African Journal of Basic & Applied Sciences 9 (6): 326-331, 2017
ISSN 2079-2034

DOI: 10.5829/idosi.ajbas.2017.326.331

Game Theory a Tool for Conflict Analysis of the Nigeria Minimum Wage Situation

[1]Okolo Emmanuel Okwudiri, [2]Orji Uka Odim and [3]V.O.S. Okeke

[1]Department of Mathematics Education,
Federal College of Education (Tech), Umunze Anambra State, Nigeria
[2]Department of Economics, Faculty of Management & Social Sciences.,
Tansian University, Umunya, Anambra State, Nigeria
[3]Department of Political Sciences, Faculty of Social Sciences,
Chukwuemeka Odumegwu Ojukwu University, Agbariam, Anambra State, Nigeria

Abstract: The study was on application of game theory to the analysis of Labour conflict. Emphasis was on minimum wage crises in Nigeria. The decay series was used to develop a bargaining model. Application of the model to the situation (game) yielded four possible outcomes, which we called equilibrium. The game in question was more of a cooperative one rather than a zero-sum. Based on the findings; the models might have provided useful information that might be used to forecast the outcomes likely to result during wage bargaining. Modal forecasts from simulated interaction method would be more accurate for all but one conflict. We equally advocate the application of this model to one of the important economic issues market price equilibrium (price determination). Although the market equilibrium is more complex, applying our model to market price determination negotiations would help to get a deeper insight into such negotiations.

Key words: Pay off · Game · Player · Labour conflict · Minimum wage

INTRODUCTION

Game theory is a branch of mathematics that studies the interactions of multiple independent decision makers that try to fulfill their own objectives. Today it is applied in economics and the other social and behavioral sciences [1]. Game theory creates a language and formal structure of analysis for making logical decisions in competitive environment. The term "Game" can be misleading. Even though game applies to recreational games, the concept of "Game" simply means interaction in which independent actors share more-or-less formal rules and consequences [1].

The formal application of game theory requires knowledge of the following details:

The identity of independent actors, Their preferences, what they know, what strategic acts they are allowed to make? and how each decision influences the outcome of the game?

Depending on the model, various other requirements or assumption may be necessary.

Finally, each independent actor is assumed to be rational

Collective Bargaining is a method of establishing wages, working conditions and other aspects of employment by means of negotiation between employers and the representatives of employees organized collectively [2]. It is assumed to be a mechanism for workers participation in industries, extension of the rights of citizenship into the economic sphere and the resolution of conflict in industries. [4], "Bargaining power refers to another person's inducement to agree on your terms. Or, to put it in another way, your bargaining power is my cost of disagreeing on your terms. This ratio measures the extent of my inducement to accept what you propose. Similarly, my bargaining power is your cost of disagreeing on my terms relative to your cost of agreeing on my terms

With the processes and functions, collective bargaining is assumed to be a very effective mechanism for resolving conflicts in industries [6]. However, evidences available shows that this has not always been the case. The observation is that in some cases, the crisis

Corresponding Author: Okolo Emmanuel Okwudiri, Department of Mathematics Education,
Federal College of Education (Tech), Umunze Anambra State, Nigeria.

which lead to collective agreement in labour relation, between employees [union] and employer' representatives are not always successfully resolved. Instead of settlements arising during negotiation, disputes arise and at some other times, disagreements, deadlocks, walkouts and negligence of agreement reached would occur. A very good example of disagreements over and negligence of agreement reached through collective bargaining process is the case of Nigerian Labour Congress and the Federal Government of Nigeria. On new minimum wage for workers, Where many state government had always refuse to honour the agreement reached with Labour and consequent labour resort to strikes.

Strike becomes a necessary end when either party defaults the agreement reached during negotiation. This is the case of Nigeria Labour Congress and the Federal government of Nigeria each time issues bothering on workers' welfare are raised or sensitive national issues.

In recent years game theoretical research on conflict resolution has emerge. In conflict resolution, each player tries to maximize its playoff. In this situation, selfishness on the part of players comes in. Hence game theory provides a good theoretical framework to analyze the minimum wage issue.

The study provides a complete and detailed study that can be used to predict the rout government and Labour will always like to follow during bargains between workers umbrella body and the Federal Government of Nigeria which would therefore provide a suitable ground for the analysis and for making recommendations that would be useful for practical purposes.

