An experimental analysis of political coalitions

A Project Report

submitted by

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in partial fulfilment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

DEPARTMENT OF Electrical Engineering
INDIAN INSTITUTE OF TECHNOLOGY MADRAS.

May 2014

THESIS CERTIFICATE

This is to certify that the thesis titled **An experimental analysis of political coalitions**, submitted by **Achuthan Sekar**, to the Indian Institute of Technology, Madras, for the award of the degree of **Bachelor of Technology**, is a bona fide record of the research work done by him under our supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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Date: 13th May 2014

ACKNOWLEDGEMENTS

I would first of all like to thank my project guide Prof RK Amit for having given me an opportunity to work under him on this project and fr having spent his valuable time guiding me and helping me when I had difficulties. Next, I would like to thank all the participants of the experiments that I conducted for this project, for having spared their time to participate in it. I would also take this opportunity to thank all my professors in my department who have taught me a lot of subjects in these four years and most all they have taught me to be diligent and sincere. I would also like to thank our HoD for having allowed me to pursue my interest in Game theory and for having allowed me to do a a BTP out of the department. Finally I would like thank my parents and my friends for standing by me through thick and thin.

ABSTRACT

This thesis tries to present the results and analysis of game theoretic experiments that were conducted as the B.Tech. Project of the author. The primary purpose of the experiments was to verify the phenomena observed in the political system today(especially in India) where the coalitions formed with large parties along with some small parties tend to be more stable than smaller parties coming together to achieve the same amount of majority. The paper will further try to present the reasons for such behavior and verify it with experimental backing. We further look at various ways of dividing the payoff, once a coalition has been formed.

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CHAPTER 1

INTRODUCTION

Politics has always been observed from the lens of game theory with players being parties and the payoff being administrative power in terms of ministries they control or cabinet seats. In the wake of general elections to the lower house of Parliament in India in 2014, we try to examine why the coalitions formed by the two major parties in the fray (BJP and Congress) have been dominating till now.We have observed that the minority government , when came to power could not stand for very long.

The main line of questioning pertains to these coalitions being more stable than the ones formed by many small parties who could come together to form the government by achieving a majority. There are a few questions to be addressed here. Many researchers have contributed to this field of research in different perspectives. One of the earliest papers was by Gamson (1969) which laid down some basics for coalition formation in tandem with Caplow's theory and put down some basic ways in which coalitions are formed based on the initial distribution of the resources. Gelman (2003) argues that individuals in a committee or election can increase their voting power by forming coalitions. This behavior is shown here to yield a prisoner's dilemma, in which a subset of voters can increase their power, while reducing average voting power for the electorate as a whole. This is an unusual form of the prisoner's dilemma in that cooperation is the selfish act that hurts the larger group. Gary Cox (1986) explicitly take into account how differential rates of support by various groups in a constituency will influence candidates' campaign promises and the likelihood that stable electoral coalitions will be forged. Daron Acemoglu (2006) say that ruling coalition needs to contain enough powerful members to win against any alternative coalition that may challenge it, and it needs to be self-enforcing, in the sense that none of its sub-coalitions should be able to secede and become the new ruling coalition.They have taken a power collective power of members to be a a measure of the stability of the coalition.Storms (1990) looks at vote seeking, office seeking and policy seeking parties an tries to explain their behavior in democracies. Ostrom (1998) tries to look at collective choices in social dilemma. Steven Brams in his book Game theory and politics, looks at different ways of dividing the payoffs in a coalition depending n the belief of the players.William Riker in his book theory of political coalitions (1962) postulates that a rational politician tries to form a coalition that is as large as necessary to win but not larger.

