

**Efficiency in Markets: Evidence from  
Classroom Experiments with a Cross-  
Section of Students from East and  
Central European Countries, and the  
Former Soviet Union**

SCOTT BEAULIER AND PETER BOETTKE AND ANNE RATHBONE\*

**Abstract**

Three experiments were run in Prague, Czech Republic to demonstrate to students the robustness of market institutions. Students participated in Vernon Smith's "double-auction" experiment, the "double-auction" with price controls, and Holt and Laury's (1997) voluntary provision of public goods experiment. Despite a large number of diverse students (121 students from 26 different countries), the expected and efficient outcomes were still realized. This is an especially powerful result given the fact that most of these participants were from post-Soviet countries where the institutions of private property and the rule of law are largely absent. This paper reports these results and highlights thoughts from participants in the experiments. The paper also provides econometric evidence. This section examines how individuals with higher levels of education performed in the experiment (undergraduate or graduate student), whether one's college major (Economics, Political Science, International Relations, Philosophy, or History) mattered, whether one's gender mattered, and whether being an American student mattered.

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\* Scott Beaulier is a Mercatus Center Social Change Graduate Fellow, and a PhD student in Economics at George Mason University. Peter J. Boettke is Professor of Economics at George Mason University, Deputy Director of the James M. Buchanan Center for Political Economy, Senior Research Fellow at the Mercatus Center, and Faculty Director of the Mercatus Center's Global Prosperity Initiative. Anne Rathbone is a PhD student in Economics at George Mason University.

# Efficiency in Markets: Evidence from Classroom Experiments with a Cross-Section of Students from East and Central European Countries, and the Former Soviet Union\*

Scott A. Beaulier  
George Mason University  
[sbeauli1@gmu.edu](mailto:sbeauli1@gmu.edu)

Anne Rathbone  
George Mason University  
[arathbone@aol.com](mailto:arathbone@aol.com)

Peter J. Boettke  
George Mason University  
[pboettke@gmu.edu](mailto:pboettke@gmu.edu)

**Abstract:** Three experiments were run in Prague, Czech Republic to demonstrate the robustness of market institutions. Students participated in Vernon Smith's "double-auction" experiment, the "double-auction" with price controls, and Holt and Laury's (1997) voluntary provision of public goods experiment. Despite a large number of diverse students (121 students from 26 different countries), the expected and efficient outcomes were still realized. This is an impressive result since most participants were from post-Soviet countries where the institutions of private property and the rule of law are largely absent. This paper reports the results from these experiments. The paper also provides econometric evidence. We examine how individuals with higher levels of education performed in the experiment (undergraduate or graduate student), whether one's college major (Economics, Political Science, International Relations, Philosophy, or History) mattered, whether one's gender mattered, and whether being an American student mattered.

\* The authors thank Matt Bradley and Matt Dobra for helpful comments and suggestions. We also thank students participating in the 2002 American Institute for Political and Economic Systems (AIPES) conference for participating in the experiments highlighted in this paper. We gratefully acknowledge the Mercatus Center and Fund for American Studies for financial assistance. A special thanks goes out to Charles Brockner for helping us track down some of the data used in this study. The standard disclaimer applies.

## *I. Introduction*

Does culture matter in economic development? Many growth and development economists (Pejovich, 2002; Harrison and Huntington, 2000; Lal, 1998; North, 1990) think culture does matter. While some evidence points to culture playing an important role in economic development, the debate is far from conclusive.<sup>1</sup>

In general economists approach the cultural variable like any other growth variable: they use survey data (Norton, 2002) and cross-country aggregate statistics to determine growth's effect. Unorthodox techniques for measuring culture's effect are usually bypassed. Though, there has been a recent shift towards "thick" description in the form of analytical narratives, case studies, and ethnographic research (Rodrik, 2003; Mischel, 1996). Given the problems of untangling interrelated variables in econometric techniques, many prominent economists have endorsed a pluralistic approach to questions of economic growth and development.

