Complementary Institutions and Economic Development: An Experimental Study

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Abstract

This paper considers the problem of why societies develop differently, a question most recently articulated by Acemoglu and Robinson (2012). We follow North (1990) in defining institutions as the "rules of the game in society." The question then becomes why do certain societies develop efficient rules or game forms and others dysfunctional ones? We investigate this question both theoretically and experimentally by examining a specific type of dynamic game (which we call the Institutional Game) in which the outcomes of initial games constrain the strategies available for later games that will be played, thereby introducing complementarities between them. When the same Institutional Game is presented to different cohorts of subjects, they solve the initial games differently leaving themselves, at the end, with different institutional structures.

Key words: Economic Development, Dynamic Games, Institutions

JEL Codes: C72, C91, O12

"Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape interaction" (North 1990, p.3)

1 Introduction

Ever since Adam Smith, one perennial problem for economists is the question of why some economies develop and others do not. Acemoglu, Johnson and Robinson (2005) and Acemoglu and Robinson (2012) list three possible explanations. As they explain, the "geography school" would claim that some economies are blessed with better climates and geographical conditions which makes agriculture and engaging in economic activities easier. A second view is that differences in development are the result of differences in the culture of the agents and the norms and conventions they develop to govern their work and social life (see Weber (1930), Greif (1994), Fernandez (2008, 2012)). Finally, there is the institutional view, of which Acemoglu and Robinson (2012), along with North (1990), North and Thomas (1973), Williamson (1985) and others are the main advocates, which claims that differences in economic development can be best attributed to differences in the institutions that different societies develop. For Acemoglu and Robinson those societies that develop or inherit efficient economic institutions, specifically those that foster strong property rights and proper incentives, prosper while those whose institutions are dysfunctional suffer.

We view economic (and political) institutions as the set of rules (game forms) by which economic (and political) activity is governed. As quoted above, North (1990) states, economic institutions are " the rules of the game in a society or, more formally, are the humanly devised constraints that shape interaction." Using this as our definition, the question then becomes why are some countries playing different games than others and why are some playing good games (i.e., games that lead to efficient outcomes) and others playing bad or dysfunctional games (games whose strategy sets are limited or only contain inferior equilibria)?

For Acemoglu and Robinson (2012), institutions are the end product of social conflict where different groups in society pursue their own selfish interests sometimes at the expense of the greater good. When elites are in power (or where political power is not shared broadly), the groups in control have the ability to seek rents at the expense of the general population and this prevents the proper set of property rights and incentives from being established. Sometimes these elites are the remnants of previous colonial experiences and sometimes they emerge on their own, but the set of institutions existing today is an outcome of this dynamic political economy exercise.

We agree that institutions often arise in this way, but take a more general approach following Schotter (1981) who looks at the emergence of social institutions. In that analysis, the set of institutions we have today is the result of decisions made in the past to solve a set of problems that all societies face. The solutions to these common problems determine the institutional structure of the economy today, an object we call the " Final Game." For example, all societies as they evolve must, at some point, decide on a legal system (common or civil), (see Glaeser and Shliefer 2002, LaPorta et al. (1998)), a banking system, a religion (Judaism, Christianity, Islam, Hinduism, etc.), a political system (monarchy, parliamentary democracy, etc.), a set of inheritance laws (primogeniture or ultimogeniture), a system of property rights (common or private), etc. We will call these problems, which in our analysis are themselves games, the "Formative Games." In total, the Formative Games and Final Game constitute a dynamic game we call the Institutional Game.

The interesting point, and focus of this paper, is that the solutions chosen to solve one of these problems places constraints on the strategies the society has when facing other problems. For example, say that a society decides to adhere to Islam. This is their solution to the religion problem. This solution, however, has implications for the type of banking system they can then employ since, under Islam, interest is not allowed and a whole set of rules become relevant when conducting Islamic banking (see Kuran (2011).[1]

A further example may be the choice of legal systems which, as LaPorta et al. (1998) have demonstrated, may have significant consequences for the way debtors and lenders and property rights are protected. Here, how a society decides on the legal system places constraints on the way stockholders are protected under bankruptcy and hence alters the strategies available to agents in other financial games they play. In other words, the existence of a solution to one societal formative problem creates constraints on the strategies available when trying to solve others. It is these complementarities and externalities that we are interested in here.

The key point of our paper is that when all of the development problems (the Formative Games) to be faced by society have been solved, different societies are left with a set of institutions (the Final Game) that may differ across societies due to different solutions to the Formative Games. In other words, the strategy sets available to some economies may be very different than others basically because they chose different solutions to the same set of Formative Games they faced. If we could rewind time and have these same societies face the same problems once again, it may very well be that they would have solved these problems differently and hence have a different set of institutions (a different Final Game) today. Alternatively, looking across societies we claim that the different institutional structures existing today are the result of different play paths through the same set of Formative Games.

The results of our experiments tend to support these assertions. What we demonstrate is that for a given set of Formative Games our subjects choose sufficiently different solutions so as to lead to a variety of different Final Games or institutional structures, many of which are inefficient. In addition, those subjects facing a relatively easy set of games to play (i.e. games in which it is not too difficult to determine an efficient Final Game) do tend to suceed more than those subjects facing more difficult institutional problems. Finally, we also offer evidence that as the discount factor induced on our subjects decreases, i.e. as they become more impatient, they tend to choose more myopically and, as a result, determine less efficient Final Games.

One motivating example for Acemoglu and Robinson (2012) is the case of Nogales, Mexico and Nogales, Arizona. Here they point out that you have two adjoining cities with the same basic population, climate, and culture but one is relatively prosperous and one relatively poor. From our perspective, and that of Acemoglu and Robinson

[1] Obviously, religion plays an important role in the cultural theories of economic development as Weber (1930) describes.

(2012), what differs is the set of institutions they are both functioning under, the Final Game that they are playing. Our point here is that the Final Game being played is a function of how these two different societies decided to solve the Formative Games they faced. The problem is complicated because the solution to one problem creates an externality or places constraints on the Final Game that the society plays.

It could also be that the solution to one Formative Game places constraints not only on the strategy set of the Final Game but also of other Formative Games. As we said above, the choice of Islam, a solution to one Formative Game, may affect how the banking game, another Formative Game, is played. In this paper, for simplicity, we will focus only on the impact of choices in Formative Games on the strategy sets of Final Games. Our contribution is to cast this institutional problem in a game theoretic framework, the Institutional Game, and in the process, stress the complementarities that exist between the Formative and Final Games.

Finally it is important to note that we consider this paper to be in the form of what Charles Plott (1987) called a "demonstration experiment." What we mean by that term here is that the purpose of our experiment is to demonstrate how the phenomenon we consider, the complementary nature of economic institutions and their path dependency, could occur in a laboratory environment and, by inference, in the real world. Such an experiment differs from what one may call theory testing or theory comparison experiments where the focus is on testing either the point predictions or the comparative statics of economic models. While our experiment is theory driven in the sense that we have an underlying model that does predict behavior, the focus of our attention is strictly on the variance of outcomes that occur when our institutional games are played and how this variance resonates in the real world when we observe institutional differences across nations.

In this paper, we will proceed as follows. In Section 2 we will describe the underlying dynamic game that forms the basis for our experiments and captures the institutional problem described above. In Section 3 we will describe our experimental design and in Section 4 we present our results. Finally, in Section 5 we offer some conclusions.

2 The Institutional Game

We define an Institutional Game as follows. Consider a set of N games indexed $t = 1, 2, 3, ..., N$ to be played sequentially by I players. The first N-1 games will be called the Formative Games while the N^{th} game will be called the Final Game and will differ in the sense that its strategy sets will be a function of the strategies chosen by the players in the Formative Games.

More precisely, each of the Formative Games is represented by its normal form $\Gamma^t[(S_i^t, o_i^t(s^t))_{i=1}^I]$ where S_i^t are the strategy sets and $o_i^t(s^t)$ are the outcome functions defining the payoffs that result for any strategy $s^t = s_1^t \times s_2^t \times \cdots \times s_I^t$ in game t for each player i.

