Laboratory Experiments in Teaching Public Economics and Policy

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Abstract: *This paper deals with classroom experiments in economics, which have been derived from laboratory experiments. These experiments cover a broad range of topics, from strictly economic ones (like market games or auctions) to those with overlaps to other domains such as public policy. The paper discusses different methodologies of research and classroom experiments, introduces the benefits of the latter and presents a concrete teaching experiment used in public economics courses at the Faculty of Economics and Administration of Masaryk University. Another link between economic experiments and public policy is outlined here as well, namely the importance of experimental results for public policy makers.*

Keywords: *experimental economics, public policy, classroom experiment*

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INTRODUCTION

The importance and recognition of experimental economics have grown during the past decades. In the times of their origins, laboratory experiments served mainly as a tool of testing and verifying economics models. Where theory was missing or unable to explain real human behaviour, laboratory findings were ready to bring explanations and complete the gap between theory and reality. Despite original scepticism about credibility of the method, economic experiments became more a more recognized by the academic world and economic scientists. It is not surprising that laboratory experiments have started to penetrate and overlap with other domains such as economics teaching or even public policy making.

This paper deals with teaching experiments as a part of experimental economics. These experiments may be used, among other, in public economics or public policy courses. Even though the emphasis is laid on economic classroom experiments, the majority of those used in public economics courses have overlaps to public policy issues. There is also another link between economic experiments and public policy which is outlined in this paper: the importance of experimental results for public policy makers.

The paper has three particular objectives: (1) to introduce the method of laboratory testing in economics, (2) to discuss the benefits and different methodologies of teaching experiments, and (3) to present a classroom experiment we have traditionally been running in our course on public economics.

The structure of the paper corresponds to the goals defined above: The first part provides the reader with a brief theoretical and methodological excursion into the field of experimental economics. It represents a necessary starting point for understanding the principles of experimental economics, its method and importance. This section relies heavily on the author's doctoral thesis (Berná, 2014). The second section focuses on teaching experiments per se. Their different methodology (and principles) compared to research experiments is discussed here, as well as various forms of experimenting and the wider benefits of using classroom experiments. The third section presents a public goods experiment traditionally used in the public economics course taught at the Faculty of Economics and Administration of Masaryk University. The design of the experiment is introduced in detail, along with related theoretical assumptions. Furthermore, the results of this classroom experiment are discussed in relation to findings of research laboratory experiments on the topic. The conclusion completes the paper by discussing another dimension of how economic experiments can help us teach public policy. This section stresses the increasing importance of experimental findings for public policy makers; several concrete examples are introduced.

ECONOMICS IN A LAB: A BRIEF EXCURSION INTO EXPERIMENTAL ECONOMICS

Experimental economics is a relatively young discipline; even during a substantial part of the last century, the possibility of laboratory testing in economics was rejected. Unlike physics or chemistry, economics was considered a strictly non-experimental discipline. Laboratory experiments started to penetrate economic science in the 1960s and had a boom in the 1980s. During that period, game theory models were progressively introduced into economic analysis. The value of experimental economics increased, and by the 1990s it had become part of the mainstream. Its importance was acknowledged in 2002 when the Nobel Prize was awarded to Vernon L. Smith, who is considered to be the founder of experimental economics, and again in 2012 when Alvin E. Roth and Lloyd Shapley were awarded.

Since its origin, experimental economics has moved from a marginal position to the mainstream of the discipline. However, experimental methods in economics remain controversial and are subject to numerous criticisms.

Motivations for laboratory testing

There are three general motivations for economic experiments. Roth & Kagel (1995, pp. 21–22) created three principle types of dialogues called *Speaking to Theorists*, *Searching for Facts*, and *Whispering in the Ears of Princes*. *Speaking to Theorists* means testing existing economic theories and models and comparing them to results obtained in a controlled environment. These experiments make it possible to observe unpredicted regularities and feed back into the theoretical literature.

Where a theory is missing or incomplete, experiments may contribute to *Searching for Facts*. The aim of experiments in this category is to isolate the causes of observed regularities and to offer accurate explications. In practical terms, the most significant contribution of laboratory experiments is probably the category called *Whispering in the Ears of Princes*, i.e. implementing experimental findings into the policy decision-making process. Experimental results may help policy makers anticipate the effects of their actions, i.e. people's reactions to them (see Section 3).

In addition to these three principal objectives, laboratory experiments may represent a useful supportive tool for teaching economics (see Section 2). Students' involvement in a scenario may help them better understand the concepts and mechanisms, making the theory less abstract. This is particularly true for classroom experiments, which do not primarily serve to contribute

to the existing body of experimental research, although under certain circumstances they can.

