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USING EXPERIMENTAL ECONOMICS TOOLS TO MEASURE SOCIAL ADDED VALUE: A CASE STUDY

Experimental economics is a research tool, where information collected in conducted experiments is used to verify the validity of economic theories, estimate the size of the studied effect or highlight the market mechanism. Economic experiments usually use money (virtual or real) to motivate participants to imitate the real incentives that occur in real markets. Experiments are used to understand how and why markets and other exchange systems operate in this way. The purpose of this chapter is to use the achievements of experimental economics to assess social added value that arises in the course of the production and delivery of public goods and to verify the effectiveness of public policy instruments that can stimulate such social added value. The article consists of (1) conceptual and methodological part, in which the details of the experiment were presented, (2) description of the research sample and (3) analysis of the results of the experiment together with developed conclusions and indications for further research on this issue. The conclusions of this article can be used in business practice in the process of programming by public authorities of instruments supporting specific public policies.

***Keywords**: social added value, experimental economy, social good, social capital*

Introduction

The use of experiments to study theories and economic regularities with the participation of groups of students dates back to Chamberlin (1948), who carried out an study showing that prices do not always reach market equilibrium. His work was continued, among others, by Vernon Smith (1962), the Nobel Memorial Prize in Economic Sciences in 2002, who conducted pioneering economic experiments on the convergence of prices and quantities with their theoretical values in a state of competitive equilibrium (Smith 1991). In our work, we attempt to apply the achievements of experimental economics to evaluate social added value created by groups during the production and delivery of public goods, as well as to verify the effectiveness of potential public policy instruments that could stimulate such value. Our research findings can only offer certain suggestions in the process of shaping legal and organizational solutions stimulating the creation of the common good due to the limitations that apply to economic experiments in regard of the difficulties in associating results of games with preferences and beliefs guiding decision-making in daily life (Smith 2005).

Research concept and methodology

Principles of experiment

From the methodological point of view, the analysis is based on a pre-experimental research plan (Thyer 2012) and its aim was to verify the possibilities of measuring preferences in terms of creating social added value through experiments involving the maximisation of individual profits. The experiment was carried out in 10 rounds of simulated undertakings, in which social added value was created. In each round, the participants were given 20 PLN each and were expected to decide how much of their allotted money to spend on creating a social good, and how much to keep in their private pockets.' Each round was played out according under different conditions in order to assess the level of social added value generated depending on the public policy instrument used. Each round was independent of the others and at the beginning, the participants were given PLN 20 each, no matter what they had decided to do with it previously.

Social goods were created with contributions from individual participants, who were additionally divided into 4 cities. Each city constituted a separate society and consisted of 4 so-called 'households,' which produced a social good to meet their own needs. It was assumed that the production of a social good would contribute first, to increasing the welfare of all the residents of a given city (e.g. a well-educated person would contribute to increasing societal welfare), and second, the improvement resulting from the provision of a given social good would be the same for all the residents. For this reason, the funds collected for the social good increased in value in each round by 60%, and then were split equally among the residents of a given city. The mechanism of creating a social good is illustrated in Figure 1 below.