Let Φ be the set of all histories of play by the players over the $N-1$ Formative Games. In particular, $\Phi = S^1 \times S^2 \times \cdots \times S^{N-1}$ where $S^t = S_1^t \times S_2^t \times \cdots \times S_I^t$ for each t. The Final Game Γ^N can be represented in normal form as $\Gamma^N[(S_i^N(\phi), o_i^N(s^N))_{i=1}^I]$ where $S_i^N(\phi)$ are the strategy sets that are a function of the history $\phi \in \Phi$ and $o_i^N(s^N)$

are the outcome functions defining the payoffs that result for any strategy chosen in game N for each player i.

Finally, payoffs over these games are discounted by a discount rate δ so that when a player at time t looks ahead at the remaining games he is discounting the payoffs he anticipates. In some cases, it may make sense to interpret our game as being played over time by different generations of players with each player i being a generation who plays one of the N games. Under this interpretation δ measures the amount by which a generation cares about its descendants.

As a clarifying example and to explain notation for the Institutional Games in the experiment, consider the following four games which represent the $I = 2$ and $N = 4$ Institutional Game played by our subjects in Treatment 1 of our experiment.

Table 1: Institutional Game Example

Formative Games

Formative Game 1 Trust Game		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Formative Game 2 Prisoner's Dilemma		
	C_1	C_2
R_1	43, 43 (-A)	9, 60
R_2	60, 9	17, 17

Formative Game 3 Coordination Game		
	C_1	C_2
R_1	34, 34	4, 4
R_2	4, 4	26, 26 (-C)

Initial Final Game

	A	B	C	D
A	34, 34	9, 51	129, 9	21, 17
B	51, 9	94, 94	17, 64	30, 30
C	9, 129	64, 17	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Here we see a set of four games with the first three constituting the Formative Games and a larger game, the Initial Final Game, whose explanation will be made clear shortly. These games are played sequentially starting with Formative Game 1 and the outcomes of all past games are observable. Note that in the Formative Games the outcomes listed in some of the cells of the matrix contain both a payoff (the numbers incorporate the discount factor) and a "consequence" for the Initial Final Game in the sense that if that cell is the outcome then a designated strategy of the Final Game will be eliminated. For example, in Formative Game 1, if Player 1 chooses R_1 and Player 2 chooses C_1, then each player gets a payoff of 17 but, in addition, strategy B will be eliminated from the strategy set of each player in the Initial Final Game. This is the sense in which institutions are complementary since the choice of one solution (outcome) in Formative Game 1 both determines an immediate payoff and a consequence for the Final Game to be played by society.

Looking ahead, in Games 2 and 3, we see that there are additional possibilities for other strategies to be eliminated from the Initial Final Game, namely strategies A and C. In some of these games there is a trade-off that exists between the myopic immediate payoff of players and its consequences for life in the Final Game. If players opt for immediate payoffs at the expense of the Final Game they play at the end, they can determine an inefficient Final Game which will lead to suboptimal outcomes.

As any combination of strategies A, B, and C can be eliminated during play of the three Formative Games, the Final Game that can result from the play of the Formative Games can be any of the following 8 games which constitute the set of potential Final Games.

Table 2: Potential Final Games

Initial Final Game				
	A	B	C	D
A	34, 34	9, 51	129, 9	21, 17
B	51, 9	94, 94	17, 64	30, 30
C	9, 129	64, 17	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Eliminate C			
	A	B	D
A	34, 34	9, 51	21, 17
B	51, 9	94, 94	30, 30
D	17, 21	30, 30	26, 26

Eliminate B			
	A	C	D
A	34, 34	129, 9	21, 17
C	9, 129	13, 13	34, 9
D	17, 21	9, 34	26, 26

Eliminate A			
	B	C	D
B	94, 94	17, 64	30, 30
C	64, 17	13, 13	34, 9
D	30, 30	9, 34	26, 26

Eliminate B,C		
	A	D
A	34, 34	21, 17
D	17, 21	26, 26

Eliminate A, C		
	B	D
B	94, 94	30, 30
D	30, 30	26, 26

Eliminate A, B		
	C	D
C	13, 13	34, 9
D	9, 34	26, 26

Eliminate A, B, C	
	D
D	26, 26

There may be a number of ways that one could view the Final Game that is selected from this potential set. Most narrowly it might be considered a one-shot Final Game which defines the institutional structure of the society. Alternatively, we might consider the Formative Games as those played historically which determine a Final Game that will be played over an infinite number of generations to come. In this interpretation, the Formative Games determine the institutional fabric of society by constraining the strategies available to future generations as North would argue. We will focus a good deal of attention on the Final Games determined in our experiment, and interpret them as the inherited institutional structure for our laboratory society. An alternative model would allow the Final Game to be played infinitely among those future generations who have inherited the game. We will consider our static Final Game to be a reduced form for this infinite horizon game, summarizing these future interactions in the one-shot play of the Final Game.

3 Experimental Design

3.1 Treatments

The experiment we performed was designed to highlight the Institutional Game outlined above. A total of 334 subjects were recruited from the general undergraduate population of New York University using the computerized recruitment program of the Center for Experimental Economics at NYU. The experiment lasted a total of 45 minutes and subjects earned, on average, \$19.60. The experiment was run using z-tree (Fischbacher (2007)). The payoffs were denominated in experimental dollars and converted to \$US at the rate of 10:1 in Treatments 1, 2, 5, and 6; 4:1 in Treatment 3; and 3:1 in Treatment 4.

Groups of subjects were recruited to play a single $I = 2$ and $N = 4$ Institutional Game like that in the example of the previous section. In the experiment, subjects started by choosing strategies in Formative Game 1 and then proceeded to Formative Games 2, 3, and finally to their determined Final Game and the outcome of each game was announced as it was completed. Subjects were paid the sum of their earnings over the four games.

We emphasize that the subjects only played the Institutional Game presented to them once. This is because societies just get one chance to develop so the same should be true for our subjects. Since subjects played the game only once, we provided them with a tool to help their understanding of the trade-offs they faced. The tool allowed subjects, for each outcome in a Formative Game, to see all the possible Final Games that could be reached if that outcome occurred. Subjects viewed these Final Games by pressing a button associated with that outcome. For example, using the game from the last section, if they pressed the button for cell (R_1,C_1) in Formative Game 1, they would see the four potential Final Games in which B is eliminated.

As an overview, there were six different Institutional Games. There were two baseline games (Treatments 1 and 2) that both consist of the same three Formative Games; a Trust Game, then a Prisoner's Dilemma Game, and then a Coordination Game. The baselines differed in their Final Games, which we call the Easy and Hard Final Game for reasons to be clear momentarily. From the baseline with the Easy Final Game we lowered the discount factor from 1 to $\delta = .66$ (Treatment 3) and then further to $\delta = .45$ (Treatment 4). Finally, from both baselines we reversed the order in which the three Formative Games were played (Treatments 5 and 6).

This yields the experimental design depicted in Table 3:

Table 3: Experimental Design

Treatment		Final Game	δ	Order	# of Subjects (Pairs)
1.	Easy Final Game Baseline	Easy	1	Original	60 (30)
2.	Hard Final Game Baseline	Hard	1	Original	58 (29)
3.	Easy Final Game Med. Discount Factor	Easy	0.66	Original	60 (30)
4.	Easy Final Game Low Discount Factor	Easy	0.45	Original	50 (25)
5.	Easy Final Game Reverse Order	Easy	1	Reverse	56 (28)
6.	Hard Final Game Reverse Order	Hard	1	Reverse	50 (25)

To be more precise about our treatments, consider the Institutional Games presented in Tables 4 and 5,each consisting of three Formative Games and the entire set of potential Final Games that could result from some play path of the three Formative Games. Table 4, which combines Tables 1 and 2, provides the games for Treatment 1 (Easy Final Game Baseline) and Table 5 for Treatment 2 (Hard Final Game Baseline). An * denotes the Pareto best equilibrium outcome in each potential Final Game.[2]

We call the Final Game in Table 4 the Easy Final Game since all the players need to do in order to determine a Final Game with an efficient equilibrium (i.e. an equilibrium with a payoff of 94 for each player), is to be sure not to eliminate strategy B in Formative Game 1. As long as this is true, then no matter what other strategies are eliminated, when the Final Game is reached, the (94,94) equilibrium will still exist (This can be easily seen by looking at all of the potential Final Games and checking). Note, however, that if B is eliminated, then no equilibrium to the resulting Final Game yields a payoff greater than 34 for each player.