Objectives of the Study: The overall objective is to develop a bargaining model in Nigeria wage negotiation and the specific objectives are;

- Use the model to show why strike is inevitable in most cases after negotiation.
- Use the model to examine the different strategies that might be taken by both players during crises. And the possible outcome in each case
- Use game theory to show that cooperation among players during negotiation pays better than hostility

Literature: A game consists of players, the possible actions of the players and consequences of the actions. The players are decision makers, who choose how they act.

Utility Representation: Since game theory involves formal reasoning, we must have a device for thinking of utility maximization in mathematical terms. Such a device is called a utility function.

Payoffs: In any game, payoffs are numbers which represent the motivations of players [8].

Rationality: The most fundamental assumption in game theory is rationality. It implies that every player is motivated by increasing his own payoff, i.e. every player is looking to maximize his own utility. Rational players are assumed to maximize their payoff.

Solution of Game: In game theory, a solution of a game is a set of the possible outcomes. A game describes what actions the players can take and what the consequences of the actions are.

Definition 2.1: A mixed strategy is procedure for playing the game by which each player chooses the strategy using a discrete probability distribution.

Nash Equilibrium

Definition 2.2: A Nash equilibrium of a strategic game (N; (A_i); (U_i)*i)is a profile*

$$a^* = (a_1^*, \ldots, a_N^*) \in A \text{ of actions with the property that for every player } i \in N \text{ we} \quad (2.1)$$

have

$$U_i(a^*) \geq Ui(a_1^*, \ldots ; ai_j\text{-}1^*;, ai^*, ai+1^*; : : : ; a_N^*) \text{ for all } a_i \in A_i. \quad (2.2)$$

When a game is played, the rationality assumption will force the game into a Nash

equilibrium

Definition 2.3: An action profile a =≥ A is said to be Pareto if there is no action profile ã = *A, such that for all I*,

$$U(a_i) \geq U(\tilde{a}_1) \quad (2.3)$$

Definition 2.4: A strategy of player i ∈ N in an extensive game with perfect information (N,H, P, (U_i)) is a function that assigns an action in A(h) to each non terminal history h ∈ H \ Z for which P(h) = I.[9]

Definition 2.5: A function is called monotonically increasing (also increasing or non-decreasing), if for all x and y such that x≤y one has f(x)≤f(y), so preserves the order

Definition 2.6: A function is called monotonically decreasing (also decreasing or non-increasing) if, whenever x≤ y, then, f(x)≥f(y)

Definition 2.7: A preference relation □ is called **convex** if for any x,y (where x and y are two consumption bundles or payoff) then

$x,y \in X$ where $y \square x$
$\forall\ \theta \in [0, 1],\ \theta y + 1(1 - \theta)x \square x$ (2.4)

Defination 2.8: A real-valued function f on an interval (or, more generally, a convex set in vector space) is said to be concave if, for any x and y in the interval and for any α in [0,1] [5]

f((1-a)x +αy ≥(1-α)f(x) + αf(y) (2.5)

THE BARGAINING MODEL AND APPLICATION

Introduce The Concept of Cost

- Let U be the cost of player A incurs for winning the game and,
- Let V be the cost of player B winning the game.
- Let P (t) and q (t) be the utility function of player 1 and player 2 respectively.

Primitives:

N = {1, 2}: players
t = {0, 1, 2 …}
P (t) = player 1's utility function
q(t) = player 2's utility function
P(t) = 0 no agreement
q(t) = 0 no agreement
t∈T: time of agreement (t =∞ : no agreement)
U = [0,1]: player 1 cost of strike
V= [0,1]: player 2cost of strike
P_0= initial amount of player 1 at t = 0
Q_0 = initial amount of player 2 at t = 0

The Model: This bargaining model represents a situation in which

- There is conflict of interest about agreement
- Individuals have the possibility of concluding a mutually beneficial agreement
- No agreement may be imposed on any individual without his approval
- Each player can go for an outside option if it pays better.

The rate of change of amount P left at any point in time depends on the amount at that time.