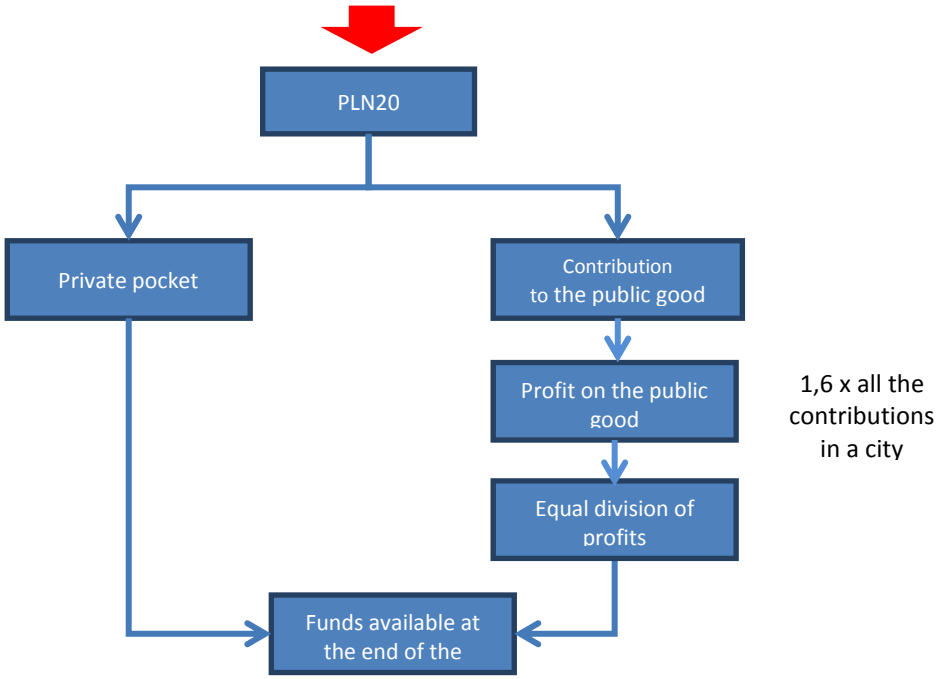

Fig. 1. General principles governing the creation of a public good in each round

Source: own study.

One of the key experiment design points involved its division into two parts. In Part One, the participants did not know the other residents in their city, hence they did not have the opportunity to communicate with one another and had to create social goods in anonymous micro-societies. In Part Two, the composition of the cities was disclosed and participants were given the opportunity to agree on and pursue joint strategies. Moreover, they were placed in the room in such a way as to create spatially coherent communities. Each round was independent of the others, i.e. the decisions made in each round and their results did not affect the subsequent rounds.

The individual goal of each participant was to maximise their personal pay-out function. Each participant was set the task of achieving the highest possible value of their assets within 10 rounds. The outcomes were then compared not only with those obtained by the other residents of their city, but also with those held by all the other participants in the experiment. The person whose assets turned out to be the most valuable was offered a reward(half a point towards his/her course completion grade, which the students found to be quite attractive) on the one hand, intended to motivate the participants to compete with one another and to make rational decisions, and on the other, meant to prevent the participants from adopting strategies maximising group benefits at the expense of individual ones.

Each round introduced different quasi-public policy instruments aimed to motivate the participants to allocate as much of their resources as possible to the creation a social good. Subsequent rounds of the game are described in detail in Table 1 below.

Table 1

Mechanisms intended to motivate experiment participants to create social added value

Round	Round protocol	Motivational mechanisms
1	Each participant may contribute any amount from PLN 0 to 20.	No motivational mechanisms
2	Each participant decides how much they wish to spend on a public good (PLN 0–20), with the obligatory minimum contribution set at PLN 6. Any smaller contribution is treated as PLN 6.	Mandatory minimum contribution to create a public good
3	Each participant may contribute any amount from PLN 0 to 20, but the contribution of one person from each city will be checked at random, and if it turns out that s/he has contributed less than 6 PLN, s/he must pay quadruple the amount short-paid (i.e. 4 x [6 PLN – actual contribution]). The amount of penalty will be given to the person who contributed the most in a given city. If there are several such persons, the amount will be divided equally among them.	Penalty for contributing less than PLN 6 for a randomly selected participant

Table 1 continuation

4	Each participant may contribute any amount from PLN 0 to 20, but a randomly selected person from each city will have their personal pay-out increased by the value of their own contribution (i.e. they will be refunded their original contribution).	A randomly selected participant is rewarded
5	Each participant may contribute any amount from PLN 0 to 20 under the following conditions: – the social good is a hospital, which will be built if at least 30 PLN is collected from contributions in the city; – if the hospital is not built, one participant is randomly chosen and his/her pay-out is reduced to zero (as if this participant 'died' – the hospital was not built, the participant fell ill and no facility was available for treatment).	A randomly selected participant is penalised for society's failure to create a social good
6	Each participant may contribute any amount from PLN 0 to 20 as per individual decision.	Potential to create social capital
7	The contribution fixed by the city is a minimum, with the provision that 2 participants are to be randomly checked and if they are found to have contributed less than the minimum, they pay double the amount short-paid to the participant who has contributed the most.	Potential to create social capital; randomly selected participants penalised for giving less than the minimum contribution
8	Each participant may contribute any amount from PLN 0 to 20, but a randomly selected participant in each city will have their personal pay-out increased by the value of their own contribution (i.e. they will be refunded their original contribution).	Potential to create social capital, potential reward for the largest amount contributed
9	As in Part One, the social good is a hospital, which will be built if at least 30 PLN is collected from contributions in the city. If the total contributions fail to reach this amount, a person is selected at random to have their pay-out reduced to zero.	Potential for creating social capital, a randomly selected participant is penalised for society's failure to create a public good
10	The group sets a minimum contribution. Everyone can denounce a single resident of their city who in their view has contributed less. Submitting one denunciation carries a fee of PLN 2; if it turns out to be true, the participant who submitted it will receive PLN 10 from the perpetrator. Moreover, the perpetrator forfeits double the amount short-paid (i.e. nobody gets it). If the denunciation is untrue, the accuser loses PLN 8 (on top of the denunciation fee).	Potential to create social capital, social control

Source: own study.