The Final Game in Table 5 we call the Hard Final Game. Note that Formative Games are identical. The difference from Table 4 is that the Initial Final Game, and consequently the other potential Final Games, has several cells whose payoffs differ. The relatively few changes in the Final Game however make it harder to attain the efficient (94,94) payoff pair as an equilibrium. It is only an equilibrium of the potential Final Game with strategies B and D, so in addition to not eliminating strategy B in Formative Game 1, strategies A and C must be eliminated in subsequent games. In other words, what we call the Hard Game is difficult because not only must the players trust in the first game (the Trust Game), but they then must cooperate in the second game (the Prisoner's Dilemma) instead of using their dominant strategy of defection and coordinate in the third game (the Coordination Game) instead of choosing the Pareto dominant outcome. All of these things are necessary in order to determine a Final Game with a (94,94) equilibrium payoff vector which will compensate the players for their sacrifices along the way. This may not be easy.

[2]Most of the Final Games have a unique equilibrium but a few have Pareto ranked equilibria. None have multiple Pareto best equilibria.

Table 4: Treatment 1 - Easy Final Game Baseline

Formative Games

Formative Game 1		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Formative Game 2		
	C_1	C_2
R_1	43, 43 (-A)	9, 60
R_2	60, 9	17, 17

Formative Game 3		
	C_1	C_2
R_1	34, 34	4, 4
R_2	4, 4	26, 26 (-C)

Potential Final Games

Initial Final Game				
	A	B	C	D
A	34, 34	9, 51	129, 9	21, 17
B	51, 9	94, 94*	17, 64	30, 30
C	9, 129	64, 17	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Eliminate C			
	A	B	D
A	34, 34	9, 51	21, 17
B	51, 9	94, 94*	30, 30
D	17, 21	30, 30	26, 26

Eliminate B			
	A	C	D
A	34, 34*	129, 9	21, 17
C	9, 129	13, 13	34, 9
D	17, 21	9, 34	26, 26

Eliminate A			
	B	C	D
B	94, 94*	17, 64	30, 30
C	64, 17	13, 13	34, 9
D	30, 30	9, 34	26, 26

Eliminate B,C		
	A	D
A	34, 34*	21, 17
D	17, 21	26, 26

Eliminate A, C		
	B	D
B	94, 94*	30, 30
D	30, 30	26, 26

Eliminate A, B		
	C	D
C	13, 13*	34, 9
D	9, 34	26, 26

Eliminate A, B, C	
	D
D	26, 26*

* indicates Pareto best equilibrium of each potential Final Game

Table 5: Treatment 2 - Hard Final Game Baseline

Formative Games

Formative Game 1		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Formative Game 2		
	C_1	C_2
R_1	43, 43 (-A)	9, 60
R_2	60, 9	17, 17

Formative Game 3		
	C_1	C_2
R_1	34, 34	4, 4
R_2	4, 4	26, 26 (-C)

Potential Final Games

Initial Final Game				
	A	B	C	D
A	34, 34*	111, 13	9, 9	21, 17
B	13, 111	94, 94	9, 129	30, 30
C	9, 9	129, 9	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Eliminate C			
	A	B	D
A	34, 34*	111, 13	21, 17
B	13, 111	94, 94	30, 30
D	17, 21	30, 30	26, 26

Eliminate B			
	A	C	D
A	34, 34*	9, 9	21, 17
C	9, 9	13, 13	34, 9
D	17, 21	9, 34	26, 26

Eliminate A			
	B	C	D
B	94, 94	9, 129	30, 30
C	129, 9	13, 13*	34, 9
D	30, 30	9, 34	26, 26

Eliminate B,C		
	A	D
A	34, 34*	21, 17
D	17, 21	26, 26

Eliminate A, C		
	B	D
B	94, 94*	30, 30
D	30, 30	26, 26

Eliminate A, B		
	C	D
C	13, 13*	34, 9
D	9, 34	26, 26

Eliminate A, B, C	
	D
D	26, 26*

* indicates Pareto best equilibrium of each potential Final Game

These two games will furnish dual baselines away from which we will make ceteris paribus changes. The treatments that we use are intended to mimic reasons why we think it may be hard for some societies to attain the efficient Final Game outcome. For example, assume that early in the history of one society the players are short-sighted. This will make them have a lower discount factor. Treatments 3 (Easy Final Game, Medium Discount Factor) and 4 (Easy Final Game, Low Discount Factor) do just this by lowering the discount factor to 0.66 and 0.45. This amounts to multiplying the payoffs for Formative Game 2 by 0.66 and 0.45, for Formative Game 3 by 0.66^2 and 0.45^2, and for all potential Final Games by 0.66^3 and 0.45^3 respectively for these two treatments. The payoffs obtained from these calculations are presented in Tables 6 and 7 in the appendix. No such treatments were run with the Hard Final Game as results suggested it was indeed very hard so that efficiency was rarely attainable even for $\delta = 1$ and thus lowering the discount factor was unlikely to result in any difference in play.

A second reason why some societies may navigate their Formative Games better than others and have better final institutions as a result, is that they play the Formative Games in a different order. For example, some societies may, for historical reasons, choose a religion before choosing a legal system which may have consequences for the type of legal system chosen and for the strategies available in the Final Game. To capture this feature we reversed the order of the Formative Games from the baselines for Treatments 5 (Easy Final Game, Reverse Order) and 6 (Hard Final Game, Reverse Order). These sets of games are presented in Table 8 and 9 in the appendix.

Finally note that a great deal of our welfare analysis will focus on the Final Games determined by our subjects. We do this because we interpret the Final Game as representing the institutional structure governing society today and into the foreseeable future. While our subjects clearly care about their own total four-game payoff (which we will discuss) much of what we care about as analysts are the Final Games determined and the payoffs reached in them.

3.2 Theoretical Predictions

In this section we provide a more rigorous analysis of the equilibria for our six treatments and provide hypotheses based on them. We employ the standard definition for equilibria in dynamic games, subgame perfection, which in the context of games with finite horizon can be obtained through backwards induction. However, because our stage games do not all have unique equilibria, there are multiple subgame perfect equilibria. To obtain a unique prediction, we impose one more restriction. As the game is solved backwards, at each node a Pareto best (for payoffs of the entire continuation game) equilibrium is selected if multiple equilibria exist. The Pareto best selection is unique for the games in our treatments, so this provides a unique prediction for the whole dynamic game. We call this equilibrium the "Preferred Equilibrium" since, as we will make clear, it has properties which we think make it preferable to others. In addition, it is this equilibrium which we think provides subjects with their best chance of achieving an efficient outcome in the four-game problem they face and in determining an efficient Final Game. The Preferred Equilibrium of each treatment is outlined in Table 10.

Table 10: Theoretical Predictions

Treatment	Play Path	Final Game Strategies	Final Game Outcome	Payoffs
1	(R_2,C_1) (R_2,C_2) (R_1,C_1)	{A, B, C, D}	(B,B)	(149, 184)
2	(R_2,C_1) (R_1,C_1) (R_2,C_2)	{B, D}	(B,B)	(167, 202)
3	(R_2,C_1) (R_2,C_2) (R_1,C_1)	{A, B, C, D}	(B,B)	(57, 93)
4	(R_1,C_1) (R_2,C_2) (R_1,C_1)	{A,C,D}	(A,A)	(35, 35)
5	(R_1,C_1) (R_2,C_2) (R_2,C_1)	{A, B, C, D}	(B,B)	(149, 184)
6	(R_2,C_2) (R_1,C_1) (R_2,C_1)	{B, D}	(B,B)	(167, 202)

As we can see, in the Easy Game baseline as well as with the Medium discount factor (Treatments 1 and 3) the equilibrium play path predicted is (R_2,C_1) in Game 1, (R_2,C_2) in Formative Game 2 and (R_1,C_1) in Game 3 leading to a Final Game that contains all available strategies for both players (A, B, C, and D) for which (B,B) is chosen. Note that this implies that in the initial Trust Game while player 1 trusts player 2, the trust is not reciprocated. Player 1 trusts in order to keep (B,B) available in the Final Game which offsets the lost payoff of 13 (4 instead of 17) in Formative Game 1. Players cannot cooperate in Formative Game 2, because there is no incentive to deter a deviation as eliminating A does not change the equilibrium of the Final Game. Finally, players coordinate on the Pareto best equilibrium in Game 3, because eliminating C does not change the equilibrium of the Final Game so they might as well get a larger payoff in Game 3.