One approach that, to a large extent, has not contributed to our understanding of the wealth and poverty of nations has been experimental economics. We think it is unfortunate that development economists seldom subject their economic propositions to experimental scrutiny. One can imagine many ways in which the "controlled" setting provided by experimentalists could isolate variables such as culture, property rights, and the openness of borders.

This essay is an illustration of how experimental economics can say something about the wealth and poverty of nations. In particular, we will use experimental

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<sup>1</sup> Easterly and Levine (1997) have constructed a nice measure of cultural heterogeneity. While they maintain that cultural heterogeneity leads to poor policy outcomes, their measure does not eliminate the effect of the African dummy variable. In other words, culture cannot explain Africa's growth tragedy (Englebert, 2000).

economics to examine whether variables such as culture and one's education level mattered when individuals from 26 different countries interacted in the "natural" market setting. If we pick up a cultural or educational effect in experimental settings—where the institutions of private property and the rule of law are implicitly embedded in the market setting—there is some additional support for the "culture matters" or "education matters" thesis.

## *II. The Participants and the Experiments*

Our experiments emphasized the importance of incentives in any exchange, the nature of trade and the requisite institutions that surround it, and the problems with voluntary provision of public goods.<sup>2</sup> The experiments did not require an extensive background in economics for students to participate. As Holt states, "the structural parameters of standard theories are determined by *individual incentives* and the *rules specified in the instructions*...the use of classroom experiments provides an important connection between theories and key features of the markets and institutions being studied" (Holt, 1999, 603)<sup>3</sup>.

The experiments were run at the American Institute on Political and Economic Systems (AIPES) in the Czech Republic. Every year the AIPES program gives students from Eastern Europe, Central Europe, and the former Soviet Union the chance to earn either undergraduate or graduate credits from Georgetown University. 121 students were selected from a pool of more than 500 applicants. Students spend three weeks studying

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<sup>2</sup> References to specific experiments throughout this paper come from in-class experiments designed and published in several papers by Holt.

<sup>3</sup> Emphasis is ours.

political science and economics at Charles University in Prague, Czech Republic. The students who attend have diverse ethnic and academic backgrounds: in 2002, 26 different countries<sup>4</sup> were represented at this seminar, and the majors of students included Economics, History, International Relations, Philosophy, and Political Science. Among the 121 students the understanding of economic principles ranged from cursory to scholarly.

Experiments in American universities often consist of relatively homogenous populations. By contrast, the pool of students at the AIPES program represents a wide range of academic, cultural, and socio-political backgrounds. This diversity provided us with a rich research opportunity. Given that much of Eastern Europe is still lacking the institutional structures of a well-functioning market economy, we wanted to find out if robust experimental results could still be obtained.

Students were broken up into four groups of approximately 30 students. In each section students were given one hour to read the instructions, perform the experiment, and engage in follow-up discussion. Before running any of the experiments students were told they would be paid upon completion of the fourth and final experiment. The experiments were staggered: one day we ran an experiment; the next day was spent discussing the experiment's particular economic principles and implications.

The experiments were originally designed by Holt. The first experiment was from Holt (1996). The purpose of this experiment was to generate exchange within a pit market. Students were broken down into an even number of buyers and sellers.

Instructions were read to the students, and each student was given a playing card. The

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<sup>4</sup> See Table 1 for a list of all countries and the number of students from each country represented in the experiments.

students in the front of the room were buyers, so they were given red “willingness to pay” cards; students in the back of the room were sellers, so they were given black “cost” cards. Before the students arrived in the classroom, the following instructions were written on the white board: “Ace = 1 dollar”; “Keep Your Cards Confidential at All Times”; “Sellers Have Black Cards”; “Buyers Have Red Cards”; “Absolutely No Talking Until the Market Opens”.

