

# Cultural Differences in Prisoner's Dilemma Game Experiments: Evidence from a Meta-Analysis

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## Abstract

The existence of social and cultural norms and the effect of these norms on people's behavior was always a debatable issue for cognitive scientists and is still a dilemma. This paper is a Meta-Analysis of 37 papers with 107 observations from repeated prisoner's dilemma experiments comprising more than 6000 participants and conducted in 12 different countries. The findings provide evidence that there is no significant difference on repeated prisoner's dilemma's cooperation rate between different countries and cultures. While the impact of methodology of such games on cooperation rate is relatively big.

Keywords: Cooperation, Social decision-making, Iterated prisoner's dilemma Game, Meta- analysis

JEL Classification: C91, C73, D03

## 1 Introduction

In recent years thousands of computerized experiments have been conducted to understand the influential factors in people's decisions in economically relevant situations. Fortunately, these studies are not limited to specific regions and a vast body of literature could be found all around the world. Since a lot of these experiments are compatible in their experimental designs, their data could be used for answering some questions related to cultural differences between these studies. For example, Oosterbeek et al. [2004] investigate the effect of culture on offered shares and rejection rates in a meta-analysis of Ultimatum game between 32 papers from 24 countries. Johnson and Mislin [2011] investigate the cultural differences on trust and trustworthy behavior through a meta-analysis of 53 studies from 35 different countries, and Engel [2011] explains the effect of various factors like age, identification, real money payoff, et cetera on dictator's behavior in 130 studies from some western, developing and primitive countries.

The main objective of this study is to investigate the impact of cultural factors on subjects' cooperative behavior in 107 repeated prisoner's dilemma game (RPDG) within 12 countries. This study compares the effect of culture as well as methodology of the experiments on subject's behavior.

Prisoner's dilemma is a game that is widely used in experimental economics to measure behavioral and cultural differences. For instance Molina et al. [2013] investigates gender differences in cooperation in RPDG, Sutter et al. [2009] analyzes the role of reward and monitoring on cooperation, Aoyagi and Fr chet te [2009] tests the theory of imperfect public monitoring by controlling the effect of noise on individual's payoffs or Gong and Yang [2010] studies the impact of reputation on cooperation.

prisoner's dilemma game gives a great measure of conflict between cooperation and free-ride which has always held a special interest for behavioral scientists. In addition, RPDG unlike single shot games has no unique dominant strategy and depending on situation and design of a game or beliefs of players everything between mutual cooperation (CC) to mutual defection (DD) could be an equilibrium. Therefore, "conditional cooperation" (Maskin [2013]) could be an equilibrium. Being threatened to be punished after a deviation by other players, a player tries to maximize his utility by keeping up with cooperating as long as possible. Therefore since in repetition of the game, conditional cooperation could be an equilibrium, this paper investigates RPDGs to see how often players cooperate during the time.

Defining culture as common understanding of the environment and defining the environment as everything surrounding us, environment is any means that we communicate through. It could be our languages, cultures, religions or beliefs and norms as well as institutions, politics or even our histories. The question that might arise here is: do cultural norms really matter? do they really affect people's decisions in the same way? One might expect to see some common behaviors in groups where they share some of these elements by accepting that our norms could be affected by any combination of mentioned environmental elements. A large number of studies on cross-cultural differences aim to answer these questions (G chter and Herrmann [2009]; Buchan et al. [2002]; Yuki et al. [2005]; Henrich et al. [2001]). They try to find some links between a certain behavior in a society and some certain cultural factors.

Greif [1994] gives a good example of the effect of culture on strategical behavior of individuals in an interactional situation. He shows that collectivist (Maghrebi) traders were more likely to punish defecting agents collectively by not hiring those agents ever after, while individualist (Geneoese ) traders had a different strategy by punishing defecting agents once and giving them another chance to be hired and enter the market again. Looking at this game as a repeated prisoner's dilemma game the strategy of collectivists against defectors could be interpreted as Grim-Trigger and for individualists as Tit-for-Tat. This suggests a possibility that a society may be more likely to evolve cooperation when it is stricter on punishing defectors (Collectivist) and vice versa for individualistic societies. In the theory section this theory will be discussed more.

Individualism plus five other national and cultural dimensions introduced by Hofstede [1993] together with "Trust" from WVS (World Value Survey) data are considered as cultural variables in this study. Both of these measures have been used in a wide range of cross-cultural research studies. For instance, Marcus and Le [2013] controlled the behavioral differences in collectivistic and individu-

alistic cultures in three different levels: Societal, Organizational and individual level. According to them, more Collectivistic individuals were less likely to cooperate, whereby organizational was more strongly related to cooperation in collectivistic as opposed to individualistic societies. Chatman and Barsade [1995] explain that subjects' cooperative behavior as rated by coworkers is lower and does not differ significantly for Individualistic subjects, regardless of whether their organizational culture emphasized individualism or collectivism. In contrast, cooperative subjects in collectivistic cultures were rated as significantly more cooperative in collectivist culture condition than comparable subjects in the individualistic culture condition. Gorodnichenko and Roland [2012] the Individualism-Collectivism cultural dimension is the only one that has a robust effect on measures of long run growth. The puzzling issue about these measures is that similar studies using these measures came to different results.