The Easy Game with the Low discount factor (Treatment 4) has a different equilibrium play path since in Formative Game 1 it is now an equilibrium action for the Row player to eliminate B by choosing R_1. Hence we have in Formative Game 1 (R_1,C_1) while in the remaining games we get the same equilibrium actions, i.e., (R_2,C_2) in Formative Game 2 and (R_1,C_1) in Game 3 leading to an equilibrium Final Game with strategies A, C, and D and an equilibrium in the Final Game of (A,A).

The Easy Game with Reverse Order (Treatment 5) turns out to be strategically equivalent to the baseline in that the outcome of each game is the same. Of course, because the order of Formative Games is reversed, the Play Path of Formative Games is also reversed.

In the Hard Game baseline (Treatment 2) the equilibrium play path predicted is (R_2,C_1) in Formative Game 1, (R_1,C_1) in Formative Game 2 and (R_2,C_2) in Game 3 leading to a Final Game that contains only two strategies (B and D) for which (B,B) is chosen. This path is more complicated, because this is the unique potential Final Game for which (B,B) is an equilibrium. The play in the Trust Game is the same as for the Easy Game for the same reason as above. However, play in Games 2 and 3 is different. In the Prisoner's Dilemma of Formative Game 2, players cooperate because a deviation would fail to eliminate A and thus leads to a Final Game where (B,B) is not an equilibrium which offsets the gain of the deviation. In the coordination problem of Game 3, players coordinate on the Pareto inferior equilibrium again because taking the larger payoff in Game 3 fails to eliminate C and thus leads to a smaller overall payoff.

Just as with the Easy Game, in the Hard Game with Reverse Order the equilibrium is strategically equivalent to the Hard Game baseline. Again, because the order of Formative Games is reversed, the Play Path is also reversed.

In addition to the Preferred Equilibrium described above there are other subgame perfect equilibria to both the Easy and Hard Games, a few of which are worth mentioning.

While the payoff in our equilibrium is on the Pareto frontier for the Hard Game treatments, it is not for the Easy Game treatments because both players could improve by choosing (R_1,C_1) in Formative Game 2 (cooperating in the Prisoner's Dilemma). Is there any equilibrium that delivers this payoff? The answer is actually yes, but for the Easy Game baseline only. Cooperation is supportable in Formative Game 2 if the equilibrium stipulates coordination on the good payoff in Game 3, (R_1,C_1) in Game 3 if (R_1,C_1) occurs in Formative Game 2, but punishes a deviation by using the mixed strategy equilibrium in Game 3 if (R_1,C_2) or (R_2,C_1) occurs in Formative Game 2. In this case, deviating in the Prisoner's Dilemma yields a gain of 17 (60 instead of 43), but this is punished by the mixed strategy equilibrium in Game 3 (which is Pareto inferior and thus ruled out by our criterion). The resulting loss in Game 3 of 17.3 (16.7 instead of 34) is sufficient to deter the deviation. However, for Treatments 3 and 4 this resulting loss is discounted and less than 17 and thus insufficient to deter deviation.

This is the only Pareto dominating possibility in any of treatments, but if one is interested in the sum of payoffs then it would be useful to know if supporting (R_2,C_2) in Formative Game 1 (reciprocating trust) as an equilibrium is possible. This is only possible in the Hard Game baseline. There are equilibria in which (94,94) is not achieved for the Hard Game, and using one of these as a threat can deter the Column player from not reciprocating trust.

In any case, we don't find these equilibria plausible for many reasons. First, since subjects only play the game once, it would be difficult to expect players to be able to coordinate on a threat for a game yet to be played. Second, this equilibrium is not renegotiation proof and requires the subjects to believe they will carry out threats and play Pareto inferior equilibria. Finally, for the case of the Pareto dominating equilibrium in the Easy Game, the punishment is only marginally strong enough to support cooperation.[3]

For these reasons, we will let our predictions of behavior in our experiment be guided by the unique subgame perfect Preferred Equilibrium discussed above. However, even if we observe other equilibrium outcomes they will share certain properties with ours. For example, in the Easy Games, other than with the Low Discount Factor, there does not

[3] In fact there were no subjects who's choices matched the predictions of either of these two equilibria.

exist any subgame perfect equilibrium where strategy B is eliminated. Hence, if we ever see strategy B eliminated we can immediately know that such an outcome was not the product of equilibrium behavior. In the Hard Games things are more complicated. Still we know that in any efficient equilibrium the subjects reach the Final Game with just strategies B and D as it is the only one in which (B,B) is attainable. However, unlike Easy Games, and as mentioned in the discussion on other equilibria above, there are inefficient equilibria for Hard Games where the Final Games that are determined lack the (B,B) equilibrium and where the four-game payoffs are below the Pareto frontier. As a result, we see that what we call Hard Games are Hard for several reasons. One, as stated before, they are called Hard because they require several preconditions for determining an efficient Final Game. Second, Hard Games permit inefficient subgame perfect equilibria.

It is important to point out that we do not consider this paper a test of our Preferred or any other equilibrium concept. These equilibria are discussed to give the reader some guidance in organizing his or her thinking as to what is possible to occur in the experiment. Deviations from these predictions are not only expected but are welcomed since the point of our paper is to demonstrate that different institutional arrangements (Final Games) are capable of emerging from the same set of Formative Games given to different pairs of subjects. In fact, if all pairs played the same subgame perfect equilibrium, our results would lack the diversity we seek.

3.3 Research Questions

We now present six research questions that we will investigate in our Results section below. These questions arise both from the predictions of the theory underlying the experiments and from our focus on institutional matters. For example, as stated above, one of our aims in this paper is to demonstrate that different laboratory societies (pairs of subjects) when playing an identical set of Formative Games are capable of determining widely different institutional structures as defined by the Final Game they determine. While theory would indicate a unique play path through these Formative Games and hence a unique Final Game for all subject pairs, we expect a wider diversity of behavior. Hence we ask:

Question 1: In our dual baseline treatments (Treatments 1 and 2), do our subjects determine efficient Final Games and do subjects obtain the efficient (B,B) outcome?

Question 2: In our dual baseline treatments, do subjects achieve high welfare levels?

While Questions 1 and 2 represent the central focus of our paper, Questions 3 - 5 look at a number of comparative static questions that arise from our treatments. These questions are important since they add to our explanation of why certain societies are successful in defining efficient Final Games for their progeny to play and why others fail.

Question 3: Are more efficient Final Games and outcomes obtained in the Easy Game baseline than in the Hard Game baseline?

Question 4: Does lowering the discount factor lead to fewer efficient Final Games?

Question 5: Does changing the order of Formative Games affect the Final Games achieved by our subjects?

Finally, let us add the fact that there may be behavioral reasons why choices could differ from the predictions of the equilibria defined above. For example, in our game subjects first play a Trust Game, then a Prisoners' Dilemma game, and finally a Coordination Game. It is very possible that behavior in an earlier game may influence later games for behavioral and non-equilibrium reasons. For example, if subjects prove themselves not trustworthy in Formative Game 1 this may set off a set of beliefs and negative reciprocity that could trigger deviations from the equilibrium path. Such behavior is consistent with subjects who have interdependent utility functions (see Fehr and Schmidt (1999) and Bolton Ockenfels (2000) or who follow intentions-based theories like those of Rabin (1993) and Falk et al. (1997) where non-equilibrium punishments are exacted. This leads us to pose one final question.

Question 6: To what extent do behavioral effects account for the choices of our subjects?

