The experience of the Accounts Chamber of the Russian Federation in the use of the analysis of the functioning environment and special software for non-financial audits

In spite of the fact that the "Computer Audit for Non-Financial Audits" project has already been accomplished, the draft report was approved at the previous meeting of the Committee and submitted for approval to the INCOSAI, please let me make a brief report on this subject.

The Russian Federation did not participate in this project, as our country did not have sufficient experience in the use of software for non-financial audits. However, in the course of the previous year, we have acquired the relevant experience, which we consider interesting enough, and we would like to share it with others. We are not seeking to change the draft report or add our material to it. If the Committee find our report helpful, we will be happy to prepare an article for the into IT journal.

Introduction

Our country is in the process of re-orientating the whole budget system towards achieving the maximum efficiency of economy and social system. In this context, the Accounts Chamber is being faced with new, more complicated problems as compared to financial audit. Efficiency or performance audit is becoming the top priority, not so much at the stage of assessing the results of activities, as at the stage of forming state development programmes for certain activities or regions.

Therefore, the development and application of software for non-financial audit is one of the priority tasks for the IT department of the Accounts Chamber.

The original hypothesis for the use of the CAAT methods is based on the assumption that the use of computer technologies will facilitate the improvement of the audit quality, and, consequently, will contribute to the improvement of the quality of operation of the controlled objects (CO) themselves.

Until recently, as far as economy is concerned, no success could be achieved in creating adequate analytical tools of evaluating efficiency. The reason for this failure lay in the extreme complexity of functioning processes of economic systems taking place in a multi-dimensional parameter space, with these parameters being heterogeneous in their nature and interconnected in complicated relationships.

Virtually, when evaluating the efficiency of controlled objects as an economic relations system, we have to accomplish the task of forming a complex assessment of the efficiency of bodies, objects and management processes as a single cybernetic system (figure 1).

In this connection, the opportunities of the Data Envelopment Analysis (DEA) methodology are of interest; it was used by the Accounts Chamber of the Russian Federation for the purposes of social-economic diagnostics of several regions of Russia.

The DEA methodology is the outcome of an interdisciplinary research conducted in the last two decades in the field of economics, system analysis and the operations research, also based on the fundamental provisions of mathematical economics, such as industrial functions theory, Leontiev’s production models, von Neumann’s economic models, Parreto’s principles of optimality. American scientists A. Charness and V. Cooper are the founders of this approach.

Currently, over 1,000 works related to these subjects have been published and approved in dozens of companies, banks and in many regions and countries of the world. Only in 2004 two large international conferences were held – in Toronto in June (NAPW2004) and in England in September (DEA2004).

The essence of the DEA technology is as follows: to study the object with multiple input and output parameters and to analyse its activities in the interaction with functioning environment. In terms of mathematics, use of the DEA technology can be described as solving and analysing a large family of optimisation problems.

The advantage of this approach is the possibility of system correlation of heterogeneous factors affecting entity management decision making, with consequent essential improving of the evaluation of its performance.

In Russia, this line of investigation has been successfully developed by a research group under the guidance of V. E. Krivonozhko, doctor of physics and mathematical sciences.

Russian specialists have obtained a number of important results providing for a broad approach to the analysis of complex economic and social systems. Pioneer novel algorithms have been worked out for visualisation of a multi-dimensional econometric space by means of generating 2D and 3D sections. A computer system offering interesting performance capabilities has been created, dubbed by its developers as «EffiVision» (English Efficiency vision). Its creation brought to life a new class of software models, novel in their approach and directed towards modern economic analytics.

A brief description of the DEA technology

The DEA methodology and the EffiVision software package enable, after determination of the quantitative measure, the visualization of the dynamics and trends of performance of the controlled objects.

At the same time, the controlled objects *per se* are considered to be a set of a kind of Industrial Objects (IO) processing their input (resources) into output, constituting, on the whole, the vectors of the input (the results of financial audit) and output (performance indices) parameters (Figure 1).

The actual economic objects function in a multi-dimensional economic space. There is only one way of visualising and studying this multi-dimensional space, and to do that it is essential to generate various sections of a set of production potentialities and over various objects. Figure 1 shows two sections of the set of production potentialities in a 3D space. The «EffiVision» software can build any sections in a multi-dimensional economic space. In particular, the sections built may be a summary of such well known economic functions as the production function, isocost, isoquant, etc.

Figure 3 shows the section of a production function as that of the controlled objects efficiency in a model with one input index and one output index.