Holt’s instruction sheet was read to the students. If the student was a buyer the number on his red card was the amount of money he could spend in an exchange. If the student was a seller the number on her black card was the cost she incurred before selling the product. In addition, a buyer was unable to spend more than the number on his card; similarly, a seller could not sell for less than the number on her card. After the instructions were read the cards were passed out. Once students had a chance to look at their cards, they were brought to the front of the room. When everyone was in place, trading began.

One round of trading lasted for approximately five minutes. We ran the experiment for eight rounds. After the final round, the market prices along with the buyers’ and sellers’ individual costs were plotted onto a spreadsheet. The local supply and demand curves were generated, and the equilibrium price was shown. As Holt describes, “The objective is to have the students discover the supply and demand model themselves, and to realize that ‘large numbers’ of traders are not necessary for obtaining efficient, competitive outcomes” (Holt, 1996, p. 193).

The students were given an “Earnings Record Sheet” on which they recorded their name and their profit during each round. To prevent cheating on the earning sheets, two

teaching assistants recorded the names of each buyer and seller, the price the two parties settled on, and the number on their playing card. The students were told in advance that if one student was caught cheating the entire experiment would be thrown out and no one would earn their recorded profits.

When two parties agreed to an exchange, they reported to the teaching assistant. The teaching assistant recorded the student's name, the card numbers, and the strike price. The teaching assistant then shouted out this price, and the instructor also recorded the price. If students were unable to make a trade, they neither earned any profit nor suffered any losses in the round. By the third round of trading, the efficient and expected equilibrium of \$5.50 was in place.

The students began the first round rather timidly with mild announcements of "willing to sell for" and "willing to buy for" figures. By the second round students ran to the middle of the room shouting over each other in an effort to make the most profitable exchanges. The students quickly realized an important aspect of the double-auction experiment: if they did not make themselves heard, they could easily miss out on a profit opportunity. In the first few rounds the most profitable exchanges were made in the first thirty seconds. By the third round, however, almost every student who could exchange ran to the floor yelling "\$5.50!" Convergence on the \$5.50 price occurred by the third round and continued until the eighth round.

In later rounds of trading, students began entering the trading arena wearing pieces of paper stuck to their shirts with the words "Buyer" and "Seller". Not all students caught on to this innovation, but this signaling did lead to many students gravitating towards each other early in the round. In addition, those students who were buyers and

were dealt the Ace card quickly discovered it was not even worth leaving their seats at the beginning of a round: there was no way they were going to find a seller at a \$1 price; this was also true for sellers with \$10 cost cards.

After completing eight rounds of trading the remaining time was spent discussing the informational role of the price mechanism and entrepreneurship. The two most interesting comments we received were: (1) “This really helps us understand what you mean by both parties benefiting from voluntary exchange”; and (2) “This experiment was unfair!” Students were angry when dealt an Ace if they were a buyer or a ten if they were a seller.

The second experiment was also designed by Holt (1996). This double-auction with price controls illustrated the perverse effects of intervention into the market. The instructions and “Earnings Record” sheets were essentially the same. The one important difference in this experiment was that for the first four rounds a price floor of \$6.50 was imposed on all trades; for the last four rounds a price ceiling of \$3.50 was imposed. Compared to the previous day of trading without price controls, there were fewer trades in each of the eight rounds. What was particularly interesting about this experiment was the initial reaction of students. When we explained to students that there would be a mandated price floor of \$6.50 the group of sellers cheered and whistled at the news; meanwhile the buyers were very disappointed. When we instead implemented a price ceiling of \$3.50 the buyers were ecstatic, while the sellers looked disappointed. After running the experiment, however, *both* the buyers and the sellers were unhappy with this experiment. When the price was set above equilibrium, any sellers were unable to sell their product; likewise, when the price was set below the equilibrium value, many buyers

were unable to buy the product. During the discussion period, students expressed tremendous discontent, exclaiming, “This experiment sucked!” and “Why didn’t I earn anything in this experiment?”

