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COALITIONAL GAMES, EXCESSIVE COMPETITION AND A LACK OF TRUST: AN EXPERIMENTAL APPROACH

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ABSTRACT. The article tackles the issues of the effectiveness and rationality of making choices in the conditions of competition and cooperation. It confronts the economic theory of rational choice with the empirical results from an experiment. The aim of the article is to show that excessive competition and a lack of trust cause limitation of rational choice in coalitional games.
In the experiment conducted for this study purposes, a public good was used to construct a situation in which making a huge coalition is the winning strategy. Despite this fact, the research proves that under competition supported by uncertainty, which results from the lack of trust, the decision making entities behave far less rationally than the game theory would suggest. People competing with each other often take decisions irrationally.

JEL Classification: C71, C92, D71, D81

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Introduction

Both in everyday life and in the economic theory, it is important to make a rational choice. In practical situations, in the world of limited resources, rationality can be equated with the praxeological approach (Kotarbiński, 1982), namely with the efficiency postulate. It is a normative approach. In the economic theory, rationality is a positive postulate – it is assumed that one acts rationally. However, it is not always true. Irrationality can have numerous sources but psychological and social factors seem to be the most significant. Psychological factors which reduce rationality result directly from cognitive limitations (Tversky, Kahneman, 2000). Irrationality caused by social reasons is connected to interpersonal interactions.

This dualism was discovered by Vernon Smith, who identified constructivist and ecological rationality (Smith, 2007). The first concept dates from as early as the 17th century. It is equated with the attempts to model, more or less formally, the activity of entities as the result of logical reasoning (Hayek, 1967). The concept of ecological rationality is associated with human's adaptation to the environment of dynamic interpersonal interactions, with group processes of coming up with effective solutions in social systems (Hayek, 1973). Constructivist and ecological models are complementary to each other because they make it possible to cover various aspects of human activities.

Confronting the model constructivism and the adaptation concept of ecological rationality can be embedded in game theory. Game theory describes situations in which a group of people, who do not necessarily have the same interests, have to make a collective decision (Gura, 2008). Coalitional games are an extension of classical game theory because they add the possibility of building the coalitions of players. Certainly, there are also various methods of determining equilibria. Algorithms such as *minimax* (von Neumann, 1928), eliminating dominated strategies and seeking the best answer (Nash, 1951), as well as backward induction (Aumann, 1995) are mainly replaced by stable sets (von Neumann, Morgenstern, 1944), game core, Shapley value (Shapley, 1952), Shapley-Shubik index (Shapley, Shubik, 1954) and Banzhaf index (Banzhaf, 1965).

Considering the above, the purpose of the article is to show that excessive competition and a lack of trust cause limitation of rational choice in coalitional games. In other words, in this paper we will try to explore the hypothesis that in coalitional games there is an excessive competition among coalitions which could be avoided if players behaved rationally.

The article is divided into five sections. The first one tackles practical applications of game theory in social sciences, and in particular it is a review of experimental research concerning decision rationality in coalitional games.

The two following sections describe the design of the experiment and the procedure applied. The experiment idea was to show that the subjects would not be able to create one large winning coalition which would maximize the utility of each subject but there would be competition between small groups instead.

The last two sections present the discussion on the outcomes and conclusions drawn from the experiment.

1. Research review

While the description of classical game theory in publications is enriched with relatively numerous practical applications (McCain, 2009; Anderson, Geckil, 2009; Zhang, Guizani, 2011; McAdams, 2014; Munoz-Garcia, Toro-Gonzalez, 2016), cooperative games still seem to be a less known subject. The process of coalition formation and reaching equilibria in cooperative games was tackled by numerous studies (Aumann, Hart, 1992; Konisi, Ray, 2003; Gomes, Jehiel, 2005; Hyndman, Ray, 2007), but they were mainly analytical discussions. There are few experiments dedicated to forming coalition games.