Principles

Friedman & Cassar (2004) cite the following main principles of experimental economics:

- appropriate financial incentives (and rewarding of subjects immediately after the end of the experiment),
- clarity and unambiguity of instructions used, avoidance of emotional expressions,
- truthfulness of information provided (subjects must not be misled intentionally by the experimenter),
- subject anonymity,
- control over all pertinent variables.

Laboratory experiments complement other empirical methods used in economics, such as statistical analyses, questionnaires, and field studies. The advantage of experimental economics in contrast to those methods is mainly the possibility to control the experimental environment.

Control is the essence of experimental methodology. However, the level of control in experimental economics is far from being comparable to the level of control in physics or chemistry. In contrast to those two disciplines, the subjects of laboratory experiments in economics arrive each with their own history prior to the experiment.

The experimental environment is formed by economic agents and the institution within which the agents interact. The agents are equipped with economic characteristics, such as preferences, technology, available resources and information, and the experimenter needs to control all of them. "Such control can be achieved by using a reward structure to induce prescribed monetary value on actions" (Smith, 1976).

The key idea of the induced value theory (Smith, 1976) is that an experimenter is able to use financial incentives to induce some predefined characteristics in subjects so that their natural (or "home-grown") characteristics become insignificant. To do so, three conditions have to be met:

- monotonicity: subjects have to prefer a higher reward to a lower one and they cannot be satiated;
- salience: the reward must depend on subjects' actions and subjects have to understand the relationship;
- dominance: changes in subjects' utilities are caused predominantly through financial incentives, and other influences are negligible.

A very important feature and advantage of laboratory experiments is the possibility of their repetition or replication under the same circumstances. The terms repetition and replication are similar, both meaning the ability of one experimenter to reproduce the results of another. Repetition means the simple adoption of an existing design; replication may imply more-or-less important modifications of the original design.

The replicability of experimental results is essential in experimental economics. It enables researchers to verify the reliability of existing results and to test the effectiveness of design modifications. In order to ensure the possibility of replication (or repetition), it is important within each experiment to publish and archive the results and the precise design, including instructions for subjects (Friedman & Sunder, 1994).

Telling the truth to subjects is another important principle of experimental economics (Friedman and Cassar, 2004). Unlike in experimental psychology, where subjects are often told they are going to experience a particular situation while in reality they are going to be manipulated by the experimenter, there is a broad consensus among experimental economists that deception is not an acceptable practice within the field. The main argument is that any doubts on the part of a subject about the experimenter's intentions may modify the subject's behaviour and distort the results.

A related and important requirement is the clarity of instructions given to subjects. The experimenter has to make sure that all participants understand correctly what they are asked to do. In order to ensure such understanding, the experiment may contain test questions for the subjects or there may be a trial round at the beginning of the experiment.

There is some discussion of whether instructions should be written in terms as neutral as possible. The argument in favour of neutral terminology is the effort to avoid experimenter demand effects (Chaudhuri, 2009). There is a risk that the language of instruction could influence the subjects' action, and that instead of revealing their true preferences they would act in a way they think they are expected to, as it may seem to subjects that some actions are "preferable" to others. In a public goods game, for instance, using neutral terminology means that what represents a public good within the game is called a common project or group account, and that terms like free riding are eliminated completely. The counter-argument is that some topics of research require emotionally "stronger" terms in order to be representative of the real world (as in the real world our emotions often determine our actions). For example, in a study of corruption, instructions would typically contain the term 'bribe' instead of neutral appellations like 'sum of money offered' (Cameron et al., 2009).

Procedures and subjects

There are several modes of experimentation. The oldest method is the hand-run experiment, where all subjects are placed in the same room and given printed instructions. They express their decisions by answering questions on paper. After collecting the answers, the experimenters evaluate them and calculate the payoffs. This method may be quite demanding to administer, but it is still used frequently, e.g., in experiments with children (Harbaugh & Krause, 1999) and as part of classroom instruction (Holt & McDaniel, 1996). Hand-run experiments have been mostly replaced by computerized ones. Placing subjects in detached computer boxes allows the experimenter to achieve a considerably higher level of control over their actions. Subjects enter their decisions directly into a specialized program that processes them and calculates the payoffs. This method is simpler in terms of execution; on the other hand, it is more demanding in terms of facilities: a specialized laboratory is needed, the experimenter (or a member of the team) must have knowledge of computer programming, and subjects are required to have basic computer skills. Computer terminals are linked either within a local area network or using the Internet, which makes it possible to carry out experimental sessions at a distance (with subjects sitting at home, for example). Nowadays, numerous types of specialized experimental software exist, including z-Tree (Fischbacher, 2007), ConG (Pettit et al., 2012), and various applications from VeconLab and EconPort.[2, 3]

The tools of neuroeconomics may be considered to be an "upgrade" to laboratory experiments. This discipline combines research methods from several fields, including experimental and behavioural economics and neuroscience, which uses brain imaging and other techniques to infer details about how the brain works (Camerer et al., 2005). Neuroeconomics provides a complex method of studying human decision making; however, because of ethical issues, it is also quite a controversial part of economics. Recently, a study focusing on neural mechanisms supporting decision making in social interactions was presented by Rilling & Sanfey (2011).