The third experiment was taken from Holt and Laury’s (1998) “Voluntary Provision of a Public Good”. The purpose of this of this experiment was to illustrate the free-rider problem inherent in collective goods. After several rounds in which students secretly contributed or abstained from contributing to the public good, the students were then allowed to interact. The point of allowing interaction was to see if students could design some scheme that could overcome free-riding.

We started the experiment by reading the instructions and giving each student four playing cards—two red cards and two black cards. The number on the cards did not matter in this experiment. The instructions listed on the board were the following: “Keep Cards Confidential At All Times”; “Earnings =  $\$4 \times (\text{number of red cards kept by student}) + \$1 \times (\text{number of red cards played by everyone})$ ”. This experiment had fifteen rounds. Each round students handed two of their cards back to the teaching assistants. The teaching assistant recorded the total amount contributed to the public good, then returned the same cards in reverse order to each student. The students earned four dollars for each red card they kept and earned one dollar times the total number of red cards contributed to the public good. Black cards had no effect on earnings, but they were necessary to keep student contributions private (Holt and Laury, 1998, p. 210).

After each round the teaching assistant collected the red cards and announced the total number of red cards collected. For the first five rounds, each student received four dollars per red card kept. In the second five rounds, each student received two dollars per

red card kept; this lower private payout should have resulted in more contributions to the public good. Before the third five rounds were played students were given a five-minute discussion break. We kept per red card payout for the last five rounds. The discussion break allows students to discuss the dilemma and attain higher overall contributions. The students performed this experiment in four sections separately. The total contributions to the public good in each round can be seen in Table 3. As Table 3 illustrates, contributions increased steadily. When students were given the opportunity to discuss strategies after Round 10, a substantial increase in contributions occurred.<sup>5</sup>

### *III. Determinants of Experimental Performance*

The efficient and expected outcomes of the “double auction” experiment were attained. The efficient outcome is an impressive result with such a diverse group of individuals. Our data also allows us to look more specifically at what factors might have been driving individual success (or lack thereof). This section explains our econometric techniques and summarizes our results from tests we ran on whether being an Economics major mattered, whether a student’s general level of education mattered (i.e. did being a graduate student matter?), whether being an American student mattered relative to their east-European peers, and whether a student’s gender mattered.

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<sup>5</sup> During the discussion period, there were various attempts to force students to commit to contributing to the public good. One of the more amusing commitment devices was moral suasion where many students begged their peers to contribute for the greater good. One student was so distraught by the lack of voluntary contributions that he cried out, “I’ve lost all faith in humanity.” In addition to moral suasion, students asked if they could make up a rule in which all students showed their remaining cards at the end of the round so that the defectors could be detected. We vetoed this proposal out of a concern that card revelation would create too much animosity. The rule which seemed most effective in increasing cooperation rates was a “Let’s try to get 100% cooperation for one round” rule. Most of the students came to an agreement that they would all contribute as much as possible for one round. If cooperation stayed high, they would do it again the next round. This approach worked for a round or two, but as Table 3 illustrates, it broke down over time.

Estimation throughout this section is based on the aforementioned “double auction” experiment. Table 2 breaks down the 121 participants by gender, education, and major. In addition to the EX ANTE variable, which we discuss below, gender, education, major, and ethnicity serve as our four independent variables.

Early on we were concerned about the possibility that the performance differences we picking up were just the result of the random card generation. For example, if a female student was dealt poor cards in the double auction experiment, it would appear that she performed poorly. Yet, she could have been doing her best given the lousy cards she was dealt. To get around this issue we added an expected profit (EX ANTE) variable to our regressions. Since we kept track of every transaction in every experiment, it was easy to add this variable. The EX ANTE variable measures the difference between a student’s highest potential expected profit overall and their actual earnings. The expected equilibrium price for each round was \$5.50 given the card distribution of ace through ten. The students’ cards were subtracted from the equilibrium price to determine their expected surplus<sup>6</sup>. What our analysis was really after, then, is whether culture, education, gender, etc. mattered after accounting for one’s *ex ante* expected profit. Our goal is to examine whether there are significant differences between what a person expected to earn and what they actually earned. Simply put, the EX ANTE variable prevents us from picking up a difference that is simply the result of randomness in the experiment.