Definition of social added value in the experiment

In this experiment, in order to operationalise social added value, it was assumed that the social added value generated in each of the rounds is relative in nature and can be calculated in two ways:

1. as the difference between the arithmetic mean of the contributions transferred to the public good in a given round and the arithmetic mean of the contributions transferred in round 1,
2. as the difference between the median of the contributions transferred to the public good in a given round and the median of the contributions transferred in round 1.

Thus, in each of the two cases, the reference point for determining social added value was the total amount of contributions transferred in Round 1.

The background to the experiment was the so-called tragedy of the commons (Hardin 1968; Ostrom 2015). According to this concept, if a large number of users takes advantage of common resources, the latter become depleted. In this experiment, this trend is counterbalanced by certain public policy instruments intended to limit the participants' desire to maximise their individual profits at the expense of group benefit (social added value).

Research sample

The experiment was carried out in 2012–2017 with three groups of participants consisting of students from different specialties at Cracow University of Economics: Economy and Public Administration (GAP), Administration, and Economics.

In most cases, the dean's group comprised 16 individuals, but quite often[1] the experiment was conducted with larger groups. The participants were then divided into 16 households (2, 3 and sometimes 4-person ones) and decisions to contribute a certain amount of money to the social good were made in groups. However,

[1] An estimated 70-80% of households.

a certain proportion of participants in the experiment[2] were individuals who made their own decisions. In the case of a smaller groups, only 3 cities were created, inhabited by 4 residents or all 4 cities were created, each with 3 residents. However, there were very few such situations.

The first research group consisted of third-year GAP students. The group was highly homogenous, with the vast majority being 21–22 year old full-time students. Research in this group was conducted in 2012–2017 and included observations of the behaviours of a total of 304 individuals participating in the experiment.

The second research group consisted of third-year Administration students. This group was slightly less homogeneous than the first one and consisted of full-time students aged 21–22, and part-time students, where the standard deviation in the age was much higher. Moreover, part-time students often work full-time, and thereby spend less time studying, which was reflected in the decisions made during the experiment. Research in this group was conducted in 2012–2017 and included observations of the behaviours of a total of 400 individuals participating in the experiment.

The last, third research group comprised students of Economics, and predominantly consisted of full-time students. The research covered a total of 431 observations conducted in 2014–2017.

The experiment, its findings and analysis

Round 1

Round 1 first of all constituted the point of reference for calculating the social added value generated in the subsequent rounds. No extra public policy instruments were applied to influence the contributions. The participants had the first opportunity to watch the behaviour of their anonymous 'neighbours' with whom they jointly created the social good.

Administration students started off with the highest point of reference (i.e. mean PLN 8.7, median PLN 9) and the lowest standard deviation of contribution value of all three groups. A downward trend was observed in the average and mean contributions in 2012–2017, accompanied by a simultaneous increase in standard deviation.

Round 2

In Round 2, the mechanism of a mandatory minimum contribution of PLN 6 was applied. It triggered very homogeneous behaviours in all three groups surveyed –the same median values was observed, and the arithmetic mean was between PLN 9.2 and PLN 9.4, with a much lower standard deviation than in the previous round. The analysis of contributions made in 2012–2017 reveals, just as in Round 1, a steady decrease in the average contributions in the 6 years studied and an increasing standard deviation.

Round 3

The next round was, among other things, intended to investigate the participants' propensity to take risks. The highest tendency was observed amongst the students of Economics. 5.6% of Economics students contributed PLN 0 in this round, while for the GAP and Administration students, the proportions were 3.9% and 2.8%, respectively. The instrument in question slightly increased the value of the average contribution made by GAP and Administration students, but reduced it for the students of Economics, who proved to be the most willing to take risks. The analysis of contributions made in 2012–2017 again shows a decreasing trend, both in terms of the arithmetic mean and the median.