University students are the most frequently used experimental subjects. The reasons are quite simple: they are available easily and at low cost. In addition, they are usually curious and motivated to participate in research (Chaudhuri, 2009). A disadvantage of the use of students is related to the "external validity problem" (see next section). There is a risk of bias because a sample of undergraduate students is not representative of the general population. This

2 http://veconlab.econ.virginia.edu/admin.htm
3 http://www.econport.org/econport/request?page=web_home

problem can be at least partly solved by using other non-student human subjects. However, these are more difficult to recruit, both in terms of time availability and financial motivation.

Advantages and criticisms

It has been stated that the major advantages of experimental economics lie in the possibilities for controlling experimental environment and for replicating the results. Some further strengths of the method deserve mention. Unlike in laboratory testing, observation of phenomena in their natural setting leaves us unable to precisely isolate the multiple factors behind them or to quantify their influence. Moreover, certain situations are difficult to observe because they are either rare or demand a special combination of factors. Some economic situations are observable only following the implementation of a special public policy.

The criticisms of experimental economics are related mainly to the interpretation and generalization of results. The extent to which experimental evidence can be extrapolated in order to explain economic reality is referred to as external validity. A crucial question is whether (and to what extent) the behaviour of experimental subjects within a simplistic model situation (artificially created by the experimenters) represents real individual behaviour outside the laboratory. This is the source of the primary criticism of the experimental method that has accompanied it from the very beginning.

This criticism is often connected to the selection of experimental subjects. As mentioned above, university students are the most frequently employed subjects, and one issue is the extent to which they are representative of the general population. Other limitations related to laboratory results (mainly due to the simplification of studied situation) also have to be taken into account when extrapolating to reality. In the laboratory, subjects are forced to interact with one another whilst addressing a small number of available options, with little control over the information flow (Casari, 2012). In the field, by contrast, people may employ multiple strategies.

When addressing the question of external validity, Guala (2012) refers to "wide" readings of experimental evidence, which can only be tested by combining laboratory data with evidence obtained "in the field". Combining lab the field data could help solve the problem of external validity and respond adequately to related criticisms. As stated by Smith (1976), "the results of laboratory studies can serve as a rigorous empirical pretest of economic theory prior to the use of field data tests. (…) The results of experiments can be directly relevant to the study and interpretation of field data". With field experiments, the

experimenter has only limited control over the environment and it is difficult (or even impossible) to measure all the relevant variables. Laboratory results may fill the gap; from this point of view, field and experimental data complement each other.

Chaudhuri (2009) mentions further frequent criticisms of the experimental method. First, in accordance with the basic principles of laboratory testing, financial rewards to participants have to be salient. Even if the amounts exceed hourly wages, however, they are still quite small, i.e., they do not involve thousands (or even millions) as the real-world interactions sometimes do. Other criticisms relate to the language of instructions. While standard practice requires that the language is neutral (non-emotive) and context-free, it appears that explicit contextualization may help subjects understand better the fundamental problem and make more informed decisions.

When designing an experimental treatment, one should endeavour to avoid experimenter demand effects, as these could limit the validity of results.

The last source of criticisms cited by Chaudhuri (2009) is associated with causal inferences. If an outcome is associated with an institution, how can an experimenter say with certainty that the former is caused by the latter? The problem of external validity refers to the ability of laboratory experiments to identify causal relationships that hold outside the laboratory, while internal validity relates to causal inferences inside the laboratory. As with preventing experimenter demand effects, it is highly important to carefully design the treatments in order to minimize inaccuracies or possible misinterpretation of results.

It is obvious that the laboratory experiment method is not perfect and has its limitations. However, it can still provide economic research with findings that could not be obtained in a different way. When designing an experiment, it is necessary to strictly respect the principles of experimental economics in order to avoid the above-mentioned risks. Laboratory experiments should be seen as a complement to other methods, rather than a substitute. As such, they can serve to strengthen existing conclusions or establish a basis for alternative explanations.