Despite the popularity of Hofstede's national and cultural dimensions and an extensive support and confirmation by many different studies there exist another group of studies criticize these measures for different reasons: Hofstede's measures are data driven instead of being theory driven, his assumptions are not precise, his samples are not fully random, et cetera. Oyserman et al. [2002] investigate Collectivism/ Individualism measures through a Meta-analysis of 170 papers which used these dimensions for finding cross-cultural differences. Their findings show that these two measures are not necessarily disjoint sets and a society could have some features of both of them. McSweeney [2002] studies the accuracy of Hofstede's assumptions which lead to inaccurate empirical descriptions regardless of the quantity of data and statistical manipulation used.

"Risk" and "Temptation" are the other two cultural variables in this study. They are related to the measure of trust as well as stake's size in RPDG. Risk is generally used in single-shot games and with stranger's settings, but since stranger's setting could be applied in repeated game by matching players randomly after each round of play it is applicable in this study where some of the games are with stranger's setting. In addition, some methodological factors like "monitoring", "matching", "average payoffs", "number of rounds" in finite games, "length of experimental sessions", "anonymity", "continuation probabilities" in indefinite games will be tested to get a clear image of the difference between the effect of culture and methodology on subject's behavior. Our findings show that culture as defined by Hofstede [1993] and specifically collectivism and individualism have almost no effect on cooperation while it can be diminished or boosted by the design of a game.

The remainder of this paper is organized as follows: In the next section, I briefly present the theoretical predictions related to the impact of risk and temptation in RPDGs. Data collection, explanatory variables and their characteristics described in section 3 and it will be followed by descriptive statistics in section 4. Section 5 is the meta analysis. Finally, the results will be presented in Section 6 and in Section 7 I conclude.

## 2 Theory:

Standard prisoner's dilemma is a single shot 2x2 game in which each player will either cooperate (C) or defect (D). Since players always better off by defecting, mutual defection is the strictly dominant strategy of this game while it is not efficient and if they both cooperate they end up with higher payoffs. However, if the same game (illustrated in Figure1) is being played repeatedly it has no dominant strategy anymore. Here, social norms play a role and each player tries to maximize his average payoff of all rounds. Maskin [2013] calls this conditional cooperation and for example one player sticks to a rule in which he plays C as long as the other one plays C as well and as soon as he defects from this rule player one will punish him by playing D for one or a few periods or his strategy could be playing D ever after.

		2	
		C	D
1	C	R,R	S,T
	D	T,S	P,P
$T > R > P > S$			

Figure 1: The prisoner's dilemma

We assume that the mutual cooperation will be maintained as long as both players cooperate and once one of them deviates the cooperation will be break-down for a while and they both deviate for  $N$  periods. The expected payoff of any player  $i$  who always cooperates is as follows:

$$V_i^C = R + \delta V_i^C = \frac{R}{1 - \delta}$$

where  $\delta < 1$  represents the weight that players put on future profit. The expected payoff of a player  $i$  who deviates for only one period is:

$$V_i^D = T + \sum_{t=1}^N \delta^t * P + \delta^{N+1} V_i^C$$

To have cooperation  $V_i^C > V_i^D$  :

$$\frac{R}{1 - \delta} > T + \sum_{t=1}^N \delta^t * P + \delta^{N+1} V_i^C$$

where the right hand side reflects the expected payoff of a player who cheated once and being punished for  $N$  periods and at period  $N + 1$  he expects to get back to the payoff of  $R$ . Since  $\sum_{t=1}^N \delta^t * P = \frac{P\delta(1-\delta^N)}{1-\delta}$  then:

$$R > T(1 - \delta) + P\delta(1 - \delta^N) + \delta^{N+1}R$$

$$T < \frac{R(1 - \delta^{N+1}) - P\delta(1 - \delta^N)}{1 - \delta}$$

Since  $\lim_{N \rightarrow \infty} \delta^N = \delta^{N+1} = 0$  then  $T - R < \delta(T - P)$ . If  $N = 0$  then  $\delta^N = 1$  and above inequality will be  $T < R$  which contradicts the assumption that  $T > R > P > S$ . This means that for games with no punishment players never stick to cooperation. Thus cooperation is stronger for a longer  $N$ , smaller  $T$  and larger  $\delta$ .

This result is in line with the results of the game introduced by Greif [1994] where players are merchants and agents, merchants hire agents to hold their merchandise in a distant city and agents could decide to be honest or to cheat based on the present and the future values of their actions. Assume that some merchants belong to an individualistic culture and others belong to a collectivist culture. In an individualistic culture, if one merchant gets cheated, the other merchants don't care. But in a collectivist culture, if one merchant gets cheated, then all merchants will punish the cheating agent by refusing to hire him ever again. The former one is similar to the case when  $N$  is small or the length of punishment is short (Tit for Tat) and the latter model is the same as the case with  $N$  is approaching to infinite (Grim Trigger). Using Greif model I can conclude that:

**Hypothesis 1:** In collectivistic societies the cooperation rate is higher than individualistic societies.

Again considering  $N$  to be infinitely long then the cooperation condition is:

$$T - R < \delta(T - P)$$

Calculating the discount factor:

$$\delta_{N \rightarrow \infty} > \frac{T - R}{T - P}$$

Since  $P > S$  I can conclude that  $\delta_{N \rightarrow \infty} > \frac{T-R}{T-S}$  which is another scope for cooperation. This measure as defined by Snijders and Keren [2001] is Temptation. Therefore the discount factor  $\delta$  should be bigger than temptation measure for each player to stick to cooperation even when the punishment period is long.

**Hypothesis 2:** For games with a larger value of temptation, a smaller proportion of the people will stick to cooperation and the percentage of cooperative behavior decreases.