Round 4

Interesting results were obtained in Round 4, where the participants' reaction to a potential reward was assessed. This mechanism, just as the compulsory minimum contribution set in Round 2, led to a significant unification of the results for all three groups of participants, but more importantly, it resulted in an increase in the average and mean contributions when compared with the previous rounds. The analysis for 2012–2017 shows a slight downward trend in the value of contributions and a small difference between the median and the arithmetic mean.

Round 5

Round 5 saw a specific example of social good, namely a hospital built with the funds contributed by the participants in the experiment. Interestingly, the contribution to be allocated to the social good in the area of health care there decreased. This can be explained firstly, by the fairly young age of the participants and hence perhaps a somewhat limited awareness of health care issues, and secondly, by their low opinion about Poland's health care system. The analysis for 2012–2017 shows a fairly significant downward trend.

Round 6

In Round 6, the composition of individual cities was revealed. From then on, the participants in the experiment had the opportunity to jointly set their strategies. The potential to build social capital, which could constitute a catalyst for the creation of social added value, was released. Contributions in this round increased significantly. Remarkably, the increase was higher in the first and third research groups, even though it was in these groups that the contributions in Rounds 1–5 were usually lower than in the second group. Furthermore, the analysis of 2012–2017 results reveals an upward trend in the average contributions, with the median in 2013–2017 reaching its maximum value. For that reason, it can be concluded that a lower than average level of social capital in anonymous research groups and, as a consequence, low social added value, resulted in a greater dynamics of

[2] An estimated 20-30% of households

change immediately after the abolition of group anonymity.

Round 7

In Round 7, the minimum contribution mechanism (this time independently set by each city) and the potential penalty for non-compliance was reintroduced. In the course of the experiment, the participants contributed slightly less money to the social good than in Round 6. The reason was that the participants were tempted to maximise the value of their private funds. The results varied by research group. The lowest contributions were made by Administration students, whereas the highest were offered by Economics students. At this point, it is worth noting that in Part One of the experiment, Administration students usually made the highest contributions to the social good, while Economics students contributed the least. In Part Two of the experiment, the situation was completely reversed, and it was Economics students who made the highest average contributions. For 2012–2017, the downward trend of the arithmetic mean was small, but the median was characterised by a relatively high fluctuation.

Round 8

Round 8 was intended to verify the effectiveness of the prize mechanism, but this time, not in an anonymous society. The findings show that the perspective of a reward did not increase the average contribution to the social good. Individual factors, such as interpersonal relations among the city residents, its territorial layout or the presence of a strong personality in the city may have exerted a greater influence on the behaviour of the participants. In the successive rounds of the experiment in Part Two, the average contributions in the all the research groups became more consistent. The analysis of 2012–2017 shows a slight decreasing tendency of the arithmetic mean and, as in the previous round, a fairly high fluctuation of the median.

Round 9

The penultimate round again involved a specific example of a social good, again a hospital built with the funds contributed by the participants in the experiment. In the case of two research groups (GAP and Administration students), the differences in the average contributions made as compared with Round 8 were very small. On the other hand, the median in these groups increased. In the case of the third research group, the arithmetic mean of the contributions clearly decreased and a slight decrease in the median was noted. The analysis for 2012–2017 shows a fairly clear decreasing tendency of the arithmetic mean and nearly the maximum value of the median.

Round 10

In the last round of the experiment, denunciation was introduced as a mechanism intended to motivate the participants to make more substantial contributions to the creation of a social good. It was only possible to denounce another participant-resident of one's own city. Denouncements were possible once the tallies of returns on investments in the social good were revealed, which limited the number of denouncements if it was known that all the participants contributed the maximum amount of PLN 20. This mechanism was not used very often, and then mainly by those participants who cooperated in their group (city) with people who chose to maximise their private funds so far.

Average contributions to the creation of a social good in Round 10 amounted to c.a. 15 PLN and were similar to those in Rounds 8 and 9. This implies a certain degree of stabilisation of the participants' behaviour in Part Two of the experiment.