It is worth mentioning one of the well-known researches in this field – Astrid Dannenberg, Andreas Lange and Bodo Sturm's study (2010), where the authors emphasize that the success of cooperation depends on two significant characteristics which must be fulfilled by a coalition (institution) which is forming. The first one is extensive margin, meaning the extent to which a coalition encourages players to cooperate and discourages them from free-riding. The other factor is intensive margin, namely the extent of internalization of mutual benefits for coalition members. The conclusions from experimental studies (which consisted in forming a coalition to gain public goods through an auction) can be expressed by means of two statements. First, coalitions which try to reduce free-riding are not very attractive for new members because, according to them, such coalitions limit the gains, and that is why they collapse. This is what happens according to the model theory, which underlines the efficiency of the full internalization (huge coalition). Second, the willingness to cooperate grows when a coalition gives a player the possibility to determine his share in the gains. This is how it was shown that institution acceptance depends on how the conditions of a coalition are reached (Dannenberg *et al.*, 2010).

Cooperation under certain conditions and unwillingness to build any coalitions were also proved by E. Vinacke and A. Arkoff (1957). They studied players' willingness to start

(seemingly invalid) huge coalitions. According to the authors' approach, each player had a randomly allotted auction value (for the duration of one round). He could be stronger than the other two players but he could also be the weakest. In a multi-round approach, players always entered into two-person coalitions (or they won on their own). It appeared that after summing up payments from all rounds, at least one player (in each group) could have reached a better result if he had always entered into a huge coalition. Unwillingness to start a huge coalition can be explained here by the willingness to compete and by the fear of being betrayed in the following round (Arkoff, Vinacke, 1957).

U. Fischbachem, S. Gächter and E. Fehr (2001) indicated players' unwillingness to cooperate unconditionally. An experiment involving one-shot public goods game revealed that one third of the respondents appeared to be free riders, and a half of them decided to be conditional cooperators (Fischbachem *et al.*, 2001).

D. Kahneman and J. L. Knetsch (1992), in turn, showed a larger willingness of the respondents to be free riders than to be interactive. The authors used the willingness to pay (WTP) model (willingness to pay for public goods) to prove it. There is another interesting conclusion from the study: people gaining public goods are motivated rather by moral satisfaction than by the economic value of these goods (Kahneman, Knetsch, 1992).

Moral satisfaction and a lack of trust during an attempt at strategic voting were also the main reasons for an ineffective decision in the experiment described by C. A. Holt and L. R. Anderson (1999). A year later the same conclusions were drawn in an analogical experiment (Berdowski *et al.*, 2000). The lack of an efficient coalition during a strategic voting was also described by Straffin in the context of the presidential election in the United States in 1981 (Straffin, 2006).

The heuristics of certain social attitudes was proved by a series of numerous experiments concerning ultimatum bargaining (Dixit, Skeath, 2004; Giacomantonio *et al.*, 2010; Conrad, Irlenbusch, 2013; Güth, Kocher, 2014). The outcomes of the experiments did not match the predictions from the well-known analytical solutions of this problem (Camerer, 2003; Malawski, Jaideep, 2004).

Conscious activity of decision-making entities which consists in blocking other players who create or can create potential risk is also considered by other sources as a process preventing the formation of an optimal coalition. Such activity is to create coalition farsighted stable sets (Mariotti, Xue, 2003; Ray, Vohra, 2015). This phenomenon is known as the Blocking Approach of Coalition Formation (Lucas 1992; Ray, Vohra, 2014).

2. Experiment design

The experiment objective is to show that when a coalition is formed, excessive competition may occur, which results in ineffective decisions. The experiment idea is to show that people are not able to create one large winning coalition which would maximize the utility of single persons. The study was based on an approach similar the experiment of A. Dannenberg, A. Lange and B. Sturm. Using a public good in the experiment gives a possibility to construct a situation in which making a huge coalition is the winning strategy. This good is a public good for members of the winning coalition and a club good for other players. Club good is a good which can be consumed at the same time by some group of people but is not available for other people because they have no right to it.

Competing for the good had the character of an auction to both enhance the rivalry and enable players to build coalitions. Within specified time, one was to place an offer for buying the auctioned good. These offers could be placed by single people or by coalitions created *ad hoc*. This means that during an auction, players could build coalitions and place joint offers. The winner was the person or coalition which offered the highest price. The experiment was

based on the coalitional game model described below. It was first price auction extended with a possibility of building coalitions by the bidders.