All of the previous research in the area of political game theory has looked at stability of coalitions in terms of power of the members or on the basis of individual aspirations etc. We want to look specifically at political coalitions involving large parties. We look at two scenarios: one where the party has to be a part of any winning coalition and one in which it a winning coalition can be formed without it. We want to analyze whether coalitions of this nature actually form in political systems. If they do, then what is the reason behind the formation of such coalitions. Further, once they are formed, how do the members distribute the payoff.We specifically consider two solution concepts (the core and the Banzhaf index)and see to which of them is the actual solution close. We wish to answer these questions by conducting experiments and analyzing the outcomes.

I will now explicitly state the assumptions that we have made during our experiment:

- All political parties are neutral. They don't have any alignments apriori.
- The entire political party works like a unit. They are driven by the same motive and they cannot be broken down into further parts.
- The motivation for every party is to get as much payoff as possible by being a part of the winning coalition. They don't have any other motivations.
- A government is always formed. There cannot be a hung parliament.

1.1 Relevance in Electrical Engineering

A lot of problems in Electrical Engineering have been solved using cooperative game theory. For example Juan M Zolezzi and Hugh Rodnick look at transmission cost allocation in a network using the solutions of cooperative game theory. Spectrum sensing is a key technology in spectrum reuse and to increase the spectrum efficiency in cognitive radio networks. Xiaolei Hao et al look at a coalition formation game to come up with a energy efficient cooperative spectrum sensing method in cognitive radio networks with multiple channels. Networks have been modeled as a games in the literature. Routing games are a popular way of modeling a network that consists of selfish players who want to minimize cost when routing data through a congested network. Zaheer Khan et al look at Modeling the dynamics of coalition formation games for cooperative spectrum sharing in an interference channel.Our work could be applied to any of these cooperative games as it tries to find reasons as to why some coalitions are easily formed in practice.

CHAPTER 2

Coalition Games

In this chapter we look at some basic definitions of a normal form game, then define a coalition game. Most of the times political games are modeled as simple games and hence we define a simple games.
The following discussion has been taken from Airiau's notes on coalition games.

Definition 1. *Following is the definition of finite, n-person normal form game:* $\langle$*N,A,u*$\rangle$

- *Players:* $N = 1, ..., n$ *is a finite set of* n *, indexed by* i
- *Action set for player* i *is denoted by* A_i
  - $a = (a_1, ..., a_n) \in A = A_1 ... A + n$ *is an action profile.*
- *Utility function or Payoff function for player* $i : u_i : A \mapsto R$
  - $u = (u_1, ..., u_n)$*, is a profile of utility functions.*

For our purposes, the players are the political parties, their action profile is the set of all coalitions in which they are a member and the utility function is the payoff they get in each of this coalition.

Definition 2. *The coalition form of a N person strategic game is given by the pair* (N, v) *where* $N = 1, 2, ..., n$ *is the set of players and* v *is a real-valued function, called the characteristic function of the game, defined on the set,* 2^N*, of all coalitions (subsets of N), and satisfying:*

- $v(\emptyset) = 0$*, and*

- *(superadditivity) if S and T are disjoint coalitions ($S \cap T = \emptyset$), then $v(S) + v(T) \leqslant v(S \cup T)$.*

In our case, the characteristic function assigns a 1 to every winning coalition ad a 0 to every losing coalition. Hence, the following definition.

Definition 3. *A game (N, v) is **simple** if for every coalition $S \in N$, either $v(S) = 0$ or $v(S) = 1$.*

Political games have been modeled as non cooperative games with transferable utility and also as cooperative games. We try to modle them as simple games because it is easier for us to analyze the basic principles and know if there is any fault Ordeshook (1986).

There are many solution concepts to a cooperative game. One of them is the core. We give in this chapter the definition of the core and then also extend that to the a game with a coalition structure. There are other solution concepts as well. Like the Banzhaf power index, the nucleolus, the bargaining set. We have looked at the core and the Banzhaf index as they are more relevant to our purpose.

