HEURISTIC MODEL OF TAXPAYER BEHAVIOUR: THEORY AND METHODOLOGY

Alexey Naydenov
Institute of Economics of the Ural Branch of the Russian Academy of Sciences
Scientific associate
E-mail: naidenov@list.ru

─Abstract ─
The article concerns with the subject of studying economic behavior of taxpayers with application of agent-based and heuristic approach. It provides possibility to simulate changes in the shadow sector of economy based on evaluation of probable irrational response by economic agents to potential changes in the tax, financial and economic policies with regard to interaction between agents.
The methodology and particularities of approaches implementation are described in the article.

Key Words: *Heuristics, Taxpayer, Economic behaviour, Bounding rationality*
JEL Classification: C63, H26

1. INTRODUCTION

Decision making is defined, according to cognitive definition, as a result of mental processes that lead to the selection of a course of action (or opinion) among several alternatives (Kahneman i Tversky, 2000). For a long time the most popular model was the model of perfectly rational human that required a decision maker to be a "supremely skillful actor, whose behavior could reveal something of the requirements the environment placed on him but nothing about his own cognitive make-up" (Simon, 1981:x).

The history of decision making models was marked by several main stream paradigms coming from various scientific disciplines. Theoretical models of how people make decisions have evolved from the economic paradigm of the 1940s, through the irrational (passive) model of the 1950s and 1960s, to the cognitive and emotional models of the 1970s and the 1980s (Zaichkowsky, 1991).

From the economic view, decision maker was seen as one knowing perfect information and rationally making choices that bring him the most utility according to costs. Homo oeconomicus characterized as motivated by self-interest and capable of making rational decisions. Economic theory of decision making as

also known as expected utility theory and was considered the major paradigm in decision making. This was a normative rather than a descriptive model of behavior because it predicts how people would behave if they followed certain axioms of rational decision making.

In models of full rationality, all relevant information is assumed to be available to Homo economicus at no cost. Real humans, however, need to search for information first. In an attempt to render economic theory more realistic, Stigler (1961) introduced constraints on full rationality, such as information not being free and humans having limited time and money to search for it. The idea of optimization under constraints proposes some set of these limitations, which usually stem from external factors in the world like information costs and search times, while retaining the ideal of optimization. In this common doctrine, the bounds in bounded rationality are just another name for constraints, and bounded rationality is merely a case of optimizing under constraints.

Another conception of bounded rationality held by many psychologists and some economists is that it means internal cognitive limitations and the systematic errors – also called irrationality, biases, and cognitive illusions – that the mind's constraints lead to in judgment and decision making. For instance, in his article "Bounded rationality in individual decision making", Camerer (1997, p. 179) summarizes anomalies in decisions and errors in judgments and calls this the "exploration of procedural (bounded) rationality of individuals". This view has spread from psychology into economics and law, shaping new research areas such as behavioral economics (e.g., Camerer, 1995) and law and economics (e.g., Jolls, Sunstein, & Thaler, 1998).

When Daniel Kahneman and Amos Tversky published their "Prospect theory: Decision making under risk", in Science magazine in 1979 (Kahneman, Tversky, 1979), they wrote about heuristics and probability estimations, directly confronting economic models of rational decision making. Since then, a field called Behavioral economics started to develop. Researcher started to use cognitive psychological techniques to explain documented deviations of economic decision making from neo-classical theory of Homo oeconomicus. Behavioral economics has started to be applied to explain a number of psychological effects and phenomena related to making (irrational) economic decisions.

Considering economic behavior of taxpayers as a typical economic agent it is more realistic to use heuristic models describing decision making with regard to tax evasion and tax avoidance.

2. METHODOLOGY

2.1. Principles of study

Economic agent behaviour in the context of shadow economy is considered by us as a striking example of the problem of economic decision-making under uncertainty. The given problem can be used to advantage to appraise the models developed. Economic consequences for a shadow economy agent (calling/not calling to account, or penalty provision extent at times) is considered as ambiguous information for an economic agent in the simulation task. To estimate the risk of calling to account for shadow economic activity, we have applied a probabilistic approach. Another case for model appraisal in terms of shadow economy is research experience and a substantial data base.