Together with temptation Snijders and Keren [2001] measure risk as an alternative measure for trust as follows:

$$Risk = \frac{P - S}{R - S} \tag{1}$$

which is a comparison between expected utility of a player who decides to defect permanently and expected utility of a player who mixes defection and cooperation strategies. Snijders and Keren [2001] discuss that trust is not a static concept but depends on the size of the stake, the situation players are in, et cetera. In Hypothesis3 I would like to test the effect of risk on cooperative behavior:

**Hypothesis 3:** For games with a larger value of risk, a smaller proportion of the people will stick to cooperation and the percentage of cooperative behavior decreases.

The chance of frequent interaction is clearly another important factor. Relatedly players find it easier to sustain cooperation when they can react more quickly to a deviation. to see this clearly consider a game where players interact in periods  $0, N, 2N, \dots, N^2$  where player 1 deviates in period 0 and player 2 tend to punish him for  $N$  infrequent periods. Player 1 earns:

$$V_{IF}^D = T + \frac{R}{1-\delta} - \sum_{i=1}^N \delta^{iN} R + \sum_{i=1}^N \delta^{iN} P$$

Comparing the utility of a deviating player in frequent and infrequent play when  $N$  is big enough  $V_{IF}^D > V_i^D$ :

$$T + \frac{R}{1-\delta} - \sum_{i=1}^N \delta^{iN} (R - P) > T + \sum_{i=1}^N \delta^i P + \delta^{N+1} \frac{R}{1-\delta}$$

**Hypothesis4:** When players interact continuously without any interruption cooperation is easier to sustain.

Later using this hypothesis I expect to see lower average cooperation rate for games where players are re-matched randomly after each single period of the super-game.

### 3 Data collection

#### 3.1 description of variables

To choose our references through the extensive existing literature on the web I used the major search engines like Google Scholar, Bing and BASE (Bielefeld Academic Search Engine). In addition, to take advantage of papers that are not published yet or not available on the internet I posted a request in "ESA Experimental Methods Discussion" group and asked for experiments on repeated prisoner's dilemma which were not already included in our list of studies and eventually I came up with a long list of experiments on repeated prisoner's dilemma (RPD).

Since more homogeneous data is needed for a meta-analysis, the selection of experiments in this study is based on the following properties:

- All repeated games which are either finite i.e., all subjects are informed about the number of rounds they are going to play in each super game or indefinite means they just know the continuation's probability of each game, but not the precise number of the game.
- Studies in which all players are matched exogenously and randomly at the beginning of the game, between rounds (if they are re-matched after each round) and between super games.
- There is a huge variation in RPDG experiments with punishment, these variations could be with the length, cost, risk of punishment. I chose between those studies which have no punishment at all.
- In some studies players move sequentially (Clark and Sefton [2001]) therefore second player's move is a reaction to the first player's move. This study is focused on all games where moves are simultaneously and before both players decide about their moves nobody knows about their decisions.
- Some studies had variation of payoff matrices during each super game (Bolton et al. [2000]) and for some others they had asymmetric payoff functions for different players. I chose between those in which all players have symmetric and identical payoffs.
- In most of the studies subjects are recruited from students populations. They were mostly undergraduate or graduate students from different disciplines like Economics, Business, Law, Sociology or Psychology.

and at the same time I excluded a large number of experiments in which player played some variations of the RPDG as follow:

- This study considers all the experiments where payments are certain, based on individual's effort and in a real money.
- There exist a huge literature on single-shot prisoner's dilemma with any different variations which are all excluded from this study (Bó [2005]).
- All studies where the payoff's matrices are  $n \times n$  or  $n \times m$  with  $m, n > 2$  (Halevy et al. [2008]) are excluded. Consequently, all games on groups of more than two players as well as games on networks are not considered in this meta-analysis.
- In some studies where players had the chance to communicate before or in between the games. To remove the effect of communication on individual's behavior all such studies are removed from this literature.
- Studies in which subjects are playing against computer (Sautter et al. [2007]) or computer plays against computer or subjects don't know if they will play against human or computer or with some probabilities their opponent is a computer are all excluded.

- Some paper's where games were *noisy*, meaning that each player face a situation in which a "cooperate" action could accidentally be changed into a "defect" action and vice versa (Van den Bergh and Dewitte [2006]), are excluded.
- And finally I excluded studies where selection of players is not random for example players have chance of unilateral and mutual partner selection (Hauk and Nagel [2001]).

From each paper I looked for the following information (if available): year of the publication, year of the experiment, country of the experiment, number of the subjects in all sessions, the average payoff of players, number of rounds in each finite RPD, continuation probability in each indefinite RPD, matching system of the game (whether they are matched after each round or not), monitoring (whether players are being monitored by other players or by experimenters), anonymity (whether players have any information about their opponents), AFC, ATC and the payoff matrix.

It's good to mention that all information provided in this study is extracted from papers and some times based on the subject and the goal of a paper some of our required information like the average rate of cooperation or the average payoff of each player are not mentioned in the text, but I could calculate them through other information or graphs provided in the paper. Consequently, in few cases there might be slight differences between the precise measures and calculated measures of the average cooperation rate and the average payoff of each player.