CLASSROOM EXPERIMENTS: A SLIGHTLY DIFFERENT WAY OF EXPERIMENTING

As the importance and recognition of experimental economics grew, it was somehow logical that laboratory experiments started to penetrate even economics classrooms. Traditionally, economics had been taught as a theory-in-

tensive discipline; this view, however, changed also because of the recognition of the benefits of active learning.

The very first classroom experiment was executed at the end of the first half of the last century by Edward H. Chamberlin at Harvard University (Chamberlin, 1948). In the so-called *pit market experiment*, Chamberlin let his doctoral students circulate around the room and bargain in the roles of buyers and sellers. Students had at their disposal instruction cards determining either their costs (the sellers) or redemption values (the buyers) and their task was to negotiate a price.

This experiment laid the foundation for the use of classroom experiments in economics classes. These games are effective because they insert students directly into the economic environments being studied. As Balkenborg & Kaplan (2009) state, such experiments can help illustrate how economic concepts are helpful in explaining observable behaviour, and they can also be used to discuss its limitations. Or, as stated in Holt (1999), the use of classroom experiments provides an important connection between theories and key features of the markets and institutions being studied.

Implementation of experiments in classes may be quite costly (especially in terms of teacher's time). However, their benefits have been proven. Experiments make the course more attractive and more fun both for students and the teacher. Several studies have demonstrated a positive impact of teaching experiments on students' understanding and learning of topics in question, and even on their academic performance. Emerson and Taylor (2004), Dickie (2006), or Ball, Eckel & Rojas (2006) reported improved scores and grades of students who had participated in classroom experiments.

What is more, participation in a classroom experiment may be a great motivator for a student in doing future research.

Hand-run, computerized and homework: different forms of classroom experiments

As in the case of research experiments, there exist several types of classroom experiments. Some unsophisticated games are suitable for hand-run design, while the more sophisticated ones are more suitable for computerized experiments. Both these alternatives have their pros and cons. One of the biggest advantages of hand-run experiments is the level of students' engagement in a game; while making their decisions, they meet one another *face to face,* which makes the game more interactive (and more fun). Regarding the disadvantages, Balkenborg & Kaplan (2009) mention the fact that hand-run experiments may require more careful preparation (including room structure) and help of additional assistants, volunteers or lecturers. Hand-run experiments may also be

more time demanding (which implies that a smaller number of rounds can be executed) and more complicated in terms of data collection.

Computerized experiments, on the other hand, make it possible to run a large number of experimental rounds with different matching schemes or even different treatments.[4] Nowadays, a large variety of experimental games is accessible via internet. Data collection takes place through the software and since the game is programmed it is ready to be used by a number of teachers without big preparation. However, the experimental program requires thorough preparation and additional programming before it is ready. Another complication is the need for a special computer room, which may limit the number of students who can participate. Balkenborg & Kaplan (2009) mention another problem with regard to the fact that in most cases, the experiment proceeds as fast as the slowest student, while idle students may engage in other preoccupations (such as visiting social networking websites; this problem is easily solved by blocking all programs other the experimental software.) And finally, with computerized experiments, one obviously faces the risk of possible technical problems.

Balkenborg & Kaplan (2009) mention one more form of teaching experiments: homework experiments. In this case, students may participate in an experiment by going to a website and interacting either with other online students, past participants or computer-controlled participants.

Classroom vs. research laboratory experiments: the difference

Important procedural differences exist between teaching and research experiments. A classroom experiment procedure should not be confused with "serious" experimental research because they have different motivations and objectives. While carefully executed laboratory experiments (respecting all experimental principles – see Section 1) are motivated by obtaining valid data, the main objective of classroom experiments is to improve students' understanding of theoretical concepts. This is why the "classical" experimental rules may be relaxed. For instance, usually it is not possible to reward experimental subjects at the same levels as in "real-life" experiments. Rewarding students financially for their participation might pose an issue with regard to teaching ethics.

In addition to ethical considerations, monetary rewards are not always possible because of financial constraints. Research experiments are usually

4 Matching scheme means the way in which subjects are assigned to interact with one another. In a partner scheme, subjects meet repeatedly with the same counterparts, while in a stranger scheme subjects are re-matched after each round.

supported by research grants that enable rewarding subjects at an appropriate level (see Section 1 for the methodology). This is seldom the case of classroom experiments. One possible way to alleviate this problem is to announce in advance that only one random person will be remunerated once the experiment is finished. This design, however, may reduce subjects' incentives (Holt, 1999).