4 Results

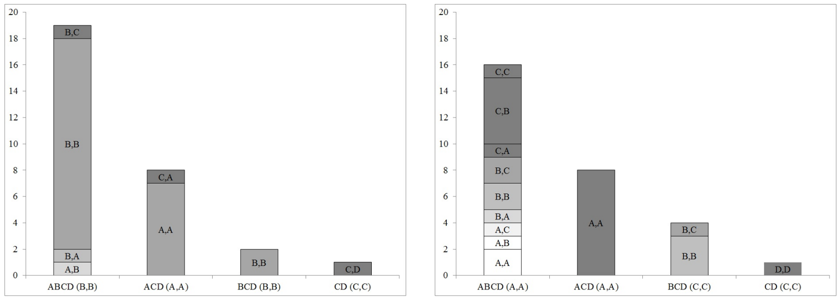
We will present our results by answering the questions posed above and discuss their implications as we move along.

4.1 Question 1: In our dual baseline treatments (Treatments 1 and 2), do our subjects determine efficient Final Games and do subjects obtain the efficient (B,B) outcome?

As we know from our discussion above, if subjects adhered to our Preferred Equilibrium we would expect that in the Easy Game baseline (Treatment 1) experiment we would observe only the Final Game with all strategies (A, B, C, and D) while in the Hard Game baseline (Treatment 2) experiment, we expect to observe only the Final Game with the strategies B and D.

For our purposes here, however, we are not concerned with testing our equilibrium predictions as much as simply observing what Final Games are defined for a given set of Formative Games and which strategies are chosen in those Final Games. To this end we present Figure 1 which displays the frequency distributions of the Final Games determined by our subject pairs in Treatments 1 and 2 (Letters in parentheses denote the equilibrium of the associated game.)

Looking at Figure 1(a), which focuses on the Easy Game baseline, two things are apparent. First, there is a variety of Final Games determined rather than just the Final Game with all strategies available as is predicted by our Preferred Equilibrium. In fact, only 63% of pairs reached this Final Game. However, in the Easy Game, any Final Game that contains the B strategy is efficient since the outcome (B,B) is an equilibrium as long as B is available. Hence, if we add in the 7% of pairs that reached the Final Game with strategies B, C, and D we see that 70% of pairs reached an efficient Final Game.



(a) Treatment 1

(b) Treatment 2

Figure 1: Final Games for Baseline Treatments

Second, 86% of pairs that achieved an efficient Final Game did indeed end up with the efficient (B,B) outcome. However, taking all pairs into consideration, in total only 60% of them achieved the (B,B) outcome.

Now let's move on to Figure 1(b) which focuses on the Hard Game baseline. Again there is a variety of Final Games determined and, for the Hard Game baseline, 0% of subjects reached the Final Game predicted by our Preferred Equilibrium. As this Final Game is the unique efficient Final Game in this treatment it is therefore the case that no pairs achieved an efficient Final Game. Clearly, the Hard Game was indeed hard.

Considering outcomes in the Final Game, since no pairs achieved the efficient Final Game in Treatment 2, we can not analyze behavior conditional on reaching it. However, unlike Treatment 1, the (B,B) outcome is available in Final Games that themselves are not efficient since, while available, (B,B) is not an equilibrium. For such games, only 25% of outcomes were indeed (B,B). Clearly, the availability of the efficient (B,B) outcome in a Final Game is not sufficient for it to be determined. In total, only 17% of all pairs were able to achieve the (B,B) outcome in this treatment.

Additionally, outcomes in the Final Game were extremely diverse. The 29 pairs determined 10 different outcomes. The only Final Game in which subjects played totally consistently was the game with strategies A, C, and D in which the equilibrium of that game, (A,A), was always selected.

Despite being somewhat outside the realm of our initial question, we also want to know how these Final Games were determined, i.e., did our subjects play along the Preferred Equilibrium play path? The answer to that question is a resounding no. Only 3 pairs played the predicted path for Treatment 1 and 0 pairs played the predicted path for Treatment 2.[4] There is much diversity in Formative Game play. Table 11 presents the distribution of outcomes for each of the three Formative Games. Note that the Preferred Equilibrium prediction for each row is a 1, for the predicted choice, and three zeros, for the other choices (The table denotes with an * the outcomes predicted along the equilibrium path of the game).

[4] Note that it is possible to determine a full Final Game in Treatment 1 including strategies A,B,C,and D yet not play along the equilibrium play path since any play that does not eliminate strategies will do. For example, if the subjects play (R_2, C_2) in Formative Game 1, strategy B will not be eliminated yet this is not the predicted outcome for this game.

Table 11: Play Path Outcomes

Formative Game	(R_1,C_1)	(R_1,C_2)	(R_2,C_1)	(R_2,C_2)
Treatment 1: Easy Game baseline				
1	.2	.1	.33*	.37
2	.1	.23	.3	.37*
3	.83*	.1	.07	.00
Treatment 2: Hard Game baseline				
1	.17	.14	.24*	.45
2	.17*	.24	.28	.31
3	.59	.31	.10	.00*
* indicates equilibrium outcome				

Clearly, there is a far greater variance in behavior than predicted by the equilibrium theory. While in some Formative Games our subjects did indeed make choices along the equilibrium play path of the game, in others they did not. Note that even in Treatment 1, where the Final Game is Easy, only 33% of pairs play the Preferred Equilibrium (R_2,C_1) in Formative Game 1. However, as long as the Row player does not play R_1 in Formative Game 1, strategy B will not be eliminated and the Final Game will be efficient. Since an additional 37% of pairs chose (R_2,C_2), as we have noted before, our subjects determined an efficient Final Game 70% of the time.

For Treatment 2, only 24% of pairs play the Preferred Equilibrium in Formative Game 1. However, 69% of pairs did not eliminate B, leaving the possibility open for an efficient Final Game to be determined in Formative Games 2 and 3 if subjects chose (R_1,C_1) and (R_2,C_2) respectively. Unfortunately this occurred only 17% and 0% of the time respectively. In words, navigating Formative Game 2 to get to the efficient Final Game was incredibly difficult for pairs and navigating Formative Game 3 even harder.[5]

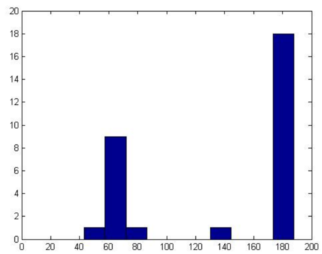
In summary, our results support the notion that we have institutional diversity because different groups of people or societies play their Formative Games differently and hence determine different institutional structures as characterized by the Final Game they define. While some groups of subjects can solve the Formative Games and create an institutional structure (Final Game) that supports efficient behavior, others do not respond to the trade-offs they face intelligently, or perhaps do so myopically, and, as a result, determine a dysfunctional Final Game. In this sense the institutions we live under are determined by the way our ancestors played their Formative games.

4.2 Question 2: In our dual baseline treatments, do subjects achieve high welfare levels?

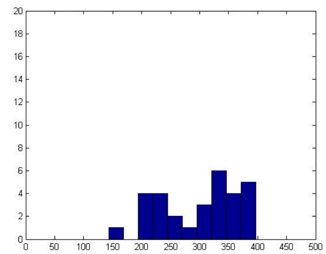
While diversity of play and Final Games indicate that we can expect a wide diversity of institutional arrangements across societies, this diversity would be of little consequence if it did not affect the payoffs of our subjects.

Here, we look at the payoffs achieved by our two-person societies, the sum of the 2 players' payoffs. Table 12 presents average subject pair payoffs in the Final Game

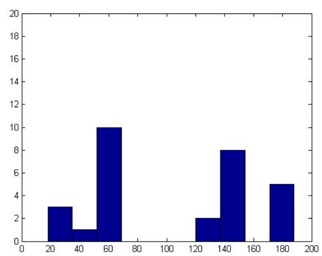
[5] If B is eliminated, the equilibrium prediction for the resulting subgame is not (R_1, C_1) in Formative Game 2, so it might be more appropriate to only consider the pairs that do not eliminate B for this point of difficult navigation. However, doing so only increase the proportion of (R_1, C_1) in Formative Game 2 to .2.



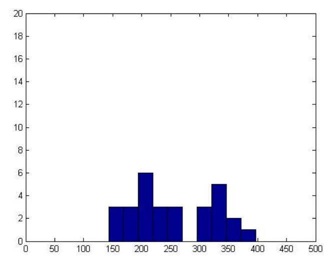
(a) Treatment 1: Final Game



(b) Treatment 1: Total



(c) Treatment 2: Final Game



(d) Treatment 2: Total

Figure 2: Welfare Histograms for Final Game and Total

and for the sum of all four games while Figure 2 shows histograms to illustrate the distributions.

