1. Interpretation of inefficiency signals

In a previous study we had identified the optimal mix of input-output variables which best characterises the financial intermediation activity, and offers a comprehensive picture on the managerial team's performance. In this context, the most adequate model for evaluating management's performance contains as *input variables*: customers deposits, other financing sources, operational expenses and loan loss provisions. *Output variables* are represented by: total volume of credits, net income from other activities, net interest income and the value of off-balance sheet activities. We have estimated for this model the individual efficiency scores of each credit institution in the considered sample,

under the assumptions of variable returns of scale and of an output oriented model, which maximises outputs. After a rigorous analysis of the final results obtained by means of DEA technique, we have reached to several conclusions.

A *first conclusion* refers to an improvement in the usage of input and output variables, suggested by the term "slack". It quantifies the proportion in which inputs values should be decreased, so that, under the assumption of constant outputs, the credit institution becomes efficient. In other words, it determines the excess of each input variable over its efficient value that ensures input minimization. From an output maximization perspective, the "slack's" value suggests how much can be increased outputs, so that the activity becomes efficient (table 1).

Inefficiency quantification ("slack") for output variables

Table 1

DMU	{S} customers credits {O}	{S} net income other activities {O}	{S} net interest income {O}	{S} off-balance sheet activities {O}
DMU 1 2003				
DMU 2 2003				
DMU 3 2003				
DMU 4 2003	0.01	7361.42	1050986.4	2423225.51
DMU 5 2003				
DMU 1 2004				
DMU 2 2004				
DMU 3 2004				
DMU 4 2004				
DMU 5 2004				
DMU 1 2005	42978731.04	0	405518.17	0.02
DMU 2 2005				
DMU 3 2005				
DMU 4 2005	0	467792.49	0	2356619.65
DMU 5 2005				
DMU 1 2006				
DMU 2 2006				
DMU 3 2006				
DMU 4 2006				
DMU 5 2006				

All the credit institutions that have no value for the term “slack” are considered efficient. One can observe that, for the year 2004, all of them are characterised by a state of efficiency.

In 2003 there is only one situation of inefficiency. To become efficient, the credit institution 4 should increase the value of all its outputs: credits with 0.01 units, net income from other activities with 7361.42 units, net interest income with 1050986.4 units and off-balance sheet activities with 2423225.51 units. In 2005 there are two cases of inefficiency.

Therefore, credit institution 1 should increase the value of outputs 1, 3 and 4, meanwhile the institution 4 should increase outputs 2 and 4. These values, estimated by means of DEA technique, shouldn't be viewed in an absolute amount because they had been obtained on the basis of the flexible weights⁽⁴⁾, which are at the core of the DEA technique. Its premise is hence to present each credit institution in the most favourable state. Consequently, those output variables that registered significant values of inefficiency should be carefully monitored.

Another conclusion regards the efficient credit institutions that lye on the efficiency frontier, and, also, those inefficient institutions which have chosen them as benchmark.

In table 2 we have presented the credit institutions analysed for a period of four years, mentioning the efficient ones, that belong to the peer group.

Peer groups

Table 2

Current rank	DMU	Benchmarks
1	DMU 1 2003	1
2	DMU 2 2003	2
3	DMU 3 2003	2
4	DMU 4 2003	3 (0.77) 5 (0.04) 19 (0.19)
5	DMU 5 2003	1
6	DMU 1 2004	0
7	DMU 2 2004	0
8	DMU 3 2004	0
9	DMU 4 2004	1
10	DMU 5 2004	0
11	DMU 1 2005	2 (0.21) 16 (0.50) 17 (0.28) 18 (0.01)
12	DMU 2 2005	0
13	DMU 3 2005	0
14	DMU 4 2005	1 (0.06) 2 (0.04) 3 (0.18) 9 (0.61) 19 (0.11)
15	DMU 5 2005	0
16	DMU 1 2006	1
17	DMU 2 2006	1
18	DMU 3 2006	1
19	DMU 4 2006	2
20	DMU 5 2006	0

Credit institutions 4, 11 and 14 proved to be inefficient, therefore each of them has its own reference set to compare with, which contains those efficient institutions characterised by a similar pattern of input and output variables with the analysed institution. For instance, the efficiency frontier for institution 4 is best described by institutions 3,5 and 19, which represent its comparison basis. It can be observed that the main weight is detained by institution 3 (0.77), meanwhile the less significant is institution 5, with 0.04. The efficiency frontier for institution 14 is best described by institutions 1, 2, 3, 9 and 19. The institutions identified as being efficient have their own frontier.