2.1. First Price Auction

The description of the auction game used in this experiment is quite simple. The subject matter of the game is a certain good which is put up for auction. The auction consists in offering by the bidders (players) consecutive, increasingly higher amounts of money that they are willing to pay for the auctioned object. Each of the players is thus characterized by a certain value w_i (valuation), which determines how precious the auctioned object is for the player. This amount is also the maximum value which a player is willing to offer for the auctioned good. Price *p* – the amount for which the auctioned good was finally sold (bought) is another significant element of an auction. In the economic approach, the maximization of the utility of player *i* which equals to $\max_i u_i(b_1, \dots, b_n) = w_i - p_i$, is the optimal finalization of an auction with *n* participants and $b_1, \dots, b_n$ offers. Depending on the way in which u_i is reached, several basic kinds of auction are distinguished.

First price auction, also known as English auction, is the most common kind of auction. It consists in a traditional bidding model, in which players outbid consecutive offers by "giving more". The final price is determined by the highest bid. The final payment of the winner amounts to $w_i - p_i$, and of the others – to 0. Thus playing below an individual level of valuation is the optimal strategy here. Excessively high bid can result in a negative payment despite winning the auction.

The following stage of the experiment involved introducing into first price auction a possibility of cooperating and building coalitions. Let's assume that the utility of player *i* (depending on whether he is part of the winning coalition *S*), who is competing for the good, is expressed by the equation:

$$u_i = \begin{cases} \beta_i(W_S - P) when\ i \in S \\ 0 \qquad when\ i \notin S \end{cases},$$

where $W_S = \sum_{i \in S} w_i$, P – the price for which the good was bought and w_i – the good valuation by player *i*. β_i is a parameter which defines the share of player *i*, who belongs to the winning coalition, in the final payment (total utility of coalition U_S). This share is proportional to the player's valuation share in the total valuation of the winning coalition, hence $\beta_i = \frac{w_i}{\sum_{j \in S} w_j}$.

As $U_S = W_S - P$, the share of player *i*'s utility in the whole coalition utility can be expressed as $u_i = \beta_i U_S$. It is easy to notice that for $W_S = P$, being part of coalition S gives the utility 0. This means that although the coalition is winning, it is ineffective. Thus submitting the final bid below the level of its own valuation is the optimal choice of a coalition (similarly to the classic model of first price auction). It is easy to show that the greater W_S and the lower the *P*, the higher the utility of the winning coalition. This means that the maximum utility is ensured by creating a large coalition (max W_S) at the beginning of an auction (min P). Moreover, the maximization of the total utility entails the maximization of particular players' utility. Although for a large coalition, the parameters β_i are lower than for small coalitions, at the same time W_S grows and *P* decreases. The longer the process of building a coalition, the higher the final price *P* will be set.

The experiment assumed the involvement of people with various education backgrounds and at various ages. This gave the possibility to confront representatives of diverse environments and to examine their willingness to create potential cooperation or

excessive competition. The selection of people from various environments is an important factor because the vast majority of experiment participants should not know each other. This will significantly raise the probability that during the game, players will enter into coalitions, above all, following their strategic decisions and not according to their likings related to friendship. During this auction players could communicate by talking with each other.

The subject matter of the auction was the possibility to hypothetically buy a painting by a famous artist. It had a considerable value but the buyers did not know it well. The hypothetical purchase was related to the way of sharing the win. After the end of the auction, the painting was to be repurchased from the winning coalition at the price equalled to its valuation. According to the model, it is the border price, which will bring neither profit nor loss as mentioned above ($W_S = P$). Under the model, the optimal strategy involves bidding below one's own valuation, so players from the winning coalition who bid rationally should earn by reselling the painting. Building a huge coalition at the beginning of the auction would be the optimal solution giving the highest payments to the players. This would minimize the purchase price P of the painting and maximize valuation W_S as the sale price. This solution maximizes the total utility (understood as profit) of a coalition and the utilities of single players. Such a design makes it possible to roughly assume that the good has club good characteristics. Only the coalition which wins the auction will be able to use the value of the profit from selling the good. Each player's share in the profits of the winning coalition will be proportional to the amount he quoted to evaluate the painting and it will be decreased by the cost of purchase. Of course, there was a possibility that players declare to high valuation but the results showed that the valuations were fair. The cost is also incurred proportionally to the valuation (according to the model). Hence, this is a solution based on fair distribution (similarly to Shapley value).