For mathematical simulation of economic decision-making under uncertainty, the following approaches are suggested that they be applied:

1) heuristic approach using neural networks;

2) stochastic programming;

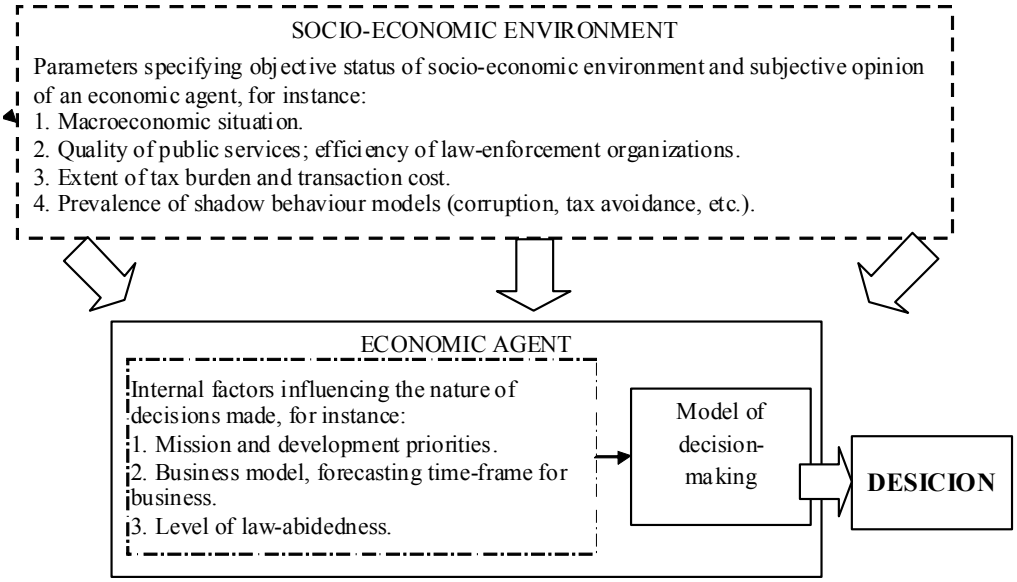
3) agent-based models.

2.1. Heuristic approach using neural networks

Neural networks can be used as tooling for model construction referred to decision-making in terms of the heuristic approach. In the course of research the following theoretical and methodological elements were carried out:

1. Improvement of a theoretical model of decision-making by economic agents in the context of shadow economy using the heuristic approach (revealing significant entry parameters). Figure 1 demonstrates it in diagram form.

Figure-1: Economic agent behaviour model in the context of shadow economy



2. Acquisition of the required data specifying environmental factors, as well as internal subjective factors of decision-making (macroeconomic data analysis will be made and study of economic entities will be conducted at a microlevel: analysis of economic activity of particular enterprises, inquiring, etc.).

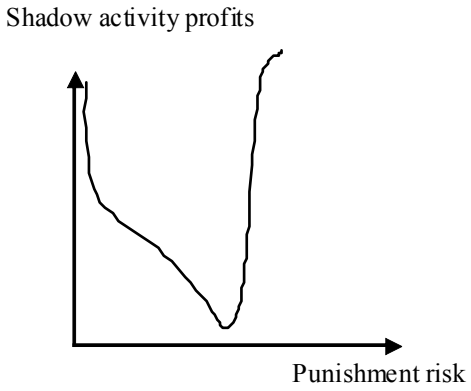
3. Development of the decision-making block using the heuristic approach.

a. Development of an estimate module of possible alternatives for an economic agent on the basis of the heuristic approach. From the viewpoint of economics and mathematics, adjustment of the obtained rational approach groundwork by applying the prospect theory is suggested as one of the alternatives of the decision-making model construction.

Application of prospect theory can be demonstrated with simulation of the heuristic approach to decision-making regarding shadow activity with an allowance for punishment risk; such a risk is estimated subjectively by an economic agent. Such heuristics as frequency judgement is used for decision-making (in this case probability to be punished is estimated based on the frequency of exposing to punishment instances in an agent's business environment, and significance of the given instances for him). Another heuristics is determination for elimination of risks (grave risk eliminates the potential for

shadow activity despite high profits; at the same time, grave risk with excessively high profits is estimated as less significant) – figure 2.