Source:Airiau

Definition 4. *A payoff vector $x = (x_1, x_2, ..., x_n)$ of proposed amounts to be received by the players, with the understanding that player i is to receive x_i, is sometimes called an imputation. The first desirable property of an imputation is* *that the total amount received by the players should be $v(N)$.*

Definition 5. *Suppose some imputation, x, is being proposed as a division of $v(N)$ among the players. If there exists a coalition, S, whose total return from x is less than what that coalition can achieve acting by itself, that is, if $\sum_{i \in S} x_i < v(S)$, then there will be a tendency for coalition S to form and upset the proposed x because such a coalition could guarantee each of its members more than they would receive from x. Such an imputation has an inherent instability.*

Definition 6. *The set C of stable imputations is called the* **core** *if $C = \{x = (x_1, ..., x_n) : \sum_{i \in S} x_i = V(N) and \sum_{i \in S} x_i v(S), \forall S \subset N\}$*

Political games are modeled generally as simple games where the winning coalition gets all the payoff. We also design a simple game for our purposes. We are interested in political coalitions. We will now define the core for a game with a coalition structure.

Definition 7. *A coalition structure is a division of the grand coalitions into subcoalitions. $S = \mathcal{C}_1, ..., \mathcal{C}_k \; where \; \bigcup_{i \in 1...k} \mathcal{C}_i = N \; and \; i \neq j \Rightarrow \mathcal{C}_i \cap \mathcal{C}_j = \emptyset$*

Definition 8. *The set of feasible payoffs for $\langle N, V, S \rangle$ is $X = \{x \in \mathbb{R}^n : for \; every \; \mathcal{C} \in S \; x(\mathcal{C}) \leq v(\mathcal{C})\}$*

Definition 9. *The core of $\langle N, V, S \rangle$ is defined by $C = \{x \in \mathbb{R}^n : (\forall \mathcal{C} \in S \; x(\mathcal{C}) \leq v(\mathcal{C})) \; and \; (\forall \mathcal{C} \subseteq N, x(\mathcal{C}) \geq v(\mathcal{C})\}$*

Definition 10. *The Banzhaf index is defined as the ratio of the number of times a player i is critical to the number of times all players are critical. A player is critical if his desertion can change a winning coalition to a losing one.*

Definition 11. *The shapley value for a player in a coalition game is defined by* $\phi_i(v) = \sum\limits_{S \subseteq N \setminus \{i\}} \frac{|S|!(n-|S|-1)!}{n!}(v(S \cup \{i\}) - v(S))$

We would like to observe if the final payoff division occurs according to which of the above solution concepts.

We consider two examples here, which also form the basic games in our experiments. They are simple games with four players in each of them. The games have been designed in a way that they emulate a real Parliament and a real political scenario. We have not considered here the political ideologies, the policy structure that each part would want. We assume that each party is office seeking and that they want nothing else. Rationality in this situation is to try and maximize the share of the cabinet seats that they get in every coalition. In other words we just assume all the parties are office seeking Storms (1990).

Game 1: Consider a Parliament of 100 seats for which an election has been held. There are four parties which have won some seats in the Parliament. We consider the split in this game to be $40, 15, 25, 10$ respectively for Party 1 2,3 and 4. The majority required to form the government is 51 seats. Hence, two or more of the parties have to come together to form a government. The payoff is 100% of cabinet seats, which the parties will have to divide among themselves. As clearly seen the winning coalitions are $\{1, 2\}, \{2, 3, 4\}, \{1, 3\}, \{1, 4\}$.

$\therefore\ v(\{1, 2\}) = 1, v(\{2, 3, 4\}) = 1, v(\{1, 2\}) = 1, v(\{1, 4\}) = 1$ and any other coalition has a payoff of 0.