Rewarding subjects (financially) is one of premises of proper laboratory testing. Once this rule is relaxed, one may face the related problem of reduced external validity of obtained data. However, it has already been pointed out that collecting valid data is not by far the main objective of classroom experiments. Another option for rewarding subjects is to use extra credit points. Holt (1999) finds these incentives more controversial than financial rewards, mainly because grade should, above all, be based on knowledge and what has been learnt in classes, and not as much on the economic conduct of students as experimental subjects. What is more, even this kind of incentives may distort subjects' economic decision making in the laboratory setting. As Holt points out, as long as students believe that there is a fixed grade distribution, they may view the experiment as a zero-sum game.

Balkenborg & Kaplan (2009) find that the most successful strategy is to give extra credit points for participation in an experiment, and not for performance. (This holds, of course, in situations where participation is optional.) According to some studies (see e.g., Dickie, 2006, or Emerson & Taylor, 2004) the use of classroom experiments improves students' scores, but this benefit disappears if credit points are based on performance. Balkenborg and Kaplan further stress that it is useful to formulate exam questions based upon the experiments.

Research and classroom experiments differ also in their duration. While a typical research experiment consists basically of reading the instructions, the experimental game itself and paying out the rewards, an extra part is essential to a classroom experiment: debriefing. Participants of a research experiment rarely know "how the experiment ended up", or how subjects other than themselves acted. As the main objective of classroom experiments in economics is to improve students' understanding of economic models and theory, it is fundamental to discus and analyse in class what was the goal of the game, how individual decisions were made and why they were made – the model and possible strategies. To allow for debriefing, the time for the experimental game itself must be reduced. To ensure that no key observation will be omitted, the teacher should prepare a well-elaborated list of debriefing questions before running the experiment.

Another premise of proper laboratory testing must be relaxed when running a classroom experiment, namely subjects' anonymity. In a regular class, it is impossible to guarantee any level of anonymity. Even if the identity of individual players (and their individual decisions) remained confidential within the experimental game, it would be, at least partially, disclosed during the debriefing. While participants of a research laboratory experiment are usually recruited in the most random way possible (in order to have a representative sample), the selection of subjects for a classroom experiment is determined by their enrolment in a course.[5]

Can classroom experiments bring any benefits to the experimenter?

So far, the different benefits of classroom experiments have been discussed only from the point of view of students involved. Knowing all the differences between the principles of proper laboratory testing and classroom experiments mentioned above, one may wonder whether data obtained in a classroom may be somehow beneficial for the experimenter. The answer is yes. While one could hardly publish an analysis of such data in a serious research journal, classroom experiments may be a cheap source of "preliminary data", informing the experimenter about some basic behavioural patterns in the situation studied (suggesting which particular situations or conducts should be further studied).

Another benefit for the experimenter is that of promotion. Students who participate in classroom experiments will often become interested in further research of the teacher and motivated to take part in it. Participation in a classroom experiment may also be their first (but not last) encounter with laboratory experiments.

EXPERIMENTS AT THE FACULTY OF ECONOMICS AND ADMINISTRATION

Several courses at the Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic, integrate laboratory experiments as a regular part of their syllabus. These experiments cover a range of situations, from strictly economic ones (such as market games or auctions) to various other topics (e.g., public policy, social issues, public choice or corruption). In this section, an experiment used traditionally in a course on Public Economics is going to be discussed. The experiment covers so-called social dilemmas. This term (first used in Dawes, 1980) represents a situation in which individual and

5 One might consider this type of selection as "partly random" if the experiment took place during the very first class.

collective interests are in conflict. A social dilemma typically results in a sub-optimal equilibrium (Samuelson, 1954), substantiating arguments in favour of public intervention.

An experiment with public goods: design and procedures

The experiment used in the Public Economics course focuses on the topic of voluntary contributions to a public good. As a variant of the so-called Public Goods Game, it is designed mostly according to Marks et al. (2003).[6] This experiment is hand-run, mainly because we find this mode more interesting, more engaging, and simply more fun for our students. The experiment covers an entire lesson of 90 minutes, and consists of distributing instructions and paper cards (possibly playing cards), reading the instructions, nine rounds of the experimental game, analysing data, presenting the results and debriefing the students.

In each of the nine rounds of the experiment, every student is given amount of experimental money on her disposal and is asked to choose between keeping this money (or its part) on her personal account and contributing it to a group account. The objective of each player (student) is to maximize her own profit. The motivation is ensured by means of adding extra credits to the course's final grade for one random student. These extra credits reflect the amount of experimental money gained by that student in the course of the experiment.