Table 12: Welfare

Treatment	Eq. Payoffs Final Game	Avg. Payoffs Final Game (s.d.)	Eq. Payoffs Total	Avg. Payoffs Total (s.d.)
1	188	141.40 (59.71)	333	301.97 (70.57)
2	188	106.41 (54.02)	369	256.24 (73.14)
Standard deviations in parentheses				

Consider Treatment 1 first. For the Final Game, the average payoff is 141.40 and this is significantly less than the Preferred Equilibrium prediction of 188 (t-test, $p < .001$). The distribution of payoffs in Figure 2 is clearly bimodal, with most pairs either achieving (A,A) and receiving a payoff of 68 or the efficient outcome (B,B) where they get the 188. The average payoff over all four games is 301.97 which also is significantly less than the Preferred Equilibrium prediction of 333 (t-test, $p = .0226$).

For Treatment 2, the averages are also lower than predicted. For the Final Game the average payoff is 106.41 and over all four games it is 256.24. Both are significantly less than the Preferred Equilibrium prediction (t-test, $p < .001$ for both). In contrast to Treatment 1, the distribution of payoffs in the Final Game is not bimodal, with payoffs being more diverse.

While it is clear that subjects failed to achieve the welfare associated with the equilibrium in both treatments on average, it is also interesting to consider the welfare impact of failing to reach an efficient Final Game. We do this by comparing the payoffs of subjects that do reach efficient Final Games (i.e., ones that contain a (B,B) equilibrium) with those of subjects who did not. This analysis is only possible for Treatment 1, since no pairs actually determined an efficient Final Game in Treatment 2. Table 13 compares welfare of those pairs that reached an efficient Final Game, those 70% of pairs that did not eliminate (B,B), versus the other 30% that did not achieve an efficient Final Game.

Table 13: Welfare Difference
Efficient Final Games (Treatment 1)

Final Game	Avg. Payoffs Final Game (s.d.)	Avg. Payoffs Total (s.d.)
Efficient	170.71 (43.56)	338.86 (44.03)
Not Efficient	73 (25.74)	215.89 (36.07)

Standard deviations in parentheses

Obviously, payoffs in the Final Game are significantly higher for those that pairs that achieved efficient Final Games as they mostly achieved the (B,B) outcome while the others mostly achieved (A,A) (Mann-Whitney test, $p < .001$). More striking however, is that achieving an efficient Final Game was immensely advantageous for overall (i.e., four-game) payoffs as well (Mann-Whitney test, $p < .001$). The difference is not only significant, but very large in magnitude.

Clearly, the diversity of Final Games led to vastly different welfare levels for our subjects. In particular, in Treatment 1 achieving an efficient Final Game was very important for our subjects.

4.3 Question 3: Are more efficient Final Games and outcomes obtained in the Easy Game baseline than in the Hard Game baseline?

We now move on to the comparative statics questions. This first question relates to differences between the Easy and Hard Game treatments. Essentially, while the first two questions just presented the results for each baseline, this section compares those results.

Put simply, there were more efficient Final Games in the Easy as opposed to the Hard baseline treatment (70% vs. 0%) as well as more efficient (B,B) outcomes (60% vs. 17%). Both differences are highly significant (test of proportions, $p < .001$).

In the spirit of Question 2, these differences are only important to the extent that they affect welfare, and they do. For example, the average Final Game payoff is larger with the Easy Game than the Hard Game baseline, 141.40 vs. 106.41 as well as over all four games, 301.97 vs. 256.24. Both differences are significant (t-test, $p = .0218$ and $p = .0176$ respectively). The difference is confirmed by the non-parametric test of distributions (Mann-Whitney test, $p = .0173$ and $p = .0132$ respectively)

Since the payoffs across these treatments differ, it may make more sense to compare payoffs that have been normalized as a fraction of the equilibrium payoff. For the sum of all four games, welfare was 91% of the equilibrium in Treatment 1 and only 69% in Treatment 2. Note that the Preferred Equilibrium payoff is higher for Treatment 2 than Treatment 1. Thus, as a fraction of equilibrium payoffs, the larger absolute payoffs in Treatment 1 are even more significantly larger than those of Treatment 2. In this sense, the already large difference noted between the payoffs of the two treatments is still understating the difference.

It seems as though subjects play the Formative Games similarly for both Treatments 1 and 2, and play only diverges in the Final Game. Evidence for this can be seen by comparing the distributions of pair choices in the three Formative Games in Treatments 1 and 2 as is done in Table 11. A Fisher exact test of the distributions of outcomes in each of the three Formative Games across these treatments reveals p-values that are highly insignificant for the first two games (Fisher exact test, $p = .865$ and $p = .906$ respectively) and barely significant (Fisher exact test, $p = .098$) for the third. However, play in the Final Game differs between these two baseline treatments. In terms of final outcomes determined, as Figure 1 shows, there are 7 different outcomes observed in the Final Game for Treatment 1 though most (18/32) are (B,B) outcomes, and 10 different outcomes in Treatment 2 where only 5 out of 29 were (B,B) outcomes. The difference between the distributions of Final Game outomes is highly significant (Fisher exact text, $p = .005$).

4.4 Question 4: Does lowering the discount factor lead to fewer efficient Final Games?

One possible explanation for why some societies have worse institutions (i.e., worse Final Games) than others is that their ancestors were too shortsighted to take the proper actions for later generations. Something like this is a constant mantra today where people think we are mortgaging our children by reckless spending today.

Clearly such an explanation makes sense since, as people playing Formative Games discount the future more and more, they become more likely to take myopic actions that may have poor consequences for those who follow (like eliminating B in the first Formative Game). In our experiment we tried to capture this phenomenon by decreasing the discount factor subjects used in our Easy Game (Treatment 1) from 1 to 0.66 in Treatment 3 and to 0.45 in Treatment 4, inducing a ceteris paribus comparison between treatments that differ only in the discount factor. From a theoretical point of view the first change, from 1 to 0.66, should have no impact on behavior since in both cases, the prediction is for pairs to reach the efficient Final Game with all strategies remaining. However, reducing the discount factor to .45 yields an equilibrium where strategy B is eliminated in the first Formative Game so the Final Game, consisting of strategies A, C, and D, is not efficient.

Before moving to results, let us explain the theory in a little more depth in order to explain our predictions. For the Easy Game baseline, efficiency is determined by the Row player in Formative Game 1. If the Row Player chooses R_1 their payoff is 17 and B is eliminated while if the Row player chooses R_2 their payoff is 4 and B is not eliminated. Thus the myopic gain from R_1 is 13. Eliminating B leads to (A,A) as the outcome of the Final Game and incurs loss 60 (94 minus 34) in Treatment 1, 18 (28 minus 10) in Treatment 3, and 6 (9 minus 3) in Treatment 4. As is evident, the myopic gain is offset by a loss that diminishes as discounting increases. While theoretically Treatments 1 and 3 are identical in that the gain is smaller than the loss, as the loss diminishes between the two treatments we expect fewer efficient Final Games in Treatment 3. Of course, we expected the fewest efficient Final Games in Treatment 4.

For Treatment 1, we have already established that the proportion of efficient Final Games is 70%. For Treatments 3 and 4, the proportion of efficient Final Games is 57% and 64% respectively. So it is true that the number of efficient Final Games did fall when discounting was introduced, but it should be noted that neither drop is significant (1-tail test of proportions, $p = .1419$ and $p = .3184$ respectively) nor is the drop monotonically decreasing with the discount factor as we expected.

This non-monotonicity is also reflected in the payoffs of the subjects both with respect to their Final Game payoffs and their total payoffs over the four games they played. Since the discount factor is changed, we cannot directly compare payoffs across the treatments as obviously the heavily discounted payoffs would be smaller. To avoid this problem, we normalize payoffs by considering the undiscounted payoffs our subjects would have received given their choices. Hence, the maximum pair payoffs for all treatments in the Final Game is 188 and the maximum pair payoffs over the entire four games is 333. The welfare results for the three treatments are presented in Table 14.