We can conclude that DEA is a diagnosis tool of inefficiency sources. The efficiency scores estimates, however, don't indicate the strategy that must be implemented so that the credit institution becomes efficient. This must be defined by the managerial team. The first step consists in a proper awareness of sources of vulnerability and of those particular aspects that can lead to a real advantage on competitors.

Moreover, the economic literature agrees that the executive board of a credit institution has a major role in developing the banking activity on a stable, viable basis. The Committee of European Banking Supervisors (2006) affirms that top management is directly responsible for the credit institution's strategy and its attitude towards risk, for the internal organisation and clear, coherent and transparent allocation of responsibilities and authority, for the ease of communication between different hierarchical structures, for internal control and audit activities.

Ware (1996) believes that the success or, contrary, the failure of a credit institution depends mainly on the staff's experience and integrity. Top management must be independent and actively involved in the elaboration of the business strategy and in the process of risk and profitability monitoring. Sergeant (1999), after having conducted several studies on the Great Britain's banking system, observed that the absence of a clear, coherent, accepted and understood strategy by all departments of a credit institution, represents a common issue for all problem institutions. The main deficiencies consist in an inadequate level

of resources (inadequacy of economic capital, improper technology, lack of experience of employees) and an inability to adjust the existent strategy, keeping in mind the economic, social, technological and legally environment. The author underlines that top management must prove a deep knowledge not only of causes and circumstances of losses, but also of sources of profit and risks assumed in order to achieve these profits.

2. Ranking of credit institutions

In order to attain a more clear picture on individual banks performance, we have proceeded to their ranking. The building of a classification tends to a global interpretation, allowing for comparisons between the performance of different credit institutions. The economic literature proposes several ranking methods, which have both limits and advantages.

In the present study we have chosen to analyse comparatively two approaches: the first one includes in the original sample two additional virtual credit institutions; the second one is based on the estimation of a superefficiency index, according to the method proposed by Andersen and Petersen.

First approach consists in including into the reference group of two virtual institutions, namely IDMU (an ideal credit institution, that employes the smallest inputs in order to produce the biggest values of outputs) and respectively ADMU (a non-ideal institution, characterised by using the biggest values for input variables, to produce the smallest outputs). The values

of input and output variables for the two above are presented in table 3. additional virtual institutions mentioned

Establishing the value of input and output variables for IDMU and ADMU

Table 3

DMU	Deposits {I}	Other financing sources {I}	Operational expenses {I}	Loan loss provisions {I}	Customers credits {O}	Net income from other activities {O}	Net interest income {O}	Off-balance sheet activities {O}
DMU 1 2003	139538879	9637154	10381500	1612517	78822383	3197753	10663317	34048114
DMU 2 2003	65093698	4417340	5867973	4131015	49900039	3812703	5414592	17413481
DMU 3 2003	10602725	1625249	1068413	134375	8517778	592267	977349	2563846
DMU 4 2003	17500859	3750588	1658057	810000	15689700	850875	233500	2157300
DMU 5 2003	27670801	7657878	3175659	182884	28661326	2286228	1338145	6705070
DMU 1 2004	175970877	23751612	11049523	2064081	102887780	5780713	13228337	49784225
DMU 2 2004	89674257	14515350	6015947	4815157	67961211	4068639	7351063	23053300
DMU 3 2004	18764451	3566395	1375985	371944	14368958	830917	1342955	5107296
DMU 4 2004	23705250	4353190	2707840	865770	20192690	1147940	2668420	3029760
DMU 5 2004	54381521	13459643	5150166	243466	46594084	3070205	3057557	7672555
DMU 1 2005	192750300	91558060	12911240	5534990	153792000	7421050	13516270	68928570
DMU 2 2005	149091250	23936520	7224180	924670	100744810	4116920	9788160	29169980
DMU 3 2005	34800737	6580042	1922259	1022035	29637374	1211283	2097031	15260697
DMU 4 2005	32080310	4260420	3760490	901080	25018990	854480	2885520	4007270
DMU 5 2005	78184050	15028750	6735550	583370	51475770	4716290	4445790	9523420
DMU 1 2006	244770650	152872150	14603790	7689520	237991770	7968340	16069510	89694350
DMU 2 2006	200867160	50021470	9760740	717930	181428020	6578930	11850320	46174710
DMU 3 2006	58201796	10487131	3322536	1724144	48931298	2192549	2502914	24591214
DMU 4 2006	43607630	5047440	3760490	914080	44093530	1752760	2552270	12620980
DMU 5 2006	99570960	17650680	7689770	1124690	66902650	5730180	5212530	19097770
IDMU	10602725	1625249	1068413	134375	237991770	7968340	16069510	89694350
ADMU	244770650	152872150	14603790	7689520	8517778	592267	233500	2157300