3. The Experiment

The experiment was conducted in a closed room with the involvement of 20 people, including 11 women and 9 men at the age of 18-35. It was a kind of one-shot game. The time of running was about 60 minutes and about 25 minutes for discussing the outcomes and conclusions.

In the preliminary part of the experiment, the rules of the game, as one-round auction with the possibility to cooperate, were presented to the participants in detail. Players were informed about the possibility of direct communication during the auction to build the coalitions. Then the subject matter of the auction – a valuable painting – was presented, and the rules of its use and payment were specified. Players were also informed about the award in the form of redemption price of auctioned good. This was the economic motivation for players behaviour during the experiment. A more rational bidding meant a higher price of redemption. Before start the game subjects were asked control questions to make sure that the rules are well understood. Next, the starting price of the painting was revealed (100 PLN), and after that each player secretly declared the amount of money which he was willing to pay for the good. The players declared the following valuations:

Table 1. Valuation of players (PLN)

w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}
650	720	800	850	885	900	935	950	955	990
w_{11}	w_{12}	w_{13}	w_{14}	w_{15}	w_{16}	w_{17}	w_{18}	w_{19}	w_{20}
1000	1000	1000	1050	1100	1150	1200	1200	1350	1500

Source: Own compilation.

As one can see, in table, there were no inflated valuations. It should be also emphasized that after each bid declared by a particular player (coalition) during the auction, the time for thinking it over and submitting a counteroffer by another player (coalition) was much longer than in case of a traditional auction, where the bidders are pushed by reminding the last bid with the expressions: "going once", "going twice", "going thrice" and "sold". This was to enable the players to cooperate and create coalitions. Then first price auction was conducted.

In the beginning, the players took rather a cautious approach to bidding and they were even more cautious to cooperate. Yet, with time, the first alliances appeared. The first five coalitions and their offers are presented in *Table 2*.

Table 2. The first two-person coalitions

Coalition	Bid
G10-G15	1200 PLN
G3-G18	1250 PLN
G1-G16	1300 PLN
G7-G8	1320 PLN
G2-G14	1350 PLN

Source: Own compilation.

When the following bids offered for the auctioned product exceeded the valuations of two-person coalitions, it was necessary to increase the alliances to three players. The general strategy of forming such coalitions involved one of the players joining an already existing two-person coalition. Coalition G5-G9-G11 was an exception: the players built a three-person team from the beginning. The first triple bid – 2,000 PLN – was offered by team G1-G4-G16. It is worth pointing out that the bid was equal to the valuation of pair G4-G16. In this case, the coalition could play without G1 but the order of joining the team was decisive here. On the other hand, the payment for coalition G4-G16 would have amounted to 0 PLN. After G1 joined, the valuation grew and that meant the increase of payment. *Table 3* presents the first four three-person coalitions which bid.

Table 3. The first three-person coalitions

Coalition	Bid
G1-G4-G16	2000 PLN
G2-G6-G14	2050 PLN
G7-G8-G17	2100 PLN
G5-G9-G11	2150 PLN

Source: Own compilation.

Presenting all the bids that were made during the auction would be rather troublesome and it would take a huge part of this study. It would be even more difficult to present the tree of this bidding as an extensive-form game. For the purpose of the final analysis, it will be more convenient to show the last bids of the coalitions bidding till the end.

Table 4. Bids of five-person coalitions

Coalition	Bid
G1-G4-G10-G15-G16	4750 PLN
G2-G6-G13-G14-G19	5000 PLN
G5-G9-G11-G12-G20	5250 PLN
G3-G7-G8-G17-G18	5300 PLN

Source: Own compilation.