### 3.2 Variables

All variables used in this study will be explained in this section. First two following dependent variables:

1. "Average first round cooperation" (AFC): is the mean cooperation rate of all players in the first round of each game. This factor could be a good indicator for the effect of culture on individual's behavior. In fact, each subject starts the game based on his own individual beliefs. This belief is a combination of his real life experience and his culture and learning through interactions with other players during the game has no effect on his decision on first round.
2. "Average total cooperation" (ATC): is the mean of cooperation of all players during the whole game. Although people learn from each other through interactions and adjust their strategies, Cultural features remain constant. Therefore, one should be able to observe the impact of culture on individual's behavior.

Independent variables are:

1. "Payoff": this variable is the average payoff of all players in each experiment. For countries other than US it is converted to US-dollar by dividing



it in original currency by purchasing power factor provided by the world bank. Since the year when the experiments were conducted for most of the studies was missing the year of conversion is set to the year of publication.

2. "Number of rounds" for finite games where all participants were informed about the horizon of the game<sup>1</sup>. This number in all finite RPDs is a common knowledge for all players before they start the game. (Ref.) shows that people cooperate more in games with bigger number of rounds.
3. "Continuation probability" gives a perception of future to players for the game with indefinite horizon although players have no idea about exact number of rounds in each game. Some studies show that people in games with higher continuation probability cooperate more. (Ref.)
4. "Payoff matrix" includes payoffs of mutual cooperation (CC), mutual defection (DD) and cooperation by one of the players and defection by the other one (CD & DC). In order to have the same range of values for each of these variables they are standardized.
5. "Time" is the length of the whole session in minutes. The average time that subjects were busy with each experiment.
6. "size of subject pool" is the number of all subjects who participated in each experiment.

a group of four dummy variables which are related to methodology of experiments:

1. "Monitoring" is related to the experiments where subjects were monitored by their opponents, the experimenter or a third-party person. Previous studies show that monitoring has a positive effect on individual's cooperation rate. In most of our studies monitoring happened from the opponent side.
2. "Matching" controls if subjects are matched once before a super-game and play with the same opponent during all rounds or after each single round they randomly matched a new player. In former model players have the chance to build up reputation during the game.
3. "Anonymity" shows if subjects have any specific information about their opponents or not. This information could be gender, age, nationality, education, etc.
4. "Finite/ Indefinite" distinguishes between finite and indefinite repeated prisoner's dilemma. This variable controls the effect of known and unknown horizon on individual's behavior.

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<sup>1</sup>???

And seven cultural variables which are divided into two groups: first six variables which are Hofstede's dimensions of national culture and "Trust" measure from WVS (World Value Survey). Followings are short definition of each of these variables:

1. Individualism (IDV) is defined as a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. In Table(3) US has the highest rate of individualism and Taiwan has the lowest rate. To distinguish between individual's behavior in individualistic and collectivistic countries I use Hofstede Individualism score to make a dummy that is equal to 1 when a country lies in the first group of countries below and is zero otherwise.
- Collectivist: Taiwan, China, Bulgaria, Japan, Spain
  - Individualist: Germany, Switzerland, Sweden, Canada, Netherlands, UK, USA

This score falls within the intervals (16,52) and (66, 92) for collectivistic and individualistic groups respectively.

- 2 Power distance index (PDI) expresses the degree to which the less powerful members of a society accept and expect that power is distributed unequally. In table3 Sweden has the lowest and China has the highest PDT in our list of countries.
- 3 Masculinity (MAS) represents a preference in society for achievement, heroism, assertiveness and material rewards for success. Sweden has the lowest and Japan has the highest rate of masculinity.
- 4 Uncertainty avoidance dimension (UAI) expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. Sweden has the lowest and Japan has the highest rate of uncertainty avoidance.
- 5 Pragmatism (PRA) describes how people in the past, as well as today, relate to the fact that so much that happens around us cannot be explained. US has the lowest and Taiwan has the highest rate of Pragmatism.
- 6 Indulgence (IND) Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Here, Bulgarian has the lowest and Sweden has the highest rate of indulgence.
- 7 Trust<sup>2</sup>: is an index defined by WVS based on this question: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people" and possible answers are

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<sup>2</sup>We used World Values Survey Wave 5: 2005-2009 for two reasons: first most of the literature is related to this period and second this wave had data for most of our countries.

A: Most people can be trusted or B: You can never be too careful when dealing with others. The trust index is formulated as follow:

$$Trust = 100 + (\%A) - (\%B)$$

## 4 Descriptive statistics

Table(1) depicts the Descriptive statistics of 107 observations in this meta-study. Number of observations less than 107 shows the number of missing values for each variables. For example, since for more than 50% of the experiments the year of experiment is missing I decided not to use this variable in this study.

The mean from the “Year of publication” is close to 2008. The oldest study used here is a paper by Selten and Stoecker [1986] and the newest one is the one by Hennig-Schmidt and Leopold-Wildburger [2014].

Table 1: Summary statistics

Variable	N	Mean	Std. Dev.	Min	Max
Year of publication	107	2008.692	5.577	1986	2014
AFC	86	47.585	19.734	4.4	88
ATC	104	40.786	22.493	2.8	88.4
Size of subject pool	103	165.99	143.558	20	520
Average of payoffs	96	21.471	8.093	4.5	34
$Piesize = \frac{Payoff \times 100}{GDP}$	95	0.047	0.018	0.019	0.092
Time	78	76.64	35.42	20	240
Published	107	0.748	0.436	0	1
Monitored	105	0.433	0.495	0	1
Anonymity	106	93.40	0.249	0	1
Matched	107	0.243	0.431	0	1
Finite or indefinite	107	0.393	0.491	0	1
Continuation probability	57	0.753	0.186	0.125	.967
Number of rounds	42	16.81	12.793	2	50
Collectivist	107	0.16	0.36	0	1
IDV	107	76.45	20.52	17	91
PDI	107	41.57	10.37	11	80
UAI	107	53.9	14.77	29	92
MAS	107	62.16	13.75	5	95
PRAG	107	49.42	26.64	26	93
IND	107	57.95	14.65	16	78
Trust	107	77.91	12.62	40.9	134.5

The first dummy variable (Published) shows that about 74% of studies is already published and the rest is discussion papers at the time I write this paper. From the second one (Monitored) it can be seen that in 43% of studies subjects

were monitored either by their opponent or by a third party. Further in more than 93% of the cases subjects had no information about their opponents and the games were completely anonymous. In addition, more than 24% (26 out of 107) of studies had random matching strategies in which players were matched randomly after each single round.