By applying DEA technique, we have generated two models:

- IDMU model (*ideal decision making unit*), which comprises the initial sample of credit institutions and the virtual ideal one, named IDMU. Theoretically, one can affirm that the IDMU score reflects the best possible relative efficiency. The purpose of this model is to indicate the changes of the individual efficiency scores, related to the score of the virtual institution. The smallest the

difference between the individual efficiency score of each credit institution and IDMU score, the more efficient will be that particular credit institution. Therefore, it will rank on a top position in the hierarchy of managerial performance.

- ADMU model (*non-ideal decision making unit*), constituted by the initial reference group, plus the virtual institution ADMU, whose score reflects the smallest degree of relative efficiency. The model was build to observe if,

excepting the ADMU institution, it can be identified other inefficient institutions. Both models had been tested under the assumption of variable returns of scale. In table 4 we have presented

comparatively the scores estimated for IDMU model, ADMU model and the initial one, and also the ranking of the best performing credit institutions, according to IDMU model.

Ranking of credit institutions according to IDMU model efficiency scores

Table 4

DMU	Initial model score (%)	IDMU model score (%)	ADMU model score (%)	Ranking
DMU 1 2003	100,00	150,70	100,00	6
DMU 2 2003	100,00	208,99	100,00	10
DMU 3 2003	100,00	1345,40	100,00	20
DMU 4 2003	102,10	936,49	102,10	18
DMU 5 2003	100,00	348,54	100,00	12
DMU 1 2004	100,00	121,48	100,00	4
DMU 2 2004	100,00	195,85	100,00	9
DMU 3 2004	100,00	958,98	100,00	19
DMU 4 2004	100,00	602,21	100,00	17
DMU 5 2004	100,00	259,54	100,00	11
DMU 1 2005	103,50	107,37	100,00	2
DMU 2 2005	100,00	164,17	100,00	7
DMU 3 2005	100,00	587,75	100,00	16
DMU 4 2005	101,56	556,90	101,56	15
DMU 5 2005	100,00	168,95	100,00	8
DMU 1 2006	100,00	100,00	100,00	1
DMU 2 2006	100,00	121,12	100,00	3
DMU 3 2006	100,00	363,43	100,00	13
DMU 4 2006	100,00	454,62	100,00	14
DMU 5 2006	100,00	139,06	100,00	5
IDMU		100,00		
ADMU			1345,40	

ADMU model has evaluated credit institution 4 as being inefficient for years 2003 and 2004. This result coincides with that estimated by the initial model. IDMU model has identified only one efficient credit institution relative to the new criteria, which is institution 1, for 2006 year.