In the last phase of the game, coalitions started to develop into bigger ones. Two-person teams started merging with three-person ones and that is how four five-person coalitions were created. It is interesting that there were no further mergers with such a balance of forces. The final bids of five-person coalitions and the bid of winning coalition are presented in *Table 4.*

4. Results and Analysis

As the *Table 4* shows, G3-G7-G8-G17-G18 appeared to be the winning coalition. The rest of the coalitions lost the auction, so their payments, including the payments of single players, amounted to 0. To do the analysis of payments, it is the best to compare the final bids (prices) with the valuations, which was done in *Table 5*.

Table 5. Bids of five-person coalitions and their valuations

Coalition	Bid	Valuation of a coalition
G1-G4-G10-G15-G16	4750 PLN	4740 PLN
G2-G6-G13-G14-G19	5000 PLN	5020 PLN
G3-G7-G8-G17-G18	5300 PLN	5085 PLN
G5-G9-G11-G12-G20	5250 PLN	5340 PLN

Source: Own compilation.

For such valuations, a simple empirical outcome arises. Coalitions with bid bigger than the valuation behaved irrationally. The "winning" coalition placed the final bid which was higher than its joint valuation. This means that regardless of the proportional distribution of purchase cost and payment, each player G3, G7, G8, G17, G18 would get a negative share of it. It is because $w_{3,7,8,17,18} - p_{3,7,8,17,18} = 5085\ PLN - 5300\ PLN = -215\ PLN$. In such a situation it would be more profitable to lose the bidding. As the analysis of single players' payments from the "winning" coalition is pointless, it is worth investigating the other coalitions' situations. In case of team G1-G4-G10-G15-G16, the situation is the same as in case of the winning team. This coalition outbid its own valuation and if this coalition had won, it would have also made a loss. As it was the weakest one, it was outbid and it had the zero result. If coalition G2-G6-G13-G14-G19 had won with its offer of 5,000 PLN, it would have gained the payment $5020\ PLN - 5000\ PLN = 20\ PLN$, whose distribution among the coalition members would have been as follows:

$$\text{G2:}\frac{720}{5020} \times 20\ PLN = 2.87\ PLN;\quad \text{G6:}\frac{900}{5020} \times 20\ PLN = 3.59\ PLN;$$

$$\text{G13:}\frac{1000}{5020} \times 20\ PLN = 3.96\ PLN;\ \text{G14:}\frac{1050}{5020} \times 20\ PLN = 4.19\ PLN;$$
$$\text{G19:}\frac{1350}{5020} \times 20\ PLN = 5.39\ PLN.$$

The payment vector for this coalition in case of winning would have amounted to $(2{,}87; 3{,}59; 3{,}96; 4{,}19; 5{,}39)$. In case of winning, coalition G5-G9-G11-G12-G20 would have gained $5340\ PLN - 5250\ PLN = 90\ PLN$. The payment vector for this coalition in case of winning would have amounted to $(14{,}92; 16{,}10; 16{,}85; 16{,}85; 25{,}28)$. In both cases, coalition members get positive payments but they are relatively low in comparison to their individual valuations.

What should players have done then to make their payments approximate the valuations? Following the example of parliamentary coalitions, they could look for the minimum winning coalition. For the total valuation of all the players equal to 20 185 PLN, such a coalition would have had to have its valuation over 10 092,5 PLN. Such a coalition could for example consist of players: G2, G13, G14, G15, G16, G17, G18, G19, G20. The other players could, however, tempt someone from the minimum winning coalition and despite the proportional distribution of payment that results from the game rules, they could offer this person more. For them, it would have been more profitable anyway in comparison to their 0 payment. That is how the lack of trust arises and it contributes to the ineffectiveness of choices in cooperative games.

It can be also analysed what would have happened if, at the stage of four or five-person coalition, the payers had cooperated further. Two equinumerous teams would have been probably created and the final bid would have probably grown twofold. However, one can also assume that in case of two coalitions, the level of competition would have been lower and the final bids would too. In that case, the payments would have increased in fact. A smaller number of competing coalitions additionally raises the level of trust (because of fewer possibilities to acquire a player), which also influences the final result in a positive way.