Table 14: Welfare

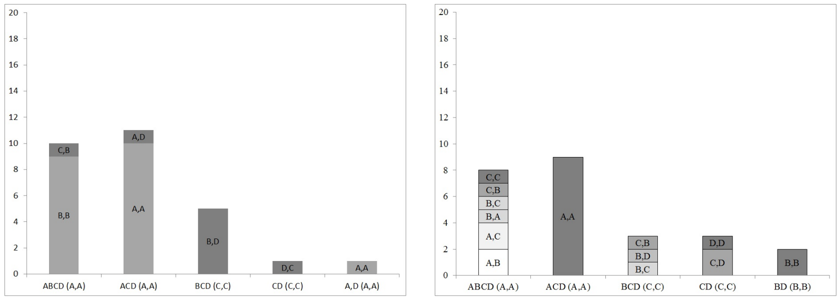
Treatment	Eq. Payoffs Final Game	Avg. Payoffs Final Game (s.d.)	Eq. Payoffs Total	Avg. Payoffs Total (s.d.)
1	188	141.40 (59.71)	333	301.97 (70.57)
3	188	122.2 (62.85)	333	276.60 (73.28)
4	188	135.04 (59.45)	333	291.68 (79.31)

Standard deviations in parentheses

As we expected, normalized payoffs were highest in that treatment where subjects discount the future least (Treatment 1) since in that treatment the fewest eliminated B. Again, however, reflecting the fact that B is eliminated most in Treatment 3 and second most in Treatment 4, the payoffs are lowest in Treatment 3 and second lowest in Treatment 4. Hence, our a priori expectations were confirmed in the sense that lowering the discount factor from 1 to either .66 or .45, lowers the payoffs of subjects but in a manner that is not monotonic in the discount factor.

Hence, changing the discount rate did lead to an increase in the determination of inefficient Final Games as we had suspected. As we saw above, however, despite this difference in the Final Games determined, there was not a statistically significant difference in the Final Game welfare or the Total welfare across these treatments.

In terms of the story we are trying to tell in this paper, if an event or shock (famine, plague, economic depression) occurs in a society that makes them discount the future more aggressively just at the time they are playing a Formative Game with future consequences, then their behavior at that point may have negative consequences for the type of Final Game their descendents are likely to play. This implies that playing the same Formative Games is not necessarily going to determine identical outcomes



(a) Treatment 5 (b) Treatment 6

Figure 3: Final Games for Reverse Order Treatments

because societies would need to play them under identical circumstances in order to determine identical results. Adverse shocks of any type that change a society's view of the future may make their behavior more myopic and consequently determine inefficient institutions.

4.5 Question 5: Does changing the order of Formative Games affect the Final Games achieved by our subjects?

In the real world, some societies face the same problems but in a different sequence. To capture this fact, we reversed the order of Formative Games to see what effects this change would have on the Final Games determined.

In Treatments 5 (using the Easy Game) and 6 (using the Hard Game) we reversed the order of the Formative Games, revising the order of the Trust and Coordination Games (Formative Games 1 and 3). This reversal has no theoretical impact for the Preferred Equilibrium on the outcome of each game. However, behaviorally, we expected differences.

We begin with Treatment 5 and focus on Final Games; in particular efficient Final Games. The whole distribution of Final Games is presented in Figure 3(a). In Treatment 5, where the Trust Game is moved from first to third place, it is placed directly before the Final Game. This should make the consequences of eliminating B very clear as the Final Game immediately follows rather than having to look forward several periods to see the consequence. Thus, behaviorally we expected the number of efficient Final Games to increase from the established baseline, where 70% of the Final Games were efficient. Surprisingly, the number of efficient Final Games actually, weakly significantly, decreased to 54%, (1-tail test of proportions, $p = .0988$). The fact that about half of Row players did not trust and eliminated B is surprising given the significant impact that eliminating strategy B has on payoffs and the fact that this game was played third, just before the Final Game where its consequences were obvious. These players gave up 60 in the Final Game, for a gain that was at most 13.

Comparing the distribution of Final Games to the established baseline of Treatment 1, the only notable difference is that the reverse order did result in one different Final

Game, with strategies A and D. However, only 1 pair achieved this Final Game and neither the distribution of Final Games nor outcomes for the Final Games are different from the baseline Treatment 1 (Fisher exact test, $p = .169$ and $p = .296$ respectively). There is also no difference in the distribution of outcomes for any of the three Formative Games (Fisher exact test, $p = .647$ for Trust Game, $p = .476$ for Prisoner's Dilemma, and $p = .363$ for Coordination Game).

For Treatment 6, in which the order is reversed with the Hard Final Game, our expectations were not as clear cut since, unlike the Easy Final game treatments, all three Formative Games are important for determining an efficient Final Game. Changing the order did, however, lead to a slight increase in the incidence of efficient Final Games since in Treatment 6 we have 2 pairs that are able to navigate the Formative Games to determine an efficient Final Game, with strategies B and D only, while in Treatment 2, there were none.

With respect to the distribution of Final Games and outcomes in the Final Games, as was true for our Easy Game treatments, there is no significant difference in the distribution of Final Games or outcomes in the Final Games when the order in which the Formative Games are played varies (i.e., comparing Treatments 6 and 2) (Fisher exact test, $p = .252$ and $p = .870$ respectively). There is also no difference in the distribution of outcomes for any of the three Formative Games (Fisher exact test, $p = .294$ for Trust Game, $p = .484$ for Prisoner's Dilemma, and $p = .350$ for Coordination Game).

While there does not seem to be much of a difference in regards to order in our experiment two things are worth noting. First, we do see several different Final Games when the order is reversed, including the emergence of at least some efficient Final Games for the Hard Game. Second, the experiment does not rule out the impact of the order of Formative Games for society. It seems likely that the order would be particularly important when Formative Games place constraints on other Formative Games, a possibility we do not consider here.

4.6 Question 6: To what extent do behavioral effects account for the choices of our subjects?

Finally, as mentioned earlier, choices in Formative Games may be interdependent or complementary either for strategic equilibrium reasons or possibly behavioral ones. First, let us concentrate on the behavior of subjects in Formative Game 2 of Treatments 1, 2, 3, and 4 (all the original order treatments) where the Prisoner's Dilemma game follows the play of the Trust Game. More precisely, we consider the behavior of subjects in Formative Game 2 after observing an (R_2,C_2) outcome (where trust is reciprocated) as compared to an (R_2,C_1) outcome (where trust is not reciprocated) in Formative Game 1. Table 15, which pools the data of the four applicable treatments, presents these two distributions.

Table 15: Formative Game 2 Conditional Outcomes (Original Order Treatments)

Formative Game 1 Outcome	(R_1,C_1)	(R_1,C_2)	(R_2,C_1)	(R_2,C_2)
(R_2,C_1)	.02	.37	.22	.39
(R_2,C_2)	.27	.27	.3	.15

What we see is that cooperation (R_1,C_1) in the Prisoner's Dilemma game (Formative Game 2) is far more likely after the reciprocation of trust. Specifically, while only 0.02 of the subjects played (R_2,C_2) after not having trust reciprocated in Formative Game 1, 0.27 did so after trust was reciprocated. Comparing Rows 1 and 2 what we see is that the distribution of choices in Formative Game 2 following (R_2,C_1) in Formative Game 1 are significantly different from the distribution of choices in Formative Game 2 following (R_2,C_2) (Fisher exact test, p = .004). These results indicate that trust may be a necessary condition for cooperation. This demonstrates a clear behavioral interdependence between Formative Games where an exhibited lack of trust in early games can affect the behavior of subjects later, when they, for example, play a Prisoner's Dilemma game.

While the results above concern the impact of trust on cooperation in the Prisoner's Dilemma game, in the treatment with the reverse order we have the opposite since the Prisoner's Dilemma game is played second while the Trust Game is played third. This allows us to look at the impact of cooperation on trust.

Table 16: Formative Game 3 Conditional Outcomes (Reverse Order Treatments)

Formative Game 2 Outcome	(R_1,C_1)	(R_1,C_2)	(R_2,C_1)	(R_2,C_2)
(R_1,C_1)	.33	.21	.31	.15
Other	.07	.21	.21	.50

Table 16 exhibits a similar behavioral interdependence. For example it is clear that cooperating, (R_1,C_1) in Formative Game 2, increases the likelihood of trust in Formative Game 3, where the Row player chooses R_2, from .46 to .71 and also the likelihood of reciprocation, where the Column player chooses C_2, from .36 to .71. In addition, the distributions of outcomes in Formative Game 3 across the first row of Table 12 differs from that of the second row, (Fisher exact test, p = .054), indicating that play following an (R_1,C_1) differs from play that follows any other outcome in Formative Game 2.