The dummy "Finite/Indefinite" depicts that from all the observations 39% (42 observations) is finite and the rest is indefinite. Number of rounds for finite games is between 2 and 50 with an average of 16.8 and in indefinite games on average players continued to the next round with the probability of 75%.

Finally Collectivist shows that 16 percent of countries in our sample are collectivistic countries.

#### 4.1 Descriptive statistics by country

Table 2 shows the descriptive statistics by country. Number of observations in second column shows that US with 56 (52%) and Germany with 23 (21%) observations have most experiments between all these 12 countries.

Table 2: Descriptive statistics

COUNTRY	Nr.	AFC.	ATC	Payoff	PDI	IDV	MAS	UAI	PRAG.	IND	Trust
Bulgaria	1	-	32	-	70	30	40	85	69	16	50.9
Canada	2	36	31.5	-	39	80	52	48	36	68	85.9
China	4	34	23.5	5.63	80	20	66	40	87	24	104.9
Germany	23	46.5	36.8	28.29	35	67	66	65	83	40	75.9
Japan	6	53.6	57.6	34	54	46	95	92	88	42	79.6
Netherlands	3	41	23.9	15.95	38	80	14	53	67	68	90.6
Spain	3	43.3	36.9	11.85	57	51	42	86	48	44	40.9
Sweden	1	49	50.5	22	31	71	5	29	53	78	134.5
Switzerland	2	36	25	-	34	68	70	58	74	66	107.4
Taiwan	2	-	19	11.6	58	17	45	69	93	49	48.6
UK	6	-	50.4	12	35	89	66	35	51	69	61.7
USA	56	49.6	44.1	22.69	40	91	62	46	26	68	78.8

AFC and ATC in column 3 and 4 are the mean of these two variables in all the experiments done in each country. For instance 49.6 is the AFC and 44.1 is the ATC for all those 56 studies done in US.

"Payoff" in column 5 is the average payoff of players between all the experiments in each country.

In the next section the result of the meta-analysis will be described. Meta-analysis enables us to compare or combine results of 107 observations across 37 experimental studies which are conducted in 13 different countries. The difference between these studies is not just related to the year when they are conducted but also to differences in sample size, geographical region, lab conditions, stakes or payoffs, etc. Meta-analysis gives us a chance to synthesize all these data and have a rigorous comparison between them.

## 5 Data Analysis

### 5.1 Prisoner's Dilemma

After defining variables and set ATC and AFC to serve as dependent variables the ground work is now to conduct two meta-regression analyses. The results of these meta regression analyses are summarized in Table 3 (a) with ATC as the dependent variable and in Table 3 (b) for AFC as the dependent variable.

Table3(a ) shows that cultural variables have no significant effect on the ATC. Not only the six cultural measures of Hofstede but also the measure of trust from VWS has no effect on it. As it explained before using Hofstede's individualism measure I divided our data to two categories of collectivistic and individualistic regions. However, as it can be seen in column 3 this measure is insignificant. The estimates in Table3(a) are, therefore, inconsistent with the H1 which means that I find no support that in collectivistic societies the ATC is higher.

Matching is the first significant variable (in first column at 1% and in columns 2-4 at 5% level). It is a dummy equal to 1 if players are randomly re-matched after each round of a super-game otherwise it is 0. I find that it has a negative and relatively large effect on ATC. Its coefficient is nearly -25 which means that matching decreases ATC by 25 percentage point and this a strong support for H4.

With risk in Table 3(a) I test H3. It has lowest significance level( 10%) and at the same time the strongest effect on cooperation rate. The coefficient shows that about a 35 percentage point difference can be expected between situations with the most and least extreme risk. I found a support for H3 that when the risk measure in a game is high people deviate from cooperation more often.

The other positively significant variable (at 1% and 5% levels) is monitoring. Monitoring is another dummy which is 1 if players' behavior are monitored. Its coefficient is close to 16 in all four columns which means monitoring increases the ATC by 16 percentage point.

Finally time is highly significant (at 1% level in first three columns and at 5% level in fourth column) however the effect size is small and the 0.42 shows than for one unit increase in time the ATC increases by 0.42 percentage point.

Again in Table 3(b) non of the cultural measures including collectivism shows any effect on AFC. This result confirms the rejection of H1 as already showed in Table3(a).

Matching is significant in this table as well. The effect size varies between four columns but in all of them it is negative and significant (at 5% and 10% levels). AFC declines between 17 to 21 percentage point when players are matched after each round. This repeats our finding in Table3(a) and is another confirmation of H4.