Figure-2: Application of prospect theory regarding shadow activity with an allowance for punishment risk



b. Construction of an economic and mathematical model that functionally describes correlation between internal and external environmental factors and subjective efficiency of the alternatives. At this point it is suggested that neural networks analysis techniques be used to reveal hidden and nonlinear dependencies based on a small data sample; in addition, they describe actual cerebration mechanisms at decision-making more appropriately due to their topology. To solve the given task, the Group Method of Data Handling technique that was applied widely to reveal various nonlinear econometric dependencies, can be offered to be used as one of the alternatives.

c. Development of an alternative selection module. As an alternative, a search procedure for tolerable criterion values (with respect to satisficing heuristics for sequential search):

- Optimization of all possible alternatives for each single criterion is accomplished; it will provide an admitted region of possible alternatives.

- Test indices are calculated.

- An admitted region is narrowed for account of neglecting unacceptable alternatives.

- Optimization in terms of a global criterion with regard to the weight indices obtained.

4. Verification of the model by way of the evaluation technique for mutual information и matching complexity.

Meanwhile, we have reached a debatable view that the algorithm given above reflects the process of decision-making by businessmen in not quite a proper way. In our opinion, the stated approach assumes efficient and "estimated" decision, which is rarely in line with the reality. Small and medium-sized businesses make a lot of decisions by intuition due, again, to information database limitation, temporary restrictions, a managerial style. As we have observed, a lot of decisions are made at a level of large corporations by intuition as well, and then a "theoretical background" consisting of formalized analytical material is provided to the decisions made. It is conceivable that it is just a specific character of decision-making in Russia.

2.2. Stochastic programming

In our opinion, it is an efficient way of decision-making simulation in the context of limited information. Stochastic programming studies a theory and extreme problem-solving procedures in the context of limited information on problem situation parameters.

The given mathematical tool can be successfully applied to solve the above-mentioned problem of profit maximization using shadow methods under uncertainty (evaluation by a decision-maker in terms of indirect limitations of shadow economic activity consequences).

2.3. Agent-based models

In order to obtain new innovative results, we shall thereafter need to expand the models of research into decision-making by economic agents by way of elaboration of a dynamic component relative to interaction of economic agents in external environment. Agent-based models are suggested that they be used as a methodological background.

General pattern of the agent-based approach is given in Figure 3.

As principal criteria influencing generation of decision-making heuristics and determining agents' cooperation, the following ones can serve as examples:

1. Between economic agents-enterprises:

a. Opportunity to be jointly involved in shadow activity.

b. Coordination of alternatives (tax avoidance schemes) and volume of shadow money.