Let $x = \{x_1, x_2, x_3, x_4\}$ be an imputation.
Consider a partition $S = \{\{1,2\},\{3\},\{4\}\}$
$X_f = \{x \in \mathbb{R}^4 : x_1 + x_2 \leq 1, x_3 \leq 0, x_4 \leq 0\}$ be the set of feasible imputations.
$\therefore C = \{x \in X_f : x_1 + x_2 + x_3 + x_4 = 1, x_1 + x_2 \geq 1, x_1 + x_3 \geq 1, x_1 + x_4 \geq 1, x_2 + x_3 + x_4 \geq 1\}$
$\therefore C = \emptyset$
It can similarly be verified that the core for all other coalition structures is also empty.

Game 2: Now consider the following division of seats $\{50, 25, 15, 10\}$. The winning coalitions are $\{1,2\}, \{1,3\}, \{1,4\}$.
$\therefore v(\{1,2\}) = 1, v(\{1,2\}) = 1, v(\{1,4\}) = 1$ and any other coalition has a payoff of 0.
Consider a partition $S = \{\{1,3\},\{2\},\{4\}\}$
$X_f = \{x \in \mathbb{R}^4 : x_1 + x_3 \leq 1, x_2 \leq 0, x_4 \leq 0\}$ be the set of feasible imputations.
$\therefore C = \{x \in X_f : x_1 + x_2 + x_3 + x_4 = 1, x_1 + x_3 \geq 1, x_1 + x_2 \geq 1, x_1 + x_4 \geq 1\}$
$\therefore C = \{x_1 = 1, x_2 = x_3 = x_4 = 0\}$.

Shapley Values for Game 1 (using definition 11): $\phi_{40} = \frac{1}{2}, \phi_{25} = \frac{1}{6}, \phi_{20} = \frac{1}{6}, \phi_{15} = \frac{1}{6}$
Shapley Values for Game 2 (using definition 11): $\phi_{50} = \frac{3}{4}, \phi_{25} = \frac{1}{12}, \phi_{15} = \frac{1}{12}, \phi_{10} = \frac{1}{12}$
Banzhaf Index for Game 1 (using definition 10): $\beta_{40} = \frac{1}{2}, \beta_{25} = \frac{1}{6}, \beta_{20} = \frac{1}{6}, \beta_{15} = \frac{1}{6}$
Banzhaf Index for Game 2 (using definition 10): $\beta_{50} = \frac{7}{10}, \beta_{25} = \frac{1}{15}, \beta_{20} = \frac{1}{10}, \beta_{10} = \frac{1}{10}$

Theorem 1. *A player who belongs to every winning coalition is a veto player. The core of a simple game is empty unless there is a veto player. This player gets all the payoff in the imputations that lie in the core. (Source: Ariel D. Procaccia's notes on Mathematical foundation on AI)*

CHAPTER 3

Experimental games and our experiment

Various experiments have been designed to verify theoretical formulations of coalition game theory. Vinacke (1969) considered task variables in experimental games, Komorita S. S. (1978) experimented on same political convention game with different experimental conditions etc. Some established and well known paradigms exist, but every investigator has his/her approach/paradigm in conducting the experiment. This is where the confusion arises. Behavioral aspects come into play as the players are not fully rational and the experiment is open to interpretation.

Because of this multitude, there is difficulty in interpretation and integration.Experimental formulation of the game affects the subjects' interpretation of the task, their motivation, and their ideas of what the experimenter wishes of them, which consequently affect the negotiations and outcomes. Komorita and Meek in their paper show that the same political convention game with different experimental conditions of communication and information will support different social theories. The extent to which the results of the game may be used to verify the theory is dependent upon the extent to which the assumptions of the theory are met by the experiment.

Because of the myriad paradigms that exist, standardization is done by evaluating paradigms.
Six desiderata have been identified by James P. Kahan (1984) to evaluate experi-

mental paradigms. Desiderata means something needed or wanted.