All decisions are taken confidentially. For simplification (and to ensure a dynamic flow of the experiment) every student is given only two tokens (represented by paper cards) in each round, giving her three options: to keep both tokens on her personal account, to divide them equally between the personal and group accounts, or contribute both tokens to the group account. (The students demonstrate their decision by marking an "X" on a token they wish to contribute to the group account and leaving blank the any token they want to keep on their personal account.) While a token kept on the personal account yields benefits only to the account's owner, a token contributed to the group account brings equal benefits to all participants, no matter whether or how much they contributed. In this logic, the group account represents a pure public good in the game, the personal accounts stand for pure private goods, and the students face a situation in which their personal interest contradicts collective interest. The students record their decisions (as well as associated payoffs) on special paper forms.

6 Several modifications of the original design were adopted. Namely, the number of disposable tokens was reduced to two (contrary to the original 25) and the number of rounds was reduced to 9 (while the original experiment used 12 rounds).

The payoff of individual *i* at the end of a round is determined by the following equation (1):

$$\pi_i = 40 \times (2 - g_i) + 10 \times \sum_{j=1}^{n} g_j \qquad (1)$$

where π_i represents the payoff of individual *i* in given round, is *i*'s contribution to the group account (being an element of the set {0,1,2}), *n* is the number of players (students in the class) and g_j is individual *j*'s contribution to the group account.[7]

Equation 1 implies that each token kept on a personal account yields 40 tokens to its owner, while each token invested to the group account yields 10 tokens to every player (student) in the class. This means that the marginal per capita return (MPCR) equals to ¼.[8]

More importantly, equation 1 implies two phenomena typical of voluntary provision of public goods (or, more generally, of social dilemmas):

1. Full free riding is the dominant strategy of player *i*, i.e. $g_i = 0$.

The aggregate payoff is maximized if everyone fully cooperates, i.e. $gi = 2$ for every *i*.[9]

In other words, while the best strategy for the group as a whole (so as to maximize the collective benefit) is to contribute everything to the public good, each rational individual will opt to be a free rider.

After each round, the teacher with her assistant collects all the tokens from the students, calculates the total contribution to the group account, and enters it into Microsoft Excel for subsequent analysis. The moment of collecting and counting the tokens creates a weak point of the game; the students are obliged to wait until the results are ready and may tend to look for other preoccupations (such as chatting or using their smartphones). This is why the teacher needs to reduce this time as much as possible and the assistance of an extra person is more than welcome. Once the result is ready, the students are familiarized with the total number of tokens collected on the group account and they can calculate their payoffs (by adding private profits from their personal accounts).

During the game, two modifications of this basic scheme are introduced in order to influence the students' decision making (and again, to make the game

7 The number of players is determined by the number of students enrolled in a given seminar, and usually amounts to 25–30.

8 Marginal Per Capita Return (MPCR), or marginal per capita income, is the ratio of profit from one payment unit invested in public goods and the opportunity cost of investing that unit.

9 While the number of players *n* amounts to 25–30, it holds that $0 < MPCR < 1 < n * MPCR$, implying the conflict between personal and collective interests.

more interesting and prevent boredom). First, the rate of return of the personal accounts is reduced by 50% after the third round of the game, (the profitability of the group account remains the same), which also changes the MPCR.

The payoff of individual i in rounds 4 to 6 is determined by the following equation (2):

$$\pi_i = 20 \times (2 - g_i) + 10 \times \sum_{j=1}^{n} g_j \qquad (2)$$

This modification does not change the theoretical equilibrium of the game; given the parameters of equation (2), the dominant strategy of all players is still to free ride.[10] However, in our experience it always changes the decisions of some students (and creates a basis for interesting reflections during the debriefing).

The second modification, occurring after the sixth round of the game, represents allowing for a one-time discussion among all participants within which they are able (if interested) to agree on a common strategy. At the same time, the MPCR returns to its original value of ¼.

Again, this strengthens the students' involvement in the game. After this one-time discussion, they continue making their decisions privately, and as there is no way of enforcing their (possible) previous agreement, it is often fun to observe how fragile this agreement can be and how the students react to its violation by some of their peers.

Once all nine rounds of the game have taken place, the data is quickly analysed by the teacher and then presented in the form of graphs to the students. Subsequently, a very important part of this teaching experiment comes: the debriefing. By means of a series of questions, the students are guided to fully understand the link between the theoretical model of voluntary contributions to a public good (and related concepts such as free riding) and the game they have just experienced. An integral part of this debriefing is to consider the possible means of *correcting* the non-optimal outcome. In the process of thinking and reasoning, the students come to a conclusion that in this situation of social dilemma, public authority needs to intervene in order to ensure socially optimal outcome. This conclusion is then discussed with respect to public policy and public goods provision.