The reasoning defined by those two criteria makes considering the formation of a huge coalition more interesting. It is a situation in which the issue of both the lack of trust and excessive competition is minimized. Hence, if two ten-person coalitions had taken a decision to bid jointly, the probability that someone would have quit such a coalition and submitted a counteroffer would have been small. That is why the bid of a huge coalition would have been again proportionally lower than the sum of the final bids of two-person coalitions and it would have brought even higher payments to the single players. Following this way thinking, the final bid would have been lower if the huge coalition had been formed at once by combining four five-person coalitions than by combining two ten-person coalitions. Considering the character of auction, where the final purchase price is outbid in successive steps (bids), one can conclude that the earlier the huge coalition is formed, the more successful it will be as regards the level of payments for single players. The optimal strategy of players involves forming a huge coalition at the start of bidding and buying the good at the starting price of 100 PLN. In case of such an unexpected course of auction, the coalition would earn $20185\ PLN - 100\ PLN = 20085\ PLN$, and the distribution of payment among single players would be calculated as follows: $Gi = \frac{w_i}{20185} \times 20085\ PLN$, then for example $G1 = \frac{650}{20185} \times 20085\ PLN = 646{,}78\ PLN$. The payment vector would have amounted to $(646{,}78; 716{,}43; 796{,}04; 845{,}79; 880{,}62; 895{,}54; 930{,}37; 945{,}29; 950{,}27; 985{,}10; 995{,}05; 995{,}05; 995{,}05; 1044{,}80; 1094{,}55; 1144{,}30; 1194{,}05; 1194{,}051343{,}31; 1492{,}57)$.

The above payments are the optimal solution for the conducted cooperative auction game.

5. Discussion

Based on game theory, an experiment was prepared. Its objective was to prove that irrational behaviour can result from fixed behaviours in groups, which encourage people to compete. Excessive rivalry is a phenomenon which appears when players must cooperate in large groups. While people are able to show trust in small groups, this task is increasingly more difficult in large groups. Instead of cooperating and maintaining rationality, excessive rivalry appears. A proprietary laboratory experiment, conducted on a group of 20 people who were not emotionally related to each other was to confirm the research hypothesis on irrational behaviour of players in the situation of limited trust and on excessive competition in coalition games. The experiment was designed in such a way that from an individual's point of view, creating a huge winning coalition together with others was the best strategy. It was ineffective to form small coalitions competing with each other. The results of first price auction were significantly different form the theoretical optimal solutions.

Considerable discrepancy between the empirical results and the theoretical prediction is satisfactory as regards the research hypothesis. Finally, the winning coalition outbid itself and its members received negative payments. This result is the effect of intense rivalry – struggling to buy the good at any cost, which makes players forget about rational decision. The coalitions were so much focused on purchasing the good that they forgot how much they really were to pay for it. However, this can be partly explained by a detrimental effect of synergy. A single player exactly knew his valuation. When he entered into two-person coalition, he probably asked his ally about it too. Members of larger coalitions (e.g., five-person ones) could skip the acquisition of information about other players' valuations during the experiment. The cost of obtaining this information (in terms of time) during the game could be too high because the coalition could miss offering a bid on time. So players had to choose: to lose the auction or make a quick transaction without any information about these valuations. Even if they had known them, they decided that jointly they were able to generate such a valuation of a coalition which would be higher than the total sum of valuations of coalition members. Players could anticipate an occurrence of a synergy effect. They think that as a coalition they will be able to offer more. This perception of purchasing power was detrimental because the total valuation of each coalition was the same as the sum of the individual valuation of coalition members.