- Generality: A general paradigm can handle situations of conflict of interest. A very general paradigm can be used to ferret out nuances. It is not restricted to only those theories making statements about limited classes of games.The dimensions of generality that are generally useful are number of players, constant sum vs non-constant sum games and types of coalition structure. This means that a general paradigm will not affect the results even if any of these factors change.
- Clarity of Task: The paradigm should make it very clear to the players that the purpose of the experiment is to form coalitions and decide the payoffs. They should be informed about the rules of the game and they should fully understand the information they have been given. The players should be intelligent enough and the paradigm simple enough to assure that the necessary reasoning and calculations can be performed satisfactorily.

- Integrity of coalition formation : The paradigm should allow the central processes i.e. formation of coalitions and division of payoffs to happen simultaneously. These two processes are inextricably intertwined in that the players choose a coalition on the basis of the payoffs they will receive in it and that these payoffs are negotiated on the basis of the coalition alternatives available to players. Any experimental paradigm should hence allow both the processes to occur together.

- Control of motivation : The experimenters idea of what is motivating people and the actual motivational bases of the players should coincide at least some degree or else the results of the experiment are uninterpretable. Reinhard (1972) demands that the players be highly motivated to succeed in the game. Maschler (1978) holds that rewards should be important enough to the players to encourage them to exert their best judgment.

- Flexibility of negotiations: The experimental structure should be less restrictive on the players so that the negotiations can be fuller and complete. Selten (1972) points out that all negotiations should be face to face with all players being to talk to each other.

- Record keeping : All the negotiations and interviews need to be recorded and analyzed.

3.1 Our experiment

A pilot experiment was initially conducted to test the effectiveness of the experimental design and the procedure followed. We found that the results we got were in line with what we were expecting to observe. Also, we could identify some problems in the understanding of the experiment among the participants and hence tried to improve the narrative we gave before every game.

We conducted two set of experiments on a sample size of 160 people. One set of experiment was to test the Game 1 described in chapter 4 and the ther set were for Game 2. We used groups of 4 people for each experiment. So, we have conducted each of the experiment 20 times. I wil now describe the experimental setup in detail.

Participants: Students from Indian Institute of Technology Madras. None of them had any background in Game theory. They were pursuing degrees like

Bachelor of Technology in engineering fields and some of them were pursuing a masters in business management. We chose 16 of them at random.

Training: The participants were trained on how to go about the game and what should be their motivation in playing the game (maximizing the payoff). A presentation was made that told them exactly what the aim of the experiment was without telling them what we were expecting to see. They were told the following things:

- What the experiment was about and background information of the game was given.
- How it will be organized.
- How they get to benefit and how they should play (maximize their payoff)
- One way of dividing the payoff (namely ratio of seats or just plain bargaining)

Set up: The experimental set up consisted of 4 gmail accounts which were linked by private chats. Participants had to log in to the accounts to chat privately with other players.

Task: The task was communicated as following " Form a winning coalition of a minimum of 51 votes and also decide on a division of the payoff among the coalition".

Explanation: To make sure they understood the task and the motivation, we told them " Assume you'd be given INR 100 if you win. You ave to come up with a division for the money".This made sure they played to maximize their payoff.

Follow up: After the experiment was over, we spoke t the participants and discussed with them how and why the coalition was formed and what were the decisions they had too make to come to the result.We also went through the logs to analyze the flow of negotiations.

Precautions: We made sure the chat history was deleted and the participants did not know each other to make sure any other behavioral effects were removed.

A training session was conducted for all the participants where they were told the following things:

- What the experiment was about and background information the game was given.
- How it will be organized.
- How they get to benefit and how they should play (maximize their payoff)
- One way of dividing the payoff (namely ratio of seats or just plain bargaining)

The paradigm satisfies the six desiderata mentioned in chapter 5.