Risk in Table3(b) is the most significant variable. The negative impact of risk on AFC is between 54 to 69 percentage point against 35 percentage point in ATC. The significance level is 1% in all columns which is a very strong support

ATC	(1)	(2)	(3)	(4)	AFC	(1)	(2)	(3)	(4)
Finite/Indefinite	6.936 (6.45)	8.019 (6.90)	7.389 (6.59)	8.922 (7.24)	Finite/Indefinite	2.642 (6.23)	7.371 (7.96)	6.991 (6.84)	5.886 (8.29)
Matching	-25.266*** (6.91)	-24.277** (7.26)	-24.315** (7.48)	-24.439** (8.04)	Matching	-21.370** (6.65)	-20.758** (6.68)	-17.604* (7.09)	-18.339* (7.37)
Monitoring	16.047** (5.70)	16.253** (5.72)	16.483** (5.85)	15.448* (6.16)	Monitoring	1.938 (5.28)	1.920 (5.28)	3.466 (5.37)	3.859 (5.47)
Anonymous	-0.588 (9.98)	-0.633 (9.98)	-0.478 (9.98)	3.647 (14.13)	Anonymous	0.347 (12.36)	-0.302 (12.38)	-1.756 (12.44)	-2.782 (12.48)
Time	0.408*** (0.11)	0.394*** (0.11)	0.403*** (0.11)	0.398** (0.12)	Time	0.258* (0.10)	0.229* (0.11)	0.225* (0.11)	0.212 (0.11)
Pie_size	-231.645 (179.61)	-177.394 (217.76)	-215.836 (185.80)	-178.436 (245.52)	Pie_size	-130.402 (163.59)	42.497 (244.03)	16.364 (189.30)	10.821 (251.59)
Temptation	-27.300 (27.08)	-25.359 (27.43)	-27.313 (27.08)	-25.590 (29.07)	Temptation	4.815 (9.02)	7.095 (9.33)	13.765 (10.73)	22.731 (13.65)
Risk	-35.264* (16.90)	-35.883* (16.96)	-35.547* (16.92)	-35.084* (17.13)	Risk	-54.732*** (15.60)	-59.595*** (16.41)	-62.826*** (16.47)	-63.843*** (16.64)
Trust	-0.221 (0.356)	-0.174 (0.422)	-0.201 (0.369)		Trust	0.0838 (0.409)	0.205 (0.431)	0.0468 (0.410)	
IDV		0.083 (0.19)			IDV		0.240 (0.25)		
Collectivist			-3.989 (12.00)		Collectivist			-25.253 (16.39)	
PDI				0.463 (2.16)	PDI				-0.983 (0.53)
UAI				0.304 (1.69)	UAI				-1.026 (0.68)
MAS				0.523 (1.41)	MAS				0.034 (0.29)
PRAG				0.366 (1.43)	PRAG				0.252 (0.24)
IND				1.050 (3.83)	IND				
_cons	41.888* (16.43)	32.833 (26.31)	41.276* (16.53)	-109.582 (556.33)	_cons	59.674** (17.94)	34.514 (31.87)	55.997** (18.09)	134.195** (48.48)
N	72	72	72	72	N	63	63	63	63

Standard errors are in parentheses  
\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

(a)

(b)

Table 3

for H3.

Monitoring, which had a positive effect on ATC, has no effect on AFC.

Time enhances AFC but the effect is small so that it grows 0.2 percentage point for one unit increase in time. First three columns are significant at 10% level however last column is not significant anymore.

Temptation in the both tables there is no main effect for temptation which means that I find no support for Hypothesis 2.

In both of the tables there is no significant relation between cooperation rate in finite or indefinite game. Also anonymity and Pie size are two other measures which are insignificant in all four column of the tables. Finally, though monitoring increased the ATC in Table3(a), it has no effect on AFC.

## 5.2 Trust Game

In this section I repeated all the meta-regression for the data from a meta-analysis paper on Trust Game (TG) by Johnson and Mislin [2011]. This study includes 162 TG experiments between 35 different countries. To have more compatible data with the data of RPDG some experiments are removed from their list of observations as follows:

- all the studies with random payments
- studies with non real payments
- studies where subjects play against computer

After removing above mentioned observation, I ended up 107 experiments from 29 countries. The variables used in this study apart from our cultural variable in previous part are as follows:

1. Average amount sent (AAS): which is the average percentage of endowment that truster sends to trustee.
2. Average amount returned (AAR): which is the average percentage of fund that truster returns to trustee.

these two variables are the dependents variables in these regressions. In addition, the dependent variables are:

1. Sender endowment in US dollar
2. Receiver endowed: this is a dummy variable which is 1 if receiver received any endowment at the begining of the game and otherwise it is 0.
3. Rate of return: which is either 2 or 3 for all the experimets in this study.
4. Monitoring
5. Anonymity

Unfortunately because of not having the amount of receiver endowment measuring Temptation for trustees and Risk for trusters is not possible<sup>3</sup>. Tables (12) and (13) in the Appendix provide descriptive statistics of variables.

Finally, Table (5) depicts the result of the analysis. In Tables 5-(a) IDV is the only cultural variable which is significant at 5% level and the coefficient shows that each unit increase in IDV score increases AAS about 0.1 percentage point. Though the effect is small it contradicts H1 which implies that in collectivistic societies cooperation rate is higher than individualistic societies.

Sender endowment has a significant positive effect on AAS at 10% level but the coefficient is 0.3 and 0.4 in different specifications. The dummy Receiver endowed has a negative effect on AAS and significance level varies between 5% and 10% level in specifications 2-4 and it is insignificant in the first one. The coefficients show that receiver being endowed can decrease AAS between 4-6 percentage point. Monitoring has a negative effect on AAS and it is only significant (4) at 10% level.