When observing the behaviour of all the participants in the experiment in successive rounds, the following were noted:

–In Part One: Round 4 (the presence of a reward mechanism) was characterised by the highest average contributions made to the creation of a social good, and in Round 2 (minimum contribution),standard deviation reached the lowest value;

- In Part Two: Round 6 (disclosure of city composition) was characterised by the highest average contributions, whereas the average values in the following rounds took a sinusoidal course;

- In Part One, the average contribution was about PLN 9, in Part Two the average contribution was about 15 PLN (increase by 60.8%), with the median reaching the maximum value of PLN 20, which means that the majority of participants in Part Two made the maximal contribution from their private funds to the creation of a social good.

Social added value in the experiment

According to the above assumptions, social added value in this experiment is calculated in two ways: as the difference between the arithmetic means of the contributions made in a given round and in Round 1 (option A) and as the difference between the median contributions made in a given round and in Round 1 (option B). Hence there view of findings focuses on Rounds 2–10.

When analysing the social added value generated by all the participants in the experiment (cf. Figure 2), of note are quite significant differences in Part Two between the two options mentioned above. In option A, the variation in the behaviours of individual participants in the study is much smaller than in option B. This is due to the nature of the arithmetic mean, which tends to flatten the results of the analysis. In this case, option B of calculating social added value seems to better reflect the behaviours of the participants, although on the other hand the median takes less account of extreme behaviours, which in this case are of certain importance.

In both options, the highest social added value for Part One of the experiment was created in Round 4. This proves that a reward is effective, even one that will

not necessarily be received, in the process of stimulating social value creation. In Part Two, social added value in option A followed a sinusoidal course, and in option B, a high value at the moment when the composition of cities was revealed, was followed by a considerable decrease in Round 7, which may be explained by the participants' intention to use the created social capital for individual purposes, and then a stable increase until the end of the experiment.

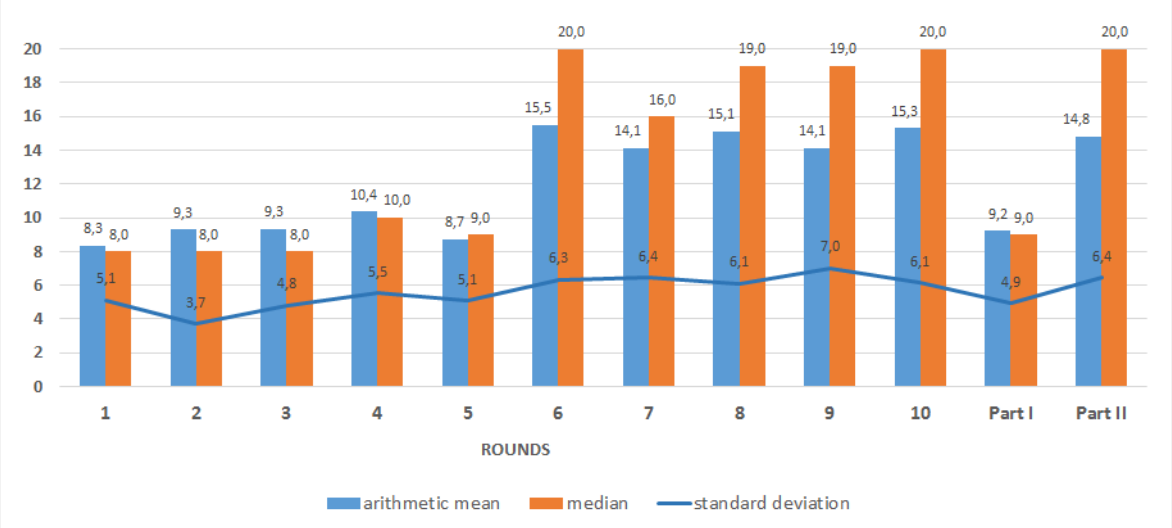

Fig. 2. Statistics for Rounds 1–10 (all three research groups)

Source: own study.