The other variables included in our regressions are dummy variables for education, ethnicity, gender, and economics major. The education variable (GRAD) was

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<sup>6</sup> If the student was a buyer then a card value higher than \$5.50 determined his highest possible expected profit in that round. If the student was a seller then a card lower than \$5.50 determined her highest possible expected profit in that round. If buyers or sellers were given cards that did not permit them to make a profit in any given round, they did not bear any losses and their expected profit in that round was zero and summed with all other rounds.

a one for graduate students; zero for undergraduates. The ethnicity variable (ETHNIC) was a one for American students; zero for non-American students. The gender variable (GENDER) was a one for males; zero for females. Finally, the major variable (ECON) was one for Economics majors; zero for all other majors.

#### *A. Factors That Mattered in Individual Economic Performance*

We ran 12 ordinary least squared (OLS) regressions to test our dependent variable (PAYOFF). All equations used a common set of independent variables: an ethnicity dummy, an education dummy, a major dummy, a gender dummy, and our expected payoff variable (EX ANTE). Table 4 reports both the qualitative and quantitative results for our regressions. Our ethnicity (ETHNIC) variable, for example, reports the coefficient and direction of an ethnicity effect: if it is negative, it implies that American students did worse than others. Our major (MAJOR) variable reports the coefficient for our Major dummy: if this coefficient is negative, Economics majors did worse, on average, than other majors. A similar intuition can be drawn from the other variables.

The (EX ANTE) variable came up positive and significant four out of the twelve regressions run. Each time the (EX ANTE) variable came up significant, the variable added approximately forty cents to student earnings. The intuition here is that the expected surplus generally was not driving the payoffs that students received over eight rounds of play. In other words, a student's initial endowment—driven by the randomly generated card values—was not a major determinant of his or her economic performance. When this variable mattered, the coefficient was small; more often than not, it did not come up statistically significant.

One of our independent variables consistently affected student performance. In six of seven regressions, gender (GENDER) came out statistically significant. In all of these regressions, the coefficient was positive and fairly large in magnitude. In addition to gender mattering, a student's education level (EDUC) and major (MAJOR) came up significant. Education (EDUC) was significant in four of seven regressions. Similar to gender, whenever our education variable was significant, it carried a positive coefficient large in magnitude. Major (MAJOR) was significant in three of seven regressions. It, too, carried a positive sign whenever it came up significant.

In every case where one of these three factors came up significant, they had a positive effect on economic performance. The following patterns held for all statistically significant variables: Males, on average, performed much better than females. On average, graduate students performed better than undergraduate students. Economics majors performed better than non-economics majors. There were no statistically significant exceptions to these patterns.

### *B. Culture Did Not Matter*

One factor *not* affecting the economic performance of our experimental participants was culture. In seven regressions, culture came up positive and statistically significant once. In addition, the one time when our ethnicity (ETHNIC) variable came up significant can be discounted, because we could not repeat that result in the six other regressions when various combinations of variables were dropped. The significant ethnicity (ETHNIC) correlation picked up in one regression seems to be nothing more than a spurious one.

#### *IV. Further Discussion of Our Econometric Results*

The results of our study of individual performance were somewhat surprising. Unlike Smith (forthcoming), we picked up a significant and positive Economics major effect. Though, Smith's finding of a negative Economics major effect (i.e., if you are an Economics major, you do worse in experiments) was picked up in several "trust games." Perhaps Economics majors fare better in the "double auction" environment. Training in economics might make students more entrepreneurial than average. In addition, perhaps some Economics majors were familiar with this experiment, which would have helped them out in the early rounds of the "double auction".