- Generality: The paradigm doesn't depend upon the kind of people participating and the instructions for every set of players remains the same.
- Clarity of task: The paradigm makes sure that the task at hand is clearly understood by the players. For this purpose, training is conducted, analogies to money were given.
- Integrity of coalition formation: Both the negotiations and the process of formation of coalitions happens at the same time in the gmail accounts. The paradigm makes sure that both can happen simultaneously.
- Motivation: It is made sure that the players play to maximize their payoff by telling them analogies to money and also by incentivizing the experiment as a competition for some of them which will have a prize at the end.
- Flexibility: The chats are private and what two players are discussing is not seen by the rest.

- Record keeping: Gmail keeps record of all the conversations.

CHAPTER 4

Results and discussion

This chapter will first present the results of all the experiments and then present the main observations and then the analysis.

Table 4.1: Results for Game 1:Division of seats being $\{40, 20, 25, 15\}$

Coalition (Party1, Party2)	Division of payoff
(40,15)	(73,27)
(40,25)	(50,50)
(40,15)	(70,30)
(40,15)	(65,35)
(40,20)	(75,25)
(40,20)	(72,28)
(40,15)	(73,27)
(40,20)	(60,40)
(40,15)	(80,20)
(40,15)	(74,26)
(40,15)	(55,45)
(40,15)	(79,21)
(40,15)	(75,25)
(40,25)	(72,28)
(40,15)	(67,33)
(40,15)	(80,20)
(40,15)	(64,36)
(40,20)	(76,24)
(40,15)	(79,21)
(40,20)	(65,35)

Observations for Game 1:

- All the coalitions have the party with 40 seats, though it was possible to make a winning coalition without it.
- Most of the coalitions have the minority member , the one with 10 votes.
- The payoff divisions vary from 50-50 to as high as 80-20. The payoff structures do not follow any pattern at the first glance i.e. they do not lie in the core.
- There exist payoffs like $\{65 - 35\}$ for the coalition $\{65, 35\}$ and also ones like $\{80 - 20\}$ for the same coalition.

Table 4.2: Results for Game 2:Division of seats being $\{50, 25, 15, 10\}$

Coalition (Party1, Party2)	Division of payoff
(50,15)	(85,15)
(50,10)	(80,20)
(50,15)	(85,15)
(50,10)	(83,17)
(50,15)	(80,20)
(50,10)	(78,22)
(50,15)	(82,18)
(50,25)	(95,5)
(50,10)	(90,10)
(50,15)	(99,1)
(50,15)	(75,25)
(50,10)	(90,10)
(50,15)	(85,15)
(50,10)	(80,20)
(50,15)	(85,15)
(50,10)	(84,16)
(50,15)	(85,15)
(50,10)	(87,13)
(50,10)	(85,15)
(50,15)	(83,17)

Observations for Game 2:

- All the coalitions have the party with 50 seats, because it was the veto player.
- Most of the coalitions have the minority member , the one with 15 votes.
- The payoff divisions vary from 65-35 to as high as 99-1. The payoff structures do not follow any pattern at the first glance i.e. they do not lie in the core as the core for this game is empty.

4.1 Summary of the negotiations

The gmail accounts were used because they could keep record of all the conversations. We present below a brief summary and salient points of all the conversations and discussions that were a part of the post-experiment analysis. For game 1 where there is no veto player, it is observed that almost all the time the three players i.e. $\{20, 25, 15\}$ were in talks with the $\{40\}$ player for a coalition meanwhile being in talks with each other as well for forming a coalition without the $\{40\}$ player. Most of the times the players started with a offer to the other player. The offer would generally be skewed on the higher side of the rational division (according to the ratio of seats). The players would g back and forth between offers and also reveal what the others are offering him to the players to negotiate aggressively. Specifically, the $\{20, 25, 15\}$ players would tell the $\{40\}$ player that they are forming a coalition without him and what the others are offering him. This player would now make an offer higher than the offer given by the others and they game would continue. It is observed that none of the $\{20, 25, 15\}$ players reveal within each other that they are in talks with the $\{40\}$ player. The bargaining they use among themselves is mostly based on their seats. It is observed that almost all the time one of the player, generally the minority one, breaks away from these negotiations and forms a coalition with the $\{40\}$ player after he reveals to him what he is getting in the other coalition and he gets something more than that.