The behaviour of the experiment participants can be also compared to the economic phenomenon of herding effect. It appears when consumers buy a good only because other consumers are interested in buying it. If there is additionally a competition stimulus, the probability of irrational behaviour grows. Competing in the experiment at any cost can be also explained by the superiority of moral satisfaction (beating the rival) over economic satisfaction (payment maximization). This theory is similar to the one obtained, i.a., by D. Kahneman and J. L. Knetsch (1992) as well as Ch. A. Holt and L. R. Anderson (1999). This in turn could be the reason why the players consciously inflated the bids during the experiment (Lucas, 1992; Ray, Vohra, 2014).

Another factor – the lack of trust – had an equally important influence on limiting the effective choice. It led to the fear of forming coalitions. On the one hand, the more numerous the coalition, the more potential "traitors" are ready to quit it. On the other hand, the larger the coalition, the relatively weaker the other alliances are and the smaller temptation to change. This paradoxical reasoning results in uncertainty which makes players to take strategies seemingly safe but significantly less effective from the game theory perspective. It is a similar result to the conservative attitudes caused by the lack of trust which were noticed in a series of experiments devoted to the phenomenon of ultimatum bargaining (Conrad, Irlenbusch, 2013; Güth, Kocher, 2014).

The outcomes also show that forming huge coalitions is not attractive for players even if it is the optimal solution. Such behaviour is caused by seemingly small influence of the members of the winning coalition on the distribution of the win. This conclusion matches the findings of the research by A. Lange and B. Sturm (2010).

6. Limitations and further studies

While summing up the experiment, one should also include its limitations. To generalize the outcomes on a larger scale, one should conduct such an experiment with at least several 20-person groups and compare the results. This would be a more reliable approach than in case of one-time experiment. Unfortunately, such a solution was impossible due to technical reasons: it required a much greater number of volunteers. Another way that would make it possible to omit the technical barrier could be an experiment on the same group of people but repeated in several rounds. Then it would be a dynamic experiment (in contrary to a static, one-round experiment). This approach could involve the problem of the abovementioned factor of learning, which would offset trust limitation and excessive competition, which were the key aspects of the experiment. While observing their behaviours in consecutive rounds, the players would draw appropriate conclusions, which they would make use of in the following rounds. As the experiment objective was to investigate the influence of natural social reflexes (ecological rationality) on making economic choices and limiting their effectiveness, a one-round auction seems to be the best solution here. It should be emphasized that the auctioned painting did not entirely fulfil the conditions of a club/public good. It was technically impossible for the winning coalition members, who lived in various towns, to admire the painting at the same time and for free (transport cost, time cost). Repurchasing the painting from the winning coalition to make them share the sale profits was an attempt to remedy this situation. It would be an interesting continuation of the research if one conducted a similar experiment with the use of an object fulfilling the criteria of a club good to a greater extent. In such an approach, the function of single player's utility would be modified. They would still proportionally share the cost of buying the good but the profit from its purchase (consumption utility) would equal to the valuation.

Conclusions

To sum up the experiment, the winning five-person coalition achieved a negative result and each of its members received a negative payment, while forming a huge coalition and fair distribution of the win between the coalition members would be the best solution. It shows irrational behaviour of people in conditions of excessive competition and lack of trust what was the objective of this article. Such an end of the experiment not only confirms the research hypothesis but it also raises a question about the actual behaviour motives of the people who make decisions under competition. Both the examples from the literature and the outcomes of the proprietary experiment confirm that forming coalitions allows players to gain higher payments. At the same time the research proves that under competition supported by uncertainty which results from the lack of trust, the decision making entities behave far less rationally than the game theory would suggest. Despite the knowledge of mathematical and economic apparatuses, people competing with each other often take decisions irrationally. Such behaviours prove that the issues of choice rationality should be analysed both with the use of economic apparatus and models as well as through other social sciences and humanities which investigate environmental competences of a human, such as sociology, psychology and philosophy. There is something in the human nature that pushes people towards unnecessary and destroying rivalry; this aspect of human behaviours is still waiting for a more thorough

economic analysis. A quotation of a French philosopher, René Girard (1993), who died in 2015, will be the best summary of the study outcomes: *Order, peace and fertility are based on cultural differences. It is not difference but the loss thereof which entails demented rivalry, the fight to the bitter end among men of a single family or society.*

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