GAME THEORY AND MODELLING OF COORDINATING INTERACTIONS IN PUBLIC POLICY

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ABSTRACT

Currently, the policy networks is one of the most promising approaches to studying of public policy, however, there are drawbacks. For this reason, this study proposes to combine policy networks with coalitional game theory to create an interdisciplinary model. Because, with the appearance of cooperation as new way of communication, the need to analyze the behavior and interactions of decentralized structures with the government, as well as analysis of the impact of such networks on the process of developing and implementing solutions becomes apparent. Using of such a model will allow the actors to develop effective strategies for conflict resolution and will allow more accurately analyze the interaction of a large number of both state and non-state actors who share common goals and interests. The study proved that the model can be used to predict the behavior of actors, depending on whether they have the determining characteristics and resources.

I.

One of the most important trends in the study of political processes in public policy is a theory of policy networks. Theory has been developed thanks to the emergence of the idea that in today’s information society, the state is unable to provide for the social needs, relying only on the principles of hierarchical control. Thus, these conditions determined the need for new approaches to the administration, based on the horizontal interactions of the main actors.

Policy networks can be defined as “a set of relatively stable relationships of non-hierarchical and interdependent in nature, linking diversity of actors, who share common interests with respect to policy and who share resources in order to promote these interests, recognizing that cooperation is the best way to achieve common goals”. [2] Also Smorgunov L.V. notes that “networks represent such a structure management of public affairs, which connects the state and civil society.” In this way, the policy network is the best analytical tool to analyze the interaction of a large number of actors linked by common goals and interests.
Policy networks can be formed in various policy areas, but they have always represented a complex structural relationship between the political institutions of the state and society. [14] Participants in the policy networks are active and conscious actors who produce policy decisions and implement its realization simultaneously. Thus, the policy networks includes political parties, NGOs, civil society organizations, interest groups, multinational corporations, the mass media, members of the federal, regional and local government, etc.

The main merit of policy networks is in the changing of the approach to the analysis of the state as an agent of policy: firstly, with a network approach, the state is not the only manufacturer of policy decisions; secondly, the formal structures are regarded as “coupled” with other agents of policies; thirdly, “government” as a hierarchically organized system is opposed to “governance”, i.e. governing without government. [11]

Evaluation of interaction within networks allows the analysis of administrative nature of political and administrative decisions, as well as allows do effective conclusions on their adjustment. That is why the concept of networks in public policy is so important, because it allows identifying the frame and capabilities of actors who take or do not take part in the political process.

However, there arises the question of modeling processes in public policy, of the interactions between actors and of the development of strategies to resolve conflicts that arise between actors within a single network, and between actors of multiple networks such as civil society organizations and public authorities. The theory of policy networks has no established tools for such analysis and it is therefore possible to create a new interdisciplinary approach to the study of public policy: the combination concept of policy networks with cooperative games that are the section of the game theory.

This approach may allow the theory of policy networks go beyond the frame of the middle-range theories and consider many more factors that influence on the stability and efficiency of the network, including external factors. Also, thanks to the mathematical interdisciplinary model we have an opportunity to simulate the processes occurring within the network, and on this basis to develop strategies for a large number of intra-group interactions of both state and non-state actors, in order to maximize benefits. As a result, such interdisciplinary model can be used to predict future interactions of actors depending on whether they have the determining characteristics and resources.
But in Russia, the Game Theory is almost never used for serious political science research and is mainly used as a tool for economic analysis. Moreover, the popularity of the Game Theory in Russia declined markedly, while such game-theoretic approaches to the study of virtually all aspects of society make up a large part of the studies in the West. Just in Europe and America is growing interest in the introduction of gaming approaches in political science, which every year is dedicated to more and more articles and textbooks. [12] Thus, it is necessary to develop an interdisciplinary model of cooperative-game approach to policy networks.

II.

In 1944, J. von Neumann, co-authored with economist O. Morgenstern, published a monograph “Theory of Games and Economic Behavior.” In addition to modeling competition and other features of the economic cooperation between the parties there was considered possibility to describe in terms of game theory, the interaction between civil society organizations. From the moment of this publication, the study of coalition formation has been one of the central questions in the theory of games.

*Game Theory* can be defined as “part of the theory of management, in which explores the problems of existence and finding the optimal control in the conflict conditions (in terms of the collision of the parties, each of which seeks to influence the development of the conflict in their own interests).” And the content of game theory is to establish the principles of optimal behavior under uncertainty, the proof of the existence of solutions satisfying these principles, the definition of algorithms for finding solutions. [5]

In the political science, the Game Theory has been used to predict election results, determining the optimal electoral platform of a political party with a known political spectrum voters, for analysis of political coalition and for analysis of decision-making in the collective bodies (including quotas).