Our education effect was also unexpected. Similar to his Economics major effect, Smith (forthcoming) has found that more educated individuals perform worse in experimental settings. By contrast, Caplan (2001) finds that higher levels of education make individuals think more like economists. Perhaps Caplan's thesis is driving part of our result. One other plausible explanation for why education mattered in our experiment might be that graduate students took the experiment more seriously. Perhaps our education effect is signaling the conscientiousness levels of two different groups of students.

The fact that gender was our most robust result does not surprise us. When we look back on how males and females behaved in the "pit," we are not surprised that males outperformed females by a wide margin. Males were more aggressive, more vocal, and more entrepreneurial in each round of trading. In many rounds, we observed female students congregating and chatting with each other rather than actively trading. On many

occasions, males with relatively worse cards were more nimble than females with better cards.

The most interesting result, however, is our finding that ethnicity did not matter. This result is somewhat consistent with earlier work done by Shiller et al. (1991, 1992). By conducting detailed surveys, Shiller et al. found no significant “attitudinal” differences (i.e. deep cultural beliefs) between individuals from ex-communist countries and individuals from capitalist countries. However, Shiller et al. did find a significant difference in one’s “situational” perspective: individuals from ex-communist countries have less trust in government and many economic institutions.

The Shiller et al. study implies that if individuals from ex-communist countries can come to trust institutions of private property, the rule of law, and open markets, there will be no additional cultural barrier standing in their way. The experimental outcomes discussed in this essay verify the Shiller et al. thesis: culture does not matter if the institutions are right. With the good institutions of the market economy embedded in the double auction experiment, we observed that one’s ethnicity did not matter.

#### *IV. Conclusion*

A tremendous amount of work has been focused on whether culture matters in economic development. The empirical core of this paper shows that culture does not matter when individuals are placed in an idealized market setting. The empirical section does suggest, however, that individuals will do better in the market (1) if they are male, (2) if they have higher education levels, and/or (3) if they are Economics majors. Our

gender finding was remarkably robust and consistently positive. The education and Economics major variables were also fairly strong.

These results do not necessarily contradict evidence provided by growth and development economists. The fact that culture was not a serious constraint in our experiments should be supported by growth and development economists sympathetic to “shock therapy.” After all, they are maintaining that if the “good institutions” of private property, the rule of law, and open markets can be rapidly implemented, the culture will not stand in the way. Indeed, we found that when these institutions are presupposed, culture was clearly not a constraint.

Our results for education and gender also have support among economists. Mankiw (1995) and Barro (1991) have picked up positive education effects in their growth studies. In addition, Caplan (2001) has found that individuals who either have higher education levels or are male in gender think more like economists. Our results are consistent with these findings.

Our research has found that the efficient experimental outcome can be reached when a large number of diverse individuals interact in the “market”. In addition to this powerful result, we were also able to provide empirical results indicating which factors matter for individual economic performance in the market. We believe that experimental economics has something to say about the wealth and poverty of nations. As this paper has attempted to demonstrate, when viewed in a certain light, experimental economics has broad implications for political economy. It is our hope that further research in experimental economics becomes even more far-reaching than our analysis in scope.