For game 2, which had a veto player, it is observed that in most of the cases the coalition is formed between the veto player and the minority player. The veto player takes low offers to the other players and they renegotiate. It is observed that the veto player does not play very rationally here. He lets go some payoff from his share to get the coalition to form quickly.

All the negotiations started with the rational division of payoffs then drifted according to the bargaining. The bargaining in every game was different. As mentioned earlier, the players revealed other offers they had to get better offers.We see that the payoff structure doesn't converge to the core.

4.2 Analysis

Average payoff for $\{50\}$ player is 84.8 in game 2 and that of $\{40\}$ player in game 1 is 70.2. The payoffs of these players according to Shapley Value is 75 and 50 respectively. Lets test the hypothesis that these values are equal.

Alternatively, we did a Wilcoxon's signed rank test on the set of payoffs for the majority player and on the values given by Shapley-Shubic Index and Banzhaf Index, and had t reject the hypothesis in both cases. Neither the Shapley-Shubic index nor the Banzhaf index can accurately predict the payoffs. We feel that the

Shapley-Shubic index may perform better because it takes into account the order of formation of the coalition and in our game the final payoff depends on the order in which players agree to join the coalition.

4.3 Main results

We will now summarize the main results of this thesis:

- The first question that we posed was if coalitions with large parties are actually stable. We have observed through experimental evidence that this is true. All the players flock to the one with the largest seats and want to form a coalition with him. We have observed that inspite of the possibility of there being a coalition without the large player, it was never formed.
- The next question that we addressed was why are such coalitions more stable. The main reasons , we found were
  - Lack of trust: There was a chance of forming a coalition that did not involve the majority player. As mentioned, at all points of time negotiations for such a coalition was happening. But , the coalition was not formed even once, because there was a lack of trust among the players. Each of them wanted to win and were negotiating with the majority player side by side. Once of them (generally the minority player) broke away from the coalition to form one with the majority player. When it was we spoke to the player who broke away, he/she almost always said that it was because he/she knew feared the others would do it and that he/she gt offered more than what this coalition would have offered him. As to why only the minority player forms the coalition, it is because he has the least to bargain for and hence the

other player gains the most by forming a coalition with him.

  - Rationality: All of them play to win. Hence, they would do so by any means possible.

- We also wanted to examine the payoff structure of the coalition formed. It can be observed that the negotiations started at the rational division and them moved away from it with negotiations. There were two main reasons for players to give up some of the payoff instead of standing their ground. We expalin our results in the same terminology as in Christopher H. Loch (2007)

  - Loss aversion: If we observe the payoffs carefully, for game 2 we see payoffs like 50-50 and for game 1 we see payoffs like 99-1. These just tell us that the players want to avoid loss. However less the payoff, they want to be a part of the winning coalition. When we spoke t the participants after the experiment, we found out that the driving factor in game 1 was this kind of loss aversion.

  - Immediacy: People tend to value things that happen sooner. They would want the payoff or benefit now rather than later. This behavior was also observed among the participants. They would get into a coalition which gives them a lesser payoff just because the other player is also ready t make a deal immediately. When spoken to people, in both games, people were ready to take lesser payoff but form a coalition as fast as they could.

- As clearly seen, the payoff structure doesnt resemble either the core, or the shapley index or the banzhaf index. One of the reasons is that the players tend to form minimum winning coalitions. The power indices consider all possible coalitions.

- We believe that the Shapley Shubik index is better in explaining the results because in this the order of formation of coalition matters. And in our case also, as soon as a winning coalition is formed, the game stops. And, the player with whom the coalition is formed determines the payoff. For example, most of the times, the minority player is the first to form a coalition with the $\{40\}$ player. Hence, the resulting payoffs.

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