It is important to emphasize why these results are important for the punch line of this paper. Specifically, when we analyze these games using backward induction, at each point subjects are supposed to look forward and envision what will occur there before they choose at any given time. Doing so is supposed to yield, in our games, an efficient result. These behavioral results indicate, however, that for some subjects they are also looking backward at the behavior of their opponents and either punishing them for their actions or updating their belief about their intentions. Such behavior can lead subjects to take actions that irrationally eliminate strategies in the Final Game and hence leave their descendents an unsatisfactory Final Game to play.

5 Conclusions

This paper considers the problem of why societies develop differently as most recently articulated by Acemoglu and Robinson (2012). We see the issue as one of institutional development where we defines institions as North (1990) does, the *rules of the game in society*. The question then becomes why do certain societies develop efficient games for their agents to play and others develop dysfunctional ones? We investigate this question both theoretically and experimentally using a specific type of dynamic game in which subjects play a sequence of games where the solution of one game affects the strategies available in others. When the same set of games is presented to different cohorts of subjects, they solve these games differently leaving themselves, at the end, with different institutional structures or what we call different Final Games.

In the experiments we ran we clearly see the path dependency of behavior and the resulting differences in institutional structures or Final Games. Some societies face more difficult problems than others and typically wind up with less efficient solutions. Others are more impatient or have lower discount factors and also determine less efficient Final Games. As was stated in the introduction, we use experiments here as a demonstration tool which allows us to point out the variance of behavior observed by sets of subjects facing identical sets of games. It is this variance that determines different institutional structures across societies.

Table 6: Treatment 3 - Easy Final Game, Medium Discount Factor

Formative Games

Formative Game 1		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Formative Game 2		
	C_1	C_2
R_1	29, 29 (-A)	6, 40
R_2	40, 6	11, 11

Formative Game 3		
	C_1	C_2
R_1	15, 15	2, 2
R_2	2, 2	12, 12 (-C)

Potential Final Games

Initial Final Game				
	A	B	C	D
A	10, 10	3, 15	38, 3	6, 5
B	15, 3	28, 28*	5, 19	9, 9
C	3, 38	19, 5	4, 4	10, 3
D	5, 6	9, 9	3, 10	8, 8

Eliminate C			
	A	B	D
A	10, 10	3, 15	6, 5
B	15, 3	28, 28*	9, 9
D	5, 6	9, 9	8, 8

Eliminate B			
	A	C	D
A	10, 10*	38, 3	6, 5
C	3, 38	4, 4	10, 3
D	5, 6	3, 10	8, 8

Eliminate A			
	B	C	D
B	28, 28*	5, 19	9, 9
C	19, 5	4, 4	10, 3
D	9, 9	3, 10	8, 8

Eliminate B,C		
	A	D
A	10, 10*	6, 5
D	5, 6	8, 8

Eliminate A, C		
	B	D
B	28, 28*	9, 9
D	9, 9	8, 8

Eliminate A, B		
	C	D
C	4, 4*	10, 3
D	3, 10	8, 8

Eliminate A, B, C	
	D
D	8, 8*

* indicates Pareto best equilibrium of each potential Final Game

Table 7: Treatment 4 - Easy Final Game, Low Discount Factor

Formative Games

Formative Game 1		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Formative Game 2		
	C_1	C_2
R_1	19, 19 (-A)	4, 27
R_2	27, 4	8, 8

Formative Game 3		
	C_1	C_2
R_1	7, 7	1, 1
R_2	1, 1	5, 5 (-C)

Potential Final Games

Initial Final Game				
	A	B	C	D
A	3, 3	1, 5	12, 1	2, 2
B	5, 1	9, 9*	2, 6	3, 3
C	1, 12	6, 2	1, 1	3, 1
D	2, 2	3, 3	1, 3	2, 2

Eliminate C			
	A	B	D
A	3, 3	1, 5	2, 2
B	5, 1	9, 9*	3, 3
D	2, 2	3, 3	2, 2

Eliminate B			
	A	C	D
A	3, 3*	12, 1	2, 2
C	1, 12	1, 1	3, 1
D	2, 2	1, 3	2, 2

Eliminate A			
	B	C	D
B	9, 9*	2, 6	3, 3
C	6, 2	1, 1	3, 1
D	3, 3	1, 3	2, 2

Eliminate B,C		
	A	D
A	3, 3*	2, 2
D	2, 2	2, 2

Eliminate A, C		
	B	D
B	9, 9*	3, 3
D	3, 3	2, 2

Eliminate A, B		
	C	D
C	1, 1*	3, 1
D	1, 3	2, 2

Eliminate A, B, C	
	D
D	2, 2*

* indicates Pareto best equilibrium of each potential Final Game

Table 8: Treatment 5 - Easy Final Game, Reverse Order

Formative Games

Formative Game 1		
	C_1	C_2
R_1	34, 34	4, 4
R_2	4, 4	26, 26 (-C)

Formative Game 2		
	C_1	C_2
R_1	43, 43 (-A)	9, 60
R_2	60, 9	17, 17

Formative Game 3		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Potential Final Games

Initial Final Game				
	A	B	C	D
A	34, 34	9, 51	129, 9	21, 17
B	51, 9	94, 94*	17, 64	30, 30
C	9, 129	64, 17	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Eliminate C			
	A	B	D
A	34, 34	9, 51	21, 17
B	51, 9	94, 94*	30, 30
D	17, 21	30, 30	26, 26

Eliminate B			
	A	C	D
A	34, 34*	129, 9	21, 17
C	9, 129	13, 13	34, 9
D	17, 21	9, 34	26, 26

Eliminate A			
	B	C	D
B	94, 94*	17, 64	30, 30
C	64, 17	13, 13	34, 9
D	30, 30	9, 34	26, 26

Eliminate B,C		
	A	D
A	34, 34*	21, 17
D	17, 21	26, 26

Eliminate A, C		
	B	D
B	94, 94*	30, 30
D	30, 30	26, 26

Eliminate A, B		
	C	D
C	13, 13*	34, 9
D	9, 34	26, 26

Eliminate A, B, C	
	D
D	26, 26*

* indicates Pareto best equilibrium of each potential Final Game

Table 9: Treatment 6 - Hard Final Game, Reverse Order

Formative Games

Formative Game 1		
	C_1	C_2
R_1	34, 34	4, 4
R_2	4, 4	26, 26 (-C)

Formative Game 2		
	C_1	C_2
R_1	43, 43 (-A)	9, 60
R_2	60, 9	17, 17

Formative Game 3		
	C_1	C_2
R_1	17, 17 (-B)	17, 17 (-B)
R_2	4, 39	34, 21

Potential Final Games

Initial Final Game				
	A	B	C	D
A	34, 34*	111, 13	9, 9	21, 17
B	13, 111	94, 94	9, 129	30, 30
C	9, 9	129, 9	13, 13	34, 9
D	17, 21	30, 30	9, 34	26, 26

Eliminate C			
	A	B	D
A	34, 34*	111, 13	21, 17
B	13, 111	94, 94	30, 30
D	17, 21	30, 30	26, 26

Eliminate B			
	A	C	D
A	34, 34*	9, 9	21, 17
C	9, 9	13, 13	34, 9
D	17, 21	9, 34	26, 26

Eliminate A			
	B	C	D
B	94, 94	9, 129	30, 30
C	129, 9	13, 13*	34, 9
D	30, 30	9, 34	26, 26

Eliminate B,C		
	A	D
A	34, 34*	21, 17
D	17, 21	26, 26

Eliminate A, C		
	B	D
B	94, 94*	30, 30
D	30, 30	26, 26

Eliminate A, B		
	C	D
C	13, 13*	34, 9
D	9, 34	26, 26

Eliminate A, B, C	
	D
D	26, 26*

* indicates Pareto best equilibrium of each potential Final Game

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