The second approach is based on the method developed by Andersen and Petersen (1993) to evaluate the efficient

entities, by estimating a superefficiency score. It consists in comparing the efficiency score of a decision making unit with the score resulted from the linear combination of the other units in the sample, excepting the current unit. The new score reflects the distance between the analysed unit and the efficiency frontier, generated by excluding this unit from the sample. Therefore, the score obtained for our output oriented model

indicates the maximum possible limit until one can decrease outputs value, so that the entity remains efficient. The superefficiency scores estimated for our sample are presented in table 5. According to this method, credit institutions that have obtained the biggest scores are the most efficient because, even in the case of a significant decrease in output values, they manage to wind off their activity in an efficient manner.

Ranking according to superefficiency scores

Table 5

DMU	Initial score (%)	Superefficiency score (%)	Ranking
DMU 1 2003	100.00	56.54	15
DMU 2 2003	100.00	40.37	17
DMU 3 2003	100.00	big	1
DMU 4 2003	102.10	102.10	19
DMU 5 2003	100.00	68.29	14
DMU 1 2004	100.00	93.65	3
DMU 2 2004	100.00	90.07	5
DMU 3 2004	100.00	98.59	2
DMU 4 2004	100.00	79.31	10
DMU 5 2004	100.00	85.07	8
DMU 1 2005	103.50	103.50	20
DMU 2 2005	100.00	91.37	4
DMU 3 2005	100.00	71.48	11
DMU 4 2005	101.56	101.56	18
DMU 5 2005	100.00	86.74	6
DMU 1 2006	100.00	70.73	12
DMU 2 2006	100.00	47.76	16
DMU 3 2006	100.00	84.71	9
DMU 4 2006	100.00	70.68	13
DMU 5 2006	100.00	86.64	7

The results obtained suggest that the inefficiency scores maintained unchanged, the delimitation being applied only for those credit institutions that proved to be efficient. For the year 2003, institution 3 received the

grade “big”, which means that, no matter the decrease in output values, its activity will remain efficient. Hence, it ranks on the first place in the hierarchy of efficient credit institutions. The interpretation of scores obtained by the remaining institutions is the same. For instance, in the year 2006, institution 5 held a score of 86.64%, which means that, in the case of a decrease in outputs value with a factor of 0.8664, the institution will still be efficient.

By comparing the ranking obtained from the two approaches, one may observe that 40% of credit institutions in the sample registered significant fluctuations, of over 4 places, in the hierarchy. The incongruities come from the different sample structure. For Andersen and Petersen method, from the initial sample we had excluded the current institution under evaluation, meanwhile, for the first approach, we had included in the sample an additional ideal best performing institution. Therefore, in this last case, the ranking had been made by relating to the best possible efficiency, and not to the relative efficiency attained by the other ones.

Conclusions

Although the top management’s performance is difficult to quantify and interpret objectively, a clue can be offered by analysing the sources of inefficiency displayed in the development of banking activity. They reflect the executive’s board ability and experience in the process of implementation of a clear, viable strategy, and in maintaining a risk profile adequated to the level of economic capital holded.

Top management must monitor both the business lines and off-balance sheet activities that generate losses, and those characterised by a good profitability. It could be the effect of an excessive risk taking, which, in cases of occurrence, will expose the credit institution to a significant capital and reputation loss.

The ranking of credit institutions allows comparisons for the whole sample. According to this, the management's performance of an individual institution, reflected in its activity, can be related to the performances of the competitors.

Notes

- (1) Credit institutions, hospitals, schools and university departments, economic agents, air-bases, maritime bases, nonprofit organisations.
- (2) It was postulated by Smith, Mayston (1987); Sexton (1989); Boussofiene, Dyson, Thanassoulis (1991).
- (3) The method is largely described in the study "DEA efficiency assessment using ideal and anti-ideal decision making units", realised by Wang Y.M., Luo Y. (2006), published in *Applied Mathematics and Computation* 173, pp. 902-915.
- (4) The weights flexibility in DEA method allows each entity to detain its own set of weights, in order to present it in the most favourable light. This characteristic of DEA method has generated numerous controversies. Charnes, Cooper, Rhodes, the authors of DEA model, consider that, in this case, the inefficient entities can be detected more accurately. If under this generous, advantageous assumption a credit institution doesn't obtain a score close to 1, it means that there is certainly a situation of inefficiency.

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