The multitude of production potentialities of controlled objects shown on Figure 3 is very informative, as it gives us an idea of the comparative efficiency of objects. This efficiency, i.e. the terms "better" or "worse", for the transformation of inputs into outputs, X→Y, in the given functioning environment, is determined by the position of the point characterising the controlled object under consideration with coordinates (X,Y) as opposed to the boundaries of this set:

– If the point is located at the efficient boundary, e.g. the points (X_1,Y_1), (X_2,Y_2), (X_3,Y_3), (X_4,Y_4) in the Figure, the object works with a 100% efficiency;
– If the point is located within the set, e.g., the point (X_5,Y_5) in Figure 2, its distance from the efficient boundary will measure the efficiency degree – the larger the distance is, the worse the efficiency of the object with coordinates (X_5,Y_5) will be.

The DEA technology allows:

- To determine the quantitative measure of the object efficiency, i.e. the distance from the efficient boundary.
- To determine the reference objects for each inefficient object, i.e. the efficient objects whose structure is the closest to them (objects (X_2,Y_2) and (X_3,Y_3) for the object (X_5,Y_5) in the Figure).
- To find the optimal directions of efficiency improvement.
- To determine the stability zones of an object, i.e. the areas of parameters (X,Y), where the regarded object does not change its status (either efficient or not). In Figure 3, the stability zone for object 5 will be the sphere with the centre at point (X_5,Y_5) tangent to the efficiency boundary.
- To monitor the dynamics and reveal the trends in the object development.

Finally, the DEA technology allows us to design the optimal development strategies with better substantiation, both for structure units and for the Controlled Objects on the whole.

The use of the DEA technology for the purposes of the Accounts Chamber of the Russian Federation

The Accounts Chamber has used the described method to analyse the budget functioning efficiency in one of the Russian regions.

As an illustration, Figures 4 and 5 show the results of the comparative efficiency of the use of tax potential of the two subjects of the Southern Federal District of the Russian Federation – the Volgograd Region and Kabardino–Balkarian Republic.

The production volumes of key industries as well as the monetary income of the population have been chosen as the primary factors affecting the tax potential of the regions. The latter index has been used, for it is a substantial tax-forming factor in the above-mentioned regions.

The resulting index was the bulk income, collected in the territory of the regions. All indices were used *per capita*, since these regions differ greatly in their size. The period of the research is 2000 – 2003.

The data of the Federal Service of State Statistics and the Federal Tax Service accumulated in the databases of the Accounts Chamber have been used as the source data.

The chosen indices for the regions have been compared both to each other and to the average value for the group of regions. The Parreto efficiency surface in this study reflected the actual obtainable level of the revenues collected in this group of regions with the existing development indices of the key industries and the level of the monetary income of the population.

Figures 4 and 5 show the results of the study reflecting various results and trends of development.

The Volgograd Region has shown a significant growth of the main development parameters during the period, as well the growth of the efficiency of the use of tax potential, as compared to the other regions of the group in question. Kabardino-Balkaria, on the contrary, along with the factual stagnation of the main production factors, has decreased the efficiency of the use of tax potential almost by one third.

Figures 6 an 7 are the sections of the Pareto efficiency surface reflecting the influence of the main factors that form tax potential of the regions, that is the development level of basic industries of economy (industry, agriculture, construction, transport and trade) is highlighted in pink, and the *per capita* level of population income zone is highlighted in green.

The green and blue curves are the sections of the Pareto efficiency surface for the whole region in 2003 and 2004. The growth of revenues collected in the South Federal District is quite obvious.

At the same time, in contrast to the Volgograd Region, where we can see a high efficiency level retention (proximity to the Pareto efficiency surface) and an essential growth of fiscal revenues, the Kabardino-Balkarian Republic is characterised by a low increase in budget system revenues, with the downswing of efficiency (remoteness from the Pareto efficiency surface).

Therefore, now we have new tools enabling us to obtain quantitative assessments of the efficiency parameters, to visualise the outcome and to facilitate the elaboration of standards for assessing efficiency of each branch of industry.

The results of the research of the described method have been submitted to the President of the Russian Federation as part of analytical documents characterising the social and economic condition of the subjects of the Southern Federal District.

The use of the above method involves certain risks, including the necessity to make a proper choice of the objects of analysis, of input parameters and of a correct interpretation of the results. However, our experience proves that proper statistics can help to solve the problem of identification of the sections of efficiency functions, including the proposals on efficiency audit standards aimed at certain types of control.