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**Table 1**

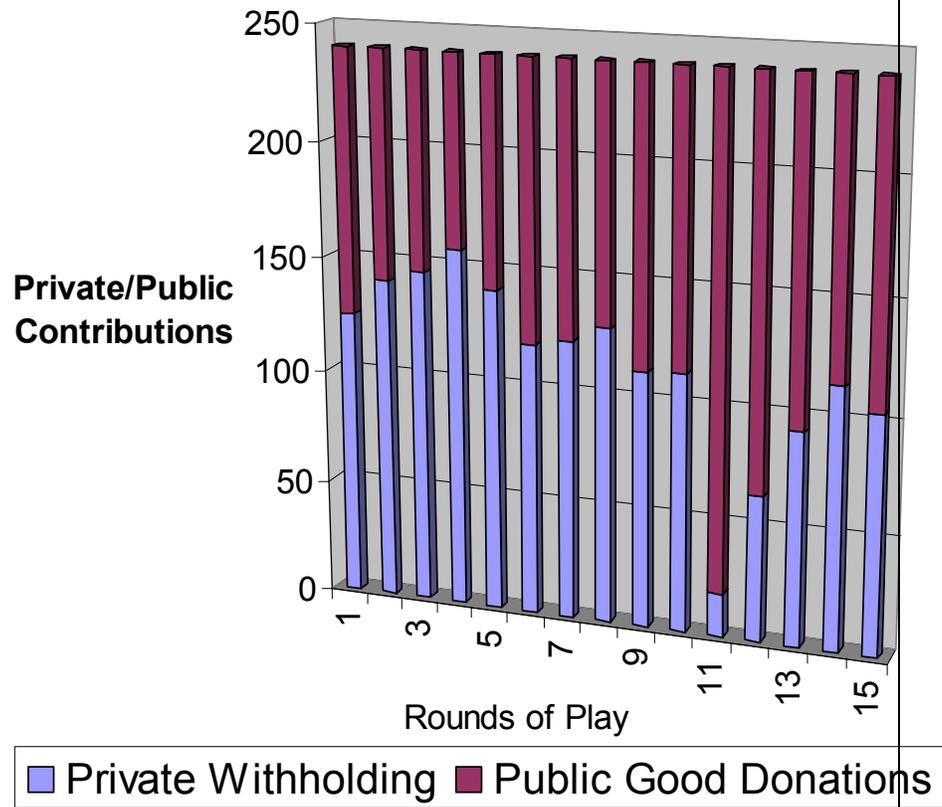
<b>Country</b>	<b># of Students</b>
Albania	3
Armenia	3
Belarus	3
Bosnia and Herzegovina	3
Bulgaria	5
Croatia	4
Czech Republic	5
Estonia	1
Georgia	8
Hungary	7
Kazakhstan	3
Kyrgyzstan	2
Latvia	4
Lithuania	5
Macedonia	3
Moldova	7
Poland	8
Romania	8
Russia	6
Slovak Republic	4
Slovenia	3
Ukraine	6
United States	11
Uzbekistan	2
Yugoslavia	7
<b>Total Countries</b>	<b>Total Students</b>
26	121

**Table 2**

Gender	Male = 46	Female = 74
Education	Graduate = 74	Undergraduate = 46
Major	Economics = 39	Other = 81

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Table 3



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**Table 4**

Regression of dependent variable (PAYOFF) on ETHNIC, EDUC, MAJOR, GENDER, and EX ANTE. All variables expressed in dollar terms. Standard errors are in parentheses.

Total number of participants=121

R<sup>2</sup> is not included for each regression, but all were between .48 and .52

ETHNIC (N=11) 1=AMERICAN	EDUC (N=74) 1=GRADUATE	MAJOR (N=39) 1=ECON. MAJOR	GENDER (N=46) 1=MALE	EX ANTE (N=121)
.400 (.038)***	-.191 (.293)	-.034 (.297)	-.050 (.290)	1.046 (.472)**
	-.101 (.294)	-.134 (.296)	.401 (.039)***	.042 (.300)
	.401 (.039)***	-.107 (.289)		-.119 (.277)
-.202 (.274)	1.040 (.467)**	.400 (.038)***		-.045 (.286)
-.050 (.285)		.993 (.462)**		.402 (.038)***
-.027 (.293)	.400 (.038)***		1.053 (.469)**	-.194 (.291)
	-.140 (.295)		.400 (.039)***	.056 (.296)
-.203 (.273)	1.047 (.463)**			.400 (.038)***
-.099 (.279)		.402 (.038)***	1.019 (.469)**	-.063 (.289)
		-.109 (.293)	.402 (.039)***	-.004 (.280)
-.091 (.276)			1.027 (.466)**	.401 (.038)***

\* significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.