*Cooperative (coalitional) games* are characterized by the fact that decision-makers players combined in fixed coalition and besides the members of a coalition can freely exchange information and make the fully coordinated decisions. So the players can join a coalition and agree on joint actions. [5] The same principle exists in the policy networks, which allows to combine these two approaches to the analysis of the political process in a single model. Indeed, the policy networks as well based on trust, moreover, the main actors seek to work out the harmonized solution for the common benefit.
The task of analyzing the game is by given opportunities, goals and information players to be able to predict the “decision” of the game, i.e., the set of possible moves and their results (outcomes) [6]:

1. **Opportunities of moves** of participants (admissible sets)
2. **Targets** of participants (preference functions)
3. **Information** and type of behavior

The result is a very elegant, although rather abstract model of decision-making, which rarely reflects reality in its entirety. However, the real value of cooperative game theory is connected with its abstraction, as it allows to political scientists to go beyond the context of individual cases and to discover common underlying mechanisms of decision-making.

On the other hand, game theory is much more specific than the general grandiose theoretical concepts. In fact, the theory is firmly embedded in the positivist ontological end of the spectrum and relies on the rationality of the players. So, what separates game theory from other theories of political and analytical frameworks is its dualism, which, on the one hand is expressed in its abstraction that allows us to consider the situation in different contexts, on the other, in her specific answers to well-defined research questions.

In cooperative game theory, it is believed possible to select by a common decision or by developed a joint strategy some a binding agreements. The group, which creates such an agreement, forms the “coalition”. The word “coalition” is better known in political discourse as a group of political parties in the parliament, which joined together to form a majority and govern together. In cooperative game theory, the coalition used to refer to any group of players in the game, which are joined together to select a common strategy. Most games with more than two players, applicable to public policy issues, provide the cases in which individual actors could get the benefit by using the method of forming coalitions with a binding agreement to select a joint strategy. We live in coalitions. Thus, the consideration of social life (and especially public policy) should be incomplete without consideration of cooperative game theory.

In the Game Theory, the set of players is denoted by the variable $N$. The typical player is denoted by $i$. Next, for each $i \in N$ is given a set of strategies $S_i$; typical strategy - $s_i$. Strategy profile is a set of strategies for each player, i.e. $s_N = (s_1, s_2, ..., s_n)$. Finally, for each player indicates his payoff function $U_i: S_N \rightarrow R$. [4]
Informally, each player chooses a strategy $s_i \in S_i$; when it will be done by all the players, it will become clear his payoff $U_i (S_N)$. Each player strives to maximize his winnings, but the main difficulty lies in the fact that his payoff depends not only on his actions, but also on the actions (strategies) of other players. And each player must (or can) take this into account in his behavior. It could be said this: in the normal form of game players are strategically independent and they can choose any strategy, but they remain bound by the utility.

One of the important points of the association of theory of policy networks and cooperative games is the simplicity of their joint visualization on graphs. Thus, the mathematical foundations of network theory (mathematical graph theory) were established by world-famous mathematician Leonhard Euler in the XVIII century, when he introduced the concept of the graph as a set of vertices and their connecting links. He is also the author of one of the key tenets of the theory of networks: the internal characteristics of graphs (networks) determine the potential of their using. [7]

The main factors to be considered in the corporate network model research:

1) Availability of resources:
   - **p** - the index of influence
   - **f** - the security forces,
   - **s** - support by society
   - **m** - funding
   - **n** - the number of participants in the network,
   - **i** - information resource
   - **a** - allies
   - **e** - interaction with external entities.

2) The presence a shared identity among members of the network;
3) Density (direct and indirect communication between all participants);
4) Altitude of network;

The algorithm for constructing a model of cooperative-network research consists of the following items:

1. Identification of key stakeholders;
2. Gathering information about the actors, the evaluation of their interests;
3. Initial assessment of the resources of key actors;
4. Empirical research of actors (method depth interviews, questionnaires);
5. Identifying the characteristics of the players, impacting on their relationship;
6. Construction of mathematical model of coordination interactions in public policy;
7. Developing effective strategies to resolve the conflict between the players; determining of the most advantageous method for interactions of actors and predicting their future relationship;

III.

In conclusion, it should be noted that the transformation of the communication processes and the development of information and communication technologies in contemporary public policy give rise to the emergence of network prerequisites of political management: speed up and simplify the mechanisms of information production, attracting non-state actors in the formulation and implementation of policies and actors striving to find common ground and work together to address current problems.[13] Game-theoretic approach to network research allows us not only to consider the situation from different perspectives, but also to develop a Pareto-optimal strategies, that will meet the participants of the communication process and will allow the state and non-state actors to reach a new level of relations, taking into account all available resources, interests and possible winnings.

References

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