At the very end of the lesson, one student is chosen by lot and her final profit is converted into extra credits for the final grade. We are aware about the limits of this way of rewarding: because of non-financial motivation and the lottery, the data obtained are of limited validity. One interesting fact is, however, that the behaviour of our students in this classroom experiment corresponds strongly to that observed in properly conducted laboratory experiments studying the same situation.

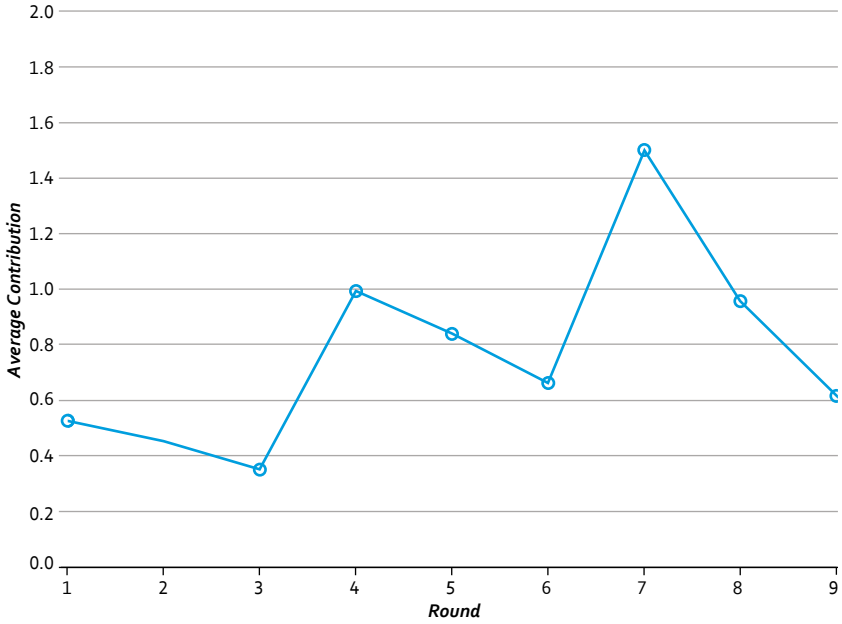
10 It still holds that 0 < MPCR < 1 < n * MPCR.

Results and discussion

In this section, selected results of our classroom experiment are discussed. Detailed results are presented elsewhere (see Špalek et al., 2008, or Špalek, 2011), and here we focus on the main (general) trends observed and how they compare to results obtained within a proper laboratory setting.

Graph 1 captures the aggregated results of the Public Goods Game classroom experiments carried at our Faculty during the years 2007 to 2014, covering data from 58 seminar groups. It shows average individual contribution (in tokens) to the group account during each of the nine game rounds.

Graph 1 Average contribution to the group account



Source: Author.

General observations

Each subject in the game was able to contribute 0, 1 or 2 tokens to the group account. As one may observe, there was no round in the game where all subjects contributed everything (i.e. 2 tokens) or nothing to the group account. The average contribution ranged from 0.35 tokens (representing less than 18% of disposable income) to 1.5 tokens (75%), depending on the stage of the game.

In the first round, our subjects contributed on average less than 0.53 tokens, which represent a little more than 26% of their disposable income. (It was even less in the two following rounds.) This is actually less than what the results of laboratory experiments (based on proper methodology) have demonstrated. Traditionally, the contributions in one-shot experiments or during the initial stages of repeated experiments are halfway between the Pareto efficient level and the theoretic Nash equilibrium (Ledyard, 1995). Usually, we observe 40% to 60% cooperation.

One can notice two hikes in the average contribution (in the 4th and the 7th rounds) which are related to the two modifications introduced in the game scheme (increasing MPCR and communication). This phenomenon is in line with traditional findings of experiments dealing with voluntary contributions to public goods. Both factors used in our classroom experiment are considered as having strong positive effects on the level of cooperation (see Ledyard, 1995, or Zelmer, 2003).

Responses to changes in MPCR

MPCR, which moved from ¼ to ½ after the third round, represents the marginal payoff to a subject from allocations to the public good, relative to the private good (the "profitability" of the public good). As MPCR increases, free riding becomes relatively less advantageous (that is, the relative profitability of the public good increases). However, the game theory equilibrium remains the same: the dominant strategy of each player is still to be a free rider.

In contrast to the theoretical assumption, experimental subjects traditionally demonstrate a (significantly) positive reaction to increasing MPCR. When the MPCR is raised between rounds, the subjects usually react by increasing appreciably their contributions in the round following the raise. However, with repetition, their contribution levels decrease and they tend to the theoretical Nash equilibrium (i.e. zero contribution). This may be because the subjects do not correctly assess the mechanism immediately, but they learn and understand it with the repetition of the given situation.