Anonymity is the only variable which is significant in all the specifications at 5% and 1% level and at the same time it has the biggest effect on AAS. Being anonymous decrease AAS between 14-22 percentage level.

In Table 5-(b) the only significant variable is rate of return which increase AAR in first two specifications at 5% level of significance.

## 6 Discussion

The results explained in the previous section have some important implications for the effect of cultural and methodological differences on people's behavior in RPDGs. The findings do not support the effect of culture on behavior. I used two groups of cultural variables in our study: the first one was Hofstede six cultural dimensions which are already explained in this paper and the second one was just one variable named "Trust" from WVS. None of these variables show any significant effect on subject's cooperative behavior in RPDGs. This might be explained by the following:

First, recently some studies widely criticized cited book Culture's Consequences, Hofstede (1980) for different reasons. For instance, McSweeney [2002] says that the inaccurate assumptions in this book lead to inaccurate empirical descriptions regardless of the quantity of data and statistical manipulation used and Oyserman et al. [2002] controlled the individualism – collectivism measure by doing a cross-national and within-United States meta-analysis and criticizing the definition of Individualism-Collectivism.

Second, more than 90% of subjects in all these studies are graduate and undergraduate students who are between 18-25 years old. In addition most of these participants are Economics students. Previous studies show that economics training encourages the view that people are motivated primarily by self-interest Frank et al. [1996] and this leads people to expect others to defect in social dilemmas Marwell and Ames [1981]. Furthermore, Bauman and Rose

<sup>3</sup>In this game there is no Temptation for truster and no Risk for trustee.



	(1)	(2)	(3)	(4)
AAS				
Sender endowment	0.377 <sup>+</sup> (0.21)	0.384 <sup>+</sup> (0.21)	0.387 <sup>+</sup> (0.21)	0.425 <sup>+</sup> (0.22)
Receiver endowed	-4.392 (2.92)	-6.054* (3.01)	-5.854 <sup>+</sup> (3.17)	-5.900 <sup>+</sup> (3.23)
Rate of return	4.345 (6.96)	3.900 (6.96)	4.462 (6.96)	2.647 (7.14)
Monitoring	-3.283 (3.05)	-3.052 (3.05)	-3.574 (3.06)	-5.835 <sup>+</sup> (3.23)
Anonymity	-15.928* (6.86)	-14.440* (6.89)	-15.658* (6.86)	-22.367** (8.26)
IDV		0.117* (0.05)		
Collectivist			-3.529 (2.99)	
PDI				-0.108 (0.10)
UAI				-0.085 (0.10)
MAS				0.080 (0.09)
PRAG				0.139 (0.10)
IND				0.272 (0.14)
_cons	57.230*** (39.98)	47.823*** (40.20)	57.029*** (39.98)	61.495* (45.07)
N	107	107	107	98
Standard errors are in parentheses				
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001				

  

	(1)	(2)	(3)	(4)
AAR				
Sender endowment	0.687 (0.53)	0.549 (0.54)	0.512 (0.54)	0.531 (0.57)
Receiver endowed	-49.722 (59.58)	-21.161 (62.06)	-8.643 (63.42)	-16.629 (76.33)
Rate of return	26.371* (12.10)	24.632* (12.14)	22.537 (12.26)	22.552 (13.72)
Monitoring	-1.867 (7.36)	-2.027 (7.36)	-0.508 (7.39)	-2.461 (7.87)
Anonymity	-3.829 (16.62)	-4.745 (16.63)	-2.708 (16.63)	4.402 (19.82)
IDV		-0.224 (0.14)		
Collectivist			14.747 (7.80)	
PDI				0.192 (0.27)
UAI				-0.184 (0.25)
MAS				0.136 (0.23)
PRAG				0.091 (0.24)
IND				0.087 (0.37)
_cons	309.364 (373.38)	155.693 (384.88)	75.417 (393.35)	49.922 (478.50)
N	97	97	97	88
Standard errors are in parentheses				
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001				

(a)

(b)

Table 4

[2011] show that they are less likely to donate than other students. Finally, in a meta analysis on dictator games Engel [2011] shows that people in student's age give less than middle age and elderly people. These studies show that culture is a system of knowledge, communication, skills and motives which could be learned, no matter where each individual is located. People could be physically far away from each other but behave similarly.

Looking at methodological differences across experiments clearly I found some positive and negative effects on subjects' cooperative behaviors. Sometimes these effects varies between AFC and ATC which can be explained as follows:

In prisoner's dilemma both single-shot and repeated games, the effect of monitoring have been studied in various methods. Almost all these studies confirm that it has a positive effect on cooperation rate. These results are in line with previous results reported by Matsushima et al. [2013], Aoyagi and Fréchette [2009], Matsushima and Toyama [2011] on the effect of monitoring on ATC. However it seems that it has no effect on AFC which might be because subjects usually adjust their strategies through trials and errors (learning) and they need some time to decide and to understand the consequence of each strategy.

Both of the dependent variables decrease by matching which confirms findings of other studies like two papers by Duffy and Ochs [2009], Yang et al. [2007] where they investigate the effect of matching on cooperation rate in RPDs. In the theory section I showed that players adhere more to cooperation if they have chance to react to a defector immediately in the next round after he deviates. Building up reputation in games with continuous matching, subjects end up with higher total payoff even if their payoffs diminish in first few rounds while being nice to a stranger has no higher payoff for a player. These kinds of games are perceived more as single-shot prisoner's dilemma than repeated games by participants.

