Game Theory: Simultaneous move games in Leadership

ZZBU5611 – Assessment 2a Case study

Introduction

There have been many notable leaders in world history: Genghis Khan, Catherine the Great, and Mahatma Gandhi, to name a few. Some leaders lead their Empires to prominence while others are known for their tyrannical rule.

This report aims to apply game theory to better understand the strategies and payoffs that have led some leaders to act benevolently, while others have acted tyrannically.

Methodology

In game theory, the interaction between players in the game impact the outcome of their individual payoffs. Players are assumed to be rational and will choose the payoff maximising pure or mixed strategy in response to moves by other players. A state of equilibrium in which no player has an incentive to deviate is known as a *Nash equilibrium*.

Suppose there are two players in this game: Leader and People.

The strategies available to People are:

1. Overthrow – payoff maximising strategy for the People when the Leader is a "Tyrant" or "Absent". Note: this strategy cannot be a Nash equilibrium as both players will have an incentive to deviate.
2. Accept – accept the current Leader and payoffs.

As per historical evidence, strategies available to Leader are:

1. "Tyrannical" – Leader acts in self-interest by pursuing personal wealth and power and is therefore able to receive a maximum payoff of 10 at the expense of People who receive a payoff of 1. Here People have maximum incentive to overthrow Leader (6) providing them with no payoff.
2. "Benevolent" – Leader acting in the interests of the state, only receive half what they would have received if acting tyrannically but allocates resources effectively providing maximum benefits to People (8). People have a lower incentive to overthrow a benevolent leader, and if such a strategy is played, will have higher payoffs than for a tyrannical leader.
3. "Absent" – Leader does not provide any leadership, creating a misallocation of resources leading to low payoff for all players (3,3). People also have an incentive to remove this leader from power.

The payoff for this game is illustrated below with Leader as the column player and People as the row player:

		Leader		
		Tyrant	**Benevolent**	**Absent**
People	*Overthrow*	*6*, **0**	*3*, **2**	*5*, **1**
	Accept	*1*, **10**	*8*, **5**	3, **3**

Findings and discussion

Using the payoff matrix for both players, we can see that no dominant strategy exists. However, Leader has a dominated strategy "Absent" which provides lower payoffs than "Benevolent". Hence this strategy would not be chosen, and we can remove it from the matrix through iterated deletion.

		Leader		
		Tyrant	**Benevolent**	~~**Absent**~~
People	*Overthrow*	*6*, **0**	*3*, **2**	~~*5*, **1**~~
	Accept	*1*, **10**	*8*, **5**	~~*3*, **3**~~

The resulting payoff matrix shows that no pure strategy Nash equilibrium exists, because either player has an incentive to deviate from any pure strategy. However, there exists a Nash equilibrium that randomise pure strategies with some probability distribution. This is known as a mixed strategy or the player's best response.

To find People's best response, we call "q" the probability of overthrow and solve for:

$$10(1-q) = 2q + 5(1-q)$$

Therefore $q = \frac{5}{7} = 0.71$

To find Leader's best response we call "p" the probability of tyrannical acts from the leader and solve for:

$$6p + 3(1-p) = p + 8(1-p)$$

Therefore $p = \frac{5}{10} = 0.5$

This suggests that the set of mutual best responses is $\left(\frac{5}{7}O + \frac{2}{7}A, \frac{1}{2}T + \frac{1}{2}B\right)$. Hence the game suggests that the payoff maximising strategy mix for leaders is to be equally tyrannical and benevolent. Additionally, the payoff maximising strategy mix for the people is to change leaders ~70% of the time and to accept them ~30% of the time.

Comparing the theoretical solution to reality, we can see that historically, Leaders in democratic societies change much more often than their tyrannical counterparts. This is despite a much higher incentive for People to overthrow tyrannical leaders. But why? The simplest explanation is that there is a substantial cost to removing them, that is not reflected in the payoff matrix. If included, it would likely reduce "q" – the probability of overthrow.

The game also shows that Leaders should play an equal strategy mix between tyrannical and benevolent leadership to optimise Leader's payoff. The "element of surprise" would make it less likely for People to distinguish a Tyrant from a Benevolent leader, thus less likely to settle on an overthrow strategy response. This strategy mix closely resembles reality as it is often difficult to tell whether a politician is a Tyrant or Benevolent leader, with seemingly equal amounts of evidence on both sides.

Conclusion

We have shown that in modelling different types of leadership using game theory, a Nash equilibrium exists where Leaders play a strategy mix of tyranny and benevolence as a best response to the People and how this solution resembles reality.