This is exactly what our classroom experiment data shows: even though free riding remains the dominant strategy after the increase in MPCR, our students react by increasing the level of contribution from under 18% to almost 50% between the third and the fourth rounds. However, the average contribution drops again in later rounds.

Responses to allowing communication

The second factor we included into our experimental game was allowing for one-time communication after the 6th round. As stressed above, communication among subjects has been identified as a factor with strong positive effects on cooperation in experiments with public goods (Ledyard, 1995; Zelmer, 2003).

The opportunity to communicate gives subjects the possibility to coordinate their actions. All subjects know that as a group they would be better off if everyone contributed everything to the public good (here the group account), so they usually agree on cooperative behaviour. The problem is that in the absence of enforcement, such an agreement is just "cheap talk" and the dominant strategy of each player remains to not contribute anything.

Despite this theoretical assumption, experimental subjects frequently raise their contributions (often in a significant way) in the round following the enabling of communication. However, if full cooperation is not reached, the subjects usually react by considerably lowering their contributions again.

And this is what we observed as well in our classroom experiment; after allowing for communication, the average contribution raises from 33% of disposable income to almost 75% (which is the highest level within the entire game). However, in the following rounds we witness a considerable decline.

Laboratory vs. classroom?

As we may have seen, while the responses of our classroom subjects to introducing (or modifying) selected factors correspond heavily to what we observe in a proper laboratory setting, the overall level of cooperation (measured by average contribution) is lower. It has been stressed formerly in this paper that results obtained in classroom experiments cannot be considered as "serious scientific data". However, the indications about individual behaviour they provide can be further studied properly within a laboratory. Still, the main merit of classroom economic experiments lies somewhere else: in improving economics teaching.

CONCLUSION

Since the second half of the last century, experimental economics has moved from a marginal position to the mainstream of economic science. With their increasing importance and recognition, economic experiments also started to penetrate other disciplines such as economics teaching and public policy decision making. Regarding economics instruction, a positive impact of classroom experiments on academic performance is well documented. Not only are they fun (for both students and teachers), but most importantly, they help students better understand economic concepts and establish a link between theoretical models and real-world human behaviour. Implementing experiments in classes and the curriculum may be costly for a teacher but it bears fruit.

A number of economic classroom experiments cover public policy issues. This is mainly the case of public economics experiments which focus on situations of social dilemmas. As long as the conflict between individual and public interest occurs (resulting usually in a socially undesirable outcome), there is room for public authority to intervene and "correct" the situation by implementing appropriate public policy.

Besides the issues of provision of public goods, public economics experiments (which can often be easily adjusted for the classroom) cover a variety of other public policy issues. For instance, we have been running an experimental series on individual compliance under different schemes of taxation. The results should tell us how tax payers act and react to variable parameters such as inspection probabilities or penalty rates.[11] Findings of this type can provide a cue on which form of tax policy could lead to an intended outcome. Even other public policies could find inspiration and answers in experimental results. For example, in pension policy, experiments may help us anticipate citizens' reactions to the implementation of different pension schemes.

During the last decade, experimental and behavioural economics started to be recognized even as a source of evidence for designing public policies. Governments of certain countries have already come to realize that the information experiments provide can hardly be obtained by any other method of economic research, and as such, they should be considered as an important instrument for public policy makers. According to Berná & Špalek (2014), when the global economic crisis started in 2008, doubts deepened about standard economic models, and behavioural economics became one of the hottest topics in public policy. More and more often are behavioural economists and psychologists consulted about various aspects of policy proposals. As an example, in

11 Preliminary results were presented in Berná and Špalek, 2015.

2010, the British Government established the *Behavioural Insights Team* which aims to apply "insights from academic research in behavioural economics and psychology to public policy and services" (BIT, 2014). There are many aspects of policy making that can be tested using behavioural or experimental methods.

The potential need for laboratory pre-testing of policy proposals can be illustrated on numerous regulatory areas. In Central Europe, there has been one example of great political and social interest: the opt-out introduced by the reform of the pension system. Various authors have pointed out (e.g., Schneider, 2009, Jahoda & Špalek, 2010, Vostatek, 2012) several behavioural concerns about the design of the pension reform. The fact that these concerns were not systematically studied by the Czech Government's policy makers may have contributed to the failure of the opt-out policy. Indeed, experience with the Slovak pension reform has shown that people, when choosing a pension plan, act only to a limited extent according to the predictions of economic theory (Berná & Špalek, 2014).

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