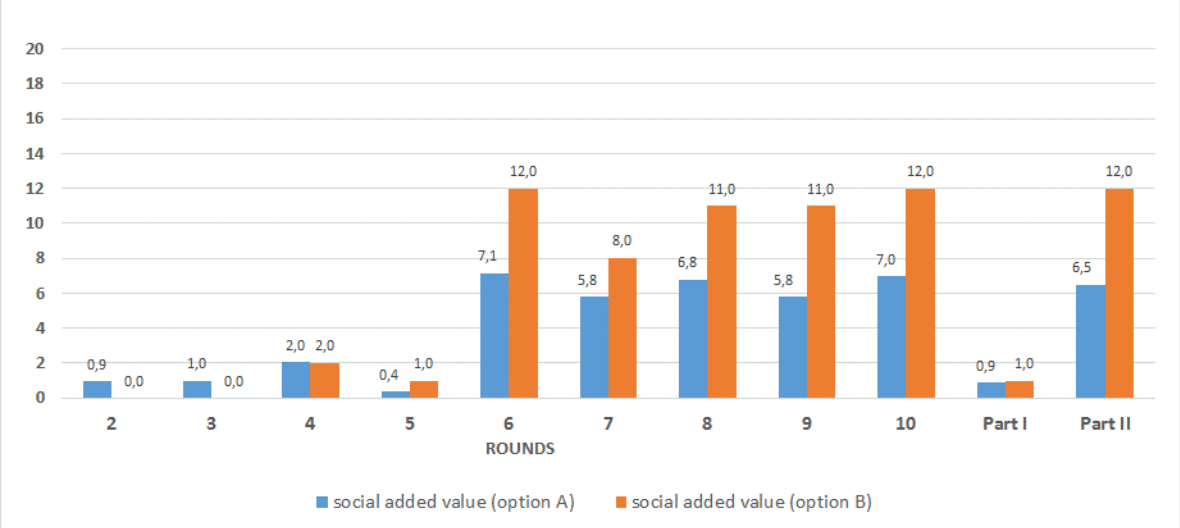

Fig. 3. Social added value (all research groups)

Source: own study.

Discussion of findings

A number of conclusions can be drawn from the experiment, which may inform research hypotheses in future economic experiments.

In an anonymous society, gamified rewards are a more effective than penalties in motivating citizens to create social added value. Interestingly, it was not certain whether the participants would actually receive the rewards in Rounds 4 and 8. Even though the chance was only 25%, many users decided to make a higher contribution. This is a mechanism applied, among others, in receipt lotteries, where participants motivated by an attractive reward, but with a very low probability of obtaining it, demonstrate behaviours that allow public authorities to minimise the grey areas in specific industries.

The disclosure of the city make-up offered a clear positive impulse for the creation of social added value, which in Part Two of the experiment was clearly higher than in its Part One. Despite the fact that the participants had the opportunity to apply the strategy of maximising individual goals, in a non-anonymous society the vast majority of participants decided in favour of maximising collective benefits.

In the experiment, societies characterised by higher levels of social capital made higher contributions to the public good. Quite possibly, greater trust amongst the residents of individual cities resulting from mutual

acquaintance gave rise to higher social added value. Low contributions to the public good in Part One of the experiment often resulted in a radical increase in the contributions in Part Two. It can therefore be concluded that the participants in the experiment in a way 'compensated' for the shortage of social capital in Part One in an open society characteristic of Part Two.

In a situation where at least one of the participants adopted a free-rider attitude, the other residents of the city usually completely ceased to cooperate, and in subsequent rounds, social added value generated in it was lower.

As the experiment unfolded, a relationship between the value of the contribution paid and spatial cohesion of the cities was observed. As of Round 6, the city make-up was revealed to the participants, who started to organises pace in the room for themselves in order to be as close to their neighbours as possible. As a result, the cities developed very different spatial arrangements, often depending on the technical conditions in the lecture room. In cities characterised by less spatial cohesion, rules set by the group were violated more often and thus the social added value created there was lower. This was also reflected in a lower level of trust between the residents. Consequently, in the experiment the spatial shape of population centres proved to be important for the contribution to social added value. This conclusion is in line with the criticism of the urban sprawl phenomenon (Balaban 2012), which, as was found experimentally, is not conducive to building social capital and thus to creating social added value.

Study limitations and indications for further research

In the experiment, social added value resulted from an important assumption based on a specific mechanism of value creation, namely that the contributions to the social good benefited all the residents of a given city, whereas the funds retained by individuals generated no profit. Such an assumption was intended to draw the participants' attention to the societal dimension of such value and focus their actions on the dilemma between cooperation with other residents and individual actions. The first strategy brought the most substantial benefits to the public at large, whereas the other one was decidedly individualistic. Therefore, the participants worked under externally set conditions, which should ostensibly encourage them to contribute all their available resources to the creation of a social good. However, it did not happen owing to the concomitant desire to maximise individual profits.