2. Between an economic agent-enterprise and the Government:

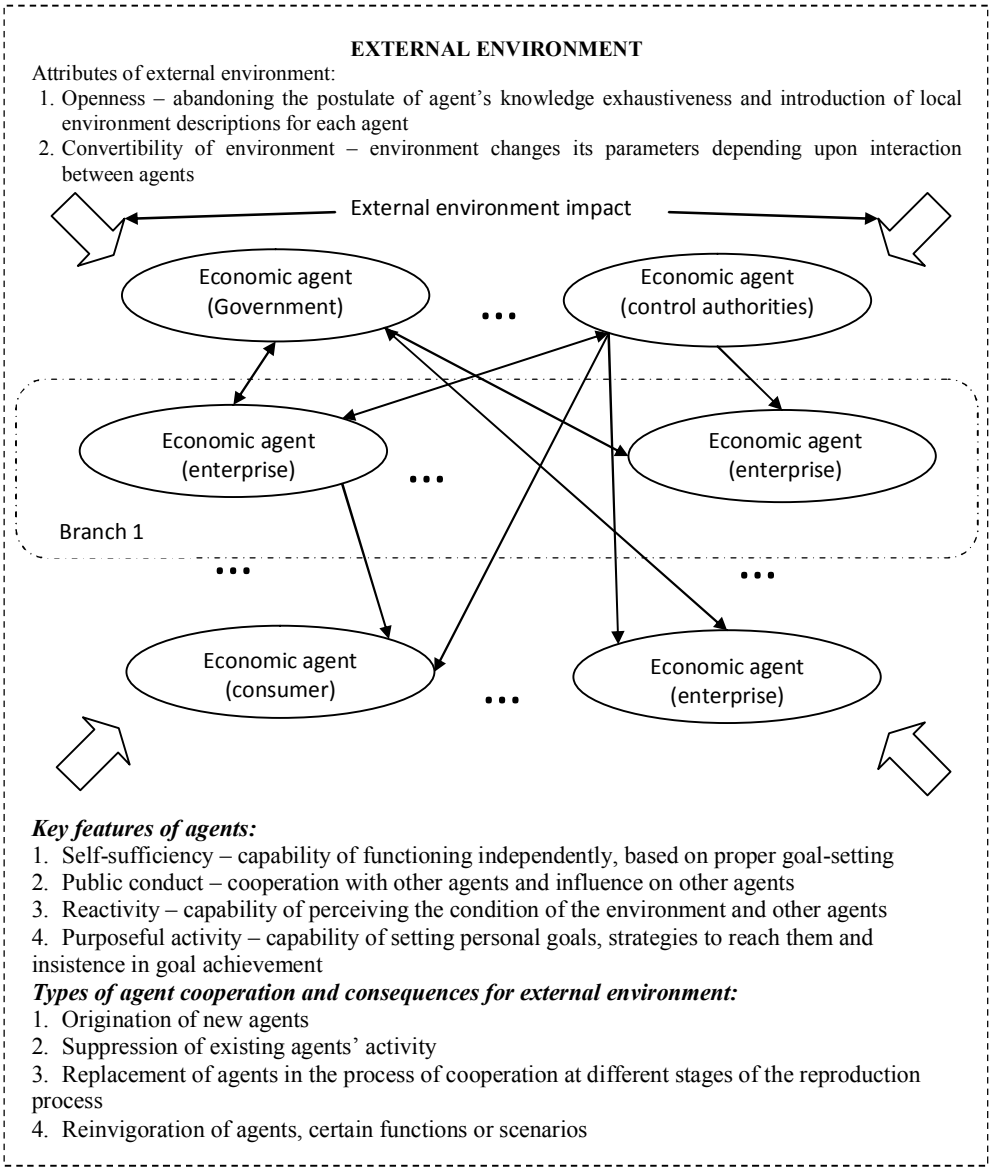
a. Readiness to drastically resist shadow activity as a result of budget wastage and socio-economic backset

b. Disposition of government bodies towards granting unreasonable privileges for business as a result of corrupt practice

3. CONCLUSION

The agent-based and heuristic approach will make it possible to simulate changes in the shadow sector of economy based on evaluation of probable irrational response by economic agents to potential changes in the tax, financial and economic policies with regard to interaction between agents. There is an opportunity to simulate interaction, for instance, in the context of the reproduction process, inside of branches and between them, as well as between government bodies and business entities.

Figure-2: Pattern of the agent-based approach



BIBLIOGRAPHY

Camerer, C. F. (1997), Progress in behavioral game theory. *Journal of Economic Perspectives*, No. 11, pp. 167−188.

Camerer, Colin F. (1995), Individual decision making. In J. H. Kagel & A. E. Roth (Eds.), The handbook of experimental economics. Princeton, NJ: Princeton University Press, pp. 587−703.
Jolls, Christine, Sunstein, Cass Robert, & Thaler, Richard. (1998). A behavioral approach to law and economics. *Stanford Law Review*, No. 50, pp. 1471−1550.
Kahneman , Daniel, Tversky, Amos Nathan. (2000), Choices, values and frame. Cambridge University Press.
Simon, Herbert Alexander (1981), The sciences of the artificial (2nd ed). Cambridge, MA: MIT Press.
Stigler, George Joseph (1961), The economics of information. *Journal of Political Economy*, No. 69, pp. 213−225.