Risk, which seems to have the biggest effect size on both dependent variables, was always controversial in studying repeated prisoner's dilemma. For instance, Embrey et al. [2014] relates the effect of risk on the horizon of the game where in short time there is not a significant difference between games with high risk and low risk while in long term the cooperation rate is lower in more risky games. Our results strongly confirmed the negative effect of risk on on both of the dependent variables and clearly the effect is stronger for AFC. It seems that when there is no learning effect and they have no idea with what kind of situation and what kind of opponents they face they avoid cooperation more often.

Time in this study has a positive effect on the dependent variables. Probably that is because in longer time they play more game and get more information about the environment and this makes them to stick to cooperation. According to Fréchette and Yuksel [2013] subjects rely more on TFT as the game becomes longer. Even though playing a few games during a time is different from playing one game continuously during the same time still the effect of learning could be similar.

It is good to mention that this study controls for the effect of all variables

on AFC. As people from the same cultural background might share a common initial strategy and since there is no prejudgment about the opponents before the first round of a game, this study assumes that AFC is a good opportunity to measure the effect of culture on subjects' cooperative behavior in each game.

in the start of the game when there is no prejudgment about the game or no information about the opponents as well as no learning effect on their behavior. However, the results show no such signal.

Unlike other studies anonymity has no significant effect on cooperation. This could be because of the limited number of observations on this variable. There are only in 8 out of 107 experiment subjects are anonymous (see Table1).

## 7 Conclusion

Repeated prisoner's dilemma, which is an extended version of classic single-shot prisoner's dilemma is being used widely by many behavioral scientists to study the evolution of cooperative behavior between individuals. Many experiments based on this game are conducted in different countries and even in different cities in one country. This paper used the data of 107 RPDG to investigate differences and similarities of cooperative behavior of individuals in 12 countries. To be able to use the data driven from from 37 experimental study I used meta-regression analysis at two level of cooperation rates: average first round cooperation and average total cooperation. AFC helps to find out about initial or default strategy of players before they get to learn their opponent strategies and ATC reveals the effect of interaction with others on ones behavior.

First, six national and cultural dimensions measured by Hofstede [1993] are used to control the effect of these variables on cooperative behavior at country level. The findings show no significant difference between countries with high score of individualism and those with low score. Second, these countries were categorized into two Individualistic and collectivistic groups to check if subjects from countries with similar cultural properties reveal similar cooperative behavior or not. Again results show no significant difference between these two groups.

The secondary results of this study suggest that, like some other previous studies, monitoring enhances ATC but has no impact on AFC. Random matching and risk both reduce cooperation rates strongly. Surprisingly Pie-size and temptation as well as horizon of the game (Finite/ Infinite) have no significant effect on subjects' cooperative behavior.

All in all culture as measured by Hofstede has no effect on players cooperative behavior in RPDGs. The result for the measure of Trust from VWS was similar. It is not possible to distinguish between countries with very high level and those with low level of trust at their cooperation level.

## 8 Appendix

### TRUST GAME:

Table 5: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
AAS	53.43	13.04	22	89	107
AAR	104.09	29.26	28	161	97
Sender endowment	8.096	6.50	0.18	44.94	107
Receiver endowed	0.66	0.47	0	1	107
Rate of return	2.92	0.42	2	<b>3</b>	107
Monitoring	0.74	0.44	0	1	107
Anonymity	0.96	0.19	0	1	107

Table 6

<b>COUNTRY</b>	<b>AAS</b>	<b>AAR</b>	<b>PDI</b>	<b>IDV</b>	<b>MAS</b>	<b>UAI</b>	<b>PRAG</b>	<b>IND</b>
Argentina	57	103	49	46	56	86	20	62
Australia	43	95	36	90	61	51	21	71
Austria	62.8	114.2	11	55	79	70	21	71
Bangladesh	46.25	133.75	80	20	55	60	47	20
Brazil	71	90	69	38	49	76	44	59
Bulgaria	56.5	117.5	70	30	40	85	69	16
Canada	59.5	87.25	39	80	52	48	36	68
China	56.2	118	80	20	66	40	61.8	49.2
Colombia	50	118	67	13	64	80	13	83
France	39.66	96.33	68	71	43	86	63	48
Germany	51.30	103.5	35	67	66	65	83	40
Honduras	49	126	80	20	40	50	.	.
India	49	87	77	48	56	40	51	26
Israel	58	135	13	54	47	81	38	.
Italy	41.42	81.14	50	76	70	75	61	30
Japan	69	95	54	46	95	92	88	42
Kenya	38.5	97	64	27	41	52	.	.
Korea/S. Korea f	67	88	60	18	39	85	100	29
Netherlands	52	89.25	38	80	14	53	67	68
New Zealand	49.5	65	22	79	58	49	33	75
Peru	46	111	64	16	42	87	46	.
Russia	50	116	93	39	36	95	81	20
South Africa	47	75	49	65	63	49	34	63
Sweden	63.66	105.33	31	71	5	29	53	78
Switzerland	66	160	34	68	70	58	74	66
Tanzania	54.5	124.5	64	27	41	52	34	38
UK	56	81	35	89	66	35	51	69
USA	59.96	110.23	40	91	62	46	26	68
Vietnam	34	.	70	20	40	30	57	35
Total	53.42	104.09	47.88	63.85	55.93	57.83	48.21	54.32

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