In the experiment, social added value was defined in relative terms with reference to the contributions made in Round 1. In Round 1, the arithmetic mean for the all three research groups varied in a small range (PLN 7.9–8.7), which suggests that according to Bernoulli's law of large numbers[3](Senet 2013), the value of about PLN 8 may be a universal starting point for determining social added value in subsequent rounds.

The participants in the experiment sometimes treated it as a game and, hence, were tempted to take greater risks that they would do in reality. The same tendency is observed in testing the so-called willingness to pay and willingness to accept –the valuation of non-market goods tends to be based on respondents' declarations rather than on their actual behaviours. A deeper insight into the experiment could be gained from a broader consideration of risk-aversion index issues (Zhou and Hey 2018).

At group level, individual contributions to the social good may have been influenced by various factors remaining outside the overt assumptions adopted for the experiment, especially in its Part Two. At that stage, the relations established with the other residents of the city had a great impact on the decisions. Time and again, the actions of certain participants aimed at achieving individual profit provoked retaliatory responses on the part of their fellow city residents. In some cities, dominating personalities were able to impose specific decisions on the other residents. Not all participants in the experiment realised that the optimal strategy from the point of view of the whole city would be to make the maximum allowed contributions to the creation of a social good.

Further research in the field of measuring social added value via experimental economics should ideally involve a study based on a four-group design (Solomon 1949) with at least two experimental groups and at least two control groups. Further to the analysis presented above, it is worth exploring in more detail the issue of the impact of rewards on participants in the process of creating social added value on the range of benefits, both in economic and social terms. Social capital's impact on social added value is also worth exploring using the methods mentioned above. Finally, a promising research venue may also involve investigating the effects of stress on decision making under experimental conditions (Buser et al. 2017).

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[3] In a sufficiently large number ofexperiments involving random events, the distribution of results can be expected to reflect the actual one.

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ВИКОРИСТАННЯ ІНСТРУМЕНТІВ ЕКСПЕРИМЕНТАЛЬНОЇ ЕКОНОМІКИ ДЛЯ ВИМІРЮВАННЯ СОЦІАЛЬНОЇ ДОДАНОЇ ВАРТОСТІ: ТЕМАТИЧНЕ ДОСЛІДЖЕННЯ

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Експериментальна економіка - це інструмент дослідження, при використанні якого інформація, зібрана шляхом проведення експериментів, використовується для перевірки обґрунтованості економічних теорій, оцінки розміру досліджуваного ефекту або виявлення ринкового механізму. Економічні експерименти зазвичай використовують гроші (віртуальні чи реальні), щоб мотивувати учасників і наслідувати реальні стимули, які виникають в реальних ринкових умовах. Експерименти використовуються для розуміння того, як і чому ринки та інші системи обміну діють/реагують в певний спосіб. Метою цієї статті є використання досягнень експериментальної економіки для оцінки суспільної доданої вартості, яка виникає в процесі виробництва та постачання суспільних благ, та перевірки ефективності інструментів публічної політики, які можуть стимулювати таку суспільну додану вартість. Стаття складається з (1) концептуальної та методичної частини, в якій представлено особливості та умови проведення експерименту, (2) опису вибірки дослідження та (3) аналізу результатів експерименту разом із запропонованими висновками та гіпотезами для подальших досліджень з проблематики, які присвячено статтю.

В ході дослідження соціальна додана вартість стала результатом важливого припущення, заснованого на конкретному механізмі створення вартості, а саме: внесок у соціальне благо приносить користь усім жителям даного міста, тоді як видатки здійснені конкретними особами не приносять їм прибутку. Таке припущення мало на меті привернути увагу учасників до суспільного виміру такої цінності та зосередити свої дії на дилемі між співпрацею з іншими мешканцями та індивідуальними діями. Перша стратегія принесла найбільшу користь для широкої громадськості, тоді як друга була чітко індивідуальною. Тому учасники працювали за умов встановлених зовнішньо, що як передбачалось повинно заохочувати їх використати всі наявні ресурси для створення соціального блага. Однак цього не сталося через супутнє прагнення максимізувати індивідуальний прибуток.

Результати даного дослідження можуть бути використані у практичній діяльності, зокрема, під час процесу програмування публічними органами влади інструментів, що сприяють реалізації обраної публічної політики.

Ключові слова: *соціальна додана вартість, експериментальна економіка, соціальне благо, соціальний капітал.*

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