Player 1utility Function: f(t,p) = - up where u is a proportion known as the cost of strike of player 1

$$i.e.\frac{dp}{dt} = -up \quad (4.1)$$

$$P(t_0) = P_0$$

$$\frac{dp}{p} = -udt$$

$$InP(t) - InP(t_0) = -u(t-t_0)$$

$$In\left(\frac{p(t)}{p(to)}\right) = -u\ (t - t_0)$$

$$\left(\frac{p(t)}{p(to)}\right) = e^{-u(t-t0)} \quad (4.2)$$

$$P(t) = p(t_o)e^{-u(t-t_0)}$$

Since t_o = o; p (t_0) = p_0

$$P(t) = pe^{-ut} \quad (4.3)$$

Player 2 Utility Function:

$$\frac{dq}{dt} = -vq \quad (4.4)$$

Similarly, solving

$$q(t) = q_o e^{-ut} \quad (4.2)$$

The Solution of The Game: Let f(t) be the solution of game.

Let f(t) = p(t) – q(t)

f(t) is continuous and differentiable in U and V. We make the following assumptions:

- Each player operates under a budget constraint
- $P_0 = q_0$ at time t=0(the initial amount of each players at t = 0)
- Both players strategy spaces are convex, closed and bounded

We shall consider the following situations:

- If f(t) >0 as t → t *
- If f(t) =0 as t → *t* *
- If f(t) < 0 as t → *t* *
- If f(t) = 0 as t → ∞

Case1.: when f(t) > 0 as t → t *
Suppose f(t) is a strictly monotonic increasing function i.e. ∀ t ∈ T ∃ t_* ∈ T such that as t → *t**, f(t) > 0

$$lim_{t \to t^*} f(t) = lim_{t \to t^*} p(t) - lim_{t \to t^*} q(t) > 0 \quad 4.6$$

$$lim_{t \to t^*} p_o e^{-ut} - lim_{t \to t^*} q_o e^{-ut} > 0$$
since $P_0 = q_0$.

$$u < v \quad 4.7$$

The implies that for f(t) to be strictly monotonic increasing function.

$u_i < v_i \; \forall \; t_* \in T$

The implication is that for player 1 to have an undue advantage over player2, player1 cost of strike u must be lower than player2's cost v.

The graph of F(t) in this instance will be

CASE 2: when f (t) =0 as t → *t* *

Suppose f (t) is a zero function i.e.

∀ t ∈T ∃ t_* ∈ T such that as t → *t* *, f(t) = 0

$$lim_{t \to t^*} f(t) = lim_{t \to t^*} p(t) - lim_{t \to t^*} q(t) = 0 \quad 4.8$$

$$lim_{t \to t^*} p_o e^{-ut} - lim_{t \to t^*} q_o e^{ut} = 0$$
Since $P_0 = q_0$
$$u = v \quad 4.9$$

Case 3: when f (t) <0 as t → *t* *
Suppose f (t) is a strictly mono decreasing function i.e.
∀ t ∈T ∃ t_* ∈ T such that as t →t *, $f(t)) < 0$

$$lim_{t \to t^*} f(t) = lim_{t \to t^*} p(t) - lim_{t \to t^*} q(t) = 0 \quad 4.10$$

$$lim_{t \to t^*} f(t) = lim_{t \to t^*} p_o e^{-ut} - lim_{t \to t^*} q_o e^{-ut} < 0$$
$P_0 e^{-ut} - q_0 e^{-vt} < 0$
Since $P_0 = q_0$
$$u > v \quad 4.11$$

This implies for the solution of the game f(t) to be strictly monotonic decreasing function.

U > v ∀ t_* ∈ T

The implication in this situation is that for player 2 to have undue advantage over player 1, his own cost of the strike should always be less than that of player1's cost. Player 2 is favoured

Case 4: when f (t) = 0 as t → t*

In this situation the strike by player 2 (Labour) has been prolonged and the player 1(Government) is yet to agree on Labour demand either.

Application of the Model
Reasons for Unusual Deadlock During Negotiation: Let consider the utility functions (payoff functions) of both players

$$\text{Playe1; } P(t) = P_0 e^{-ut} \quad 5.1$$

$$\text{Player2; } q(t) = q_0 e^{-vt} \quad 5.2$$

Taking the second derivatives

$$P(t)'' = u^2 P_0 e^{-ut} \quad 5.3$$

$$q(t)'' = v^2 q_0 \quad 5.4$$

p(t)'' > 0. This shows that (5.1) is convex utility function. This explain the tendency of player 1 deviating from the original agreement or the proposed new minimum wage by player 2,and consequently player 2 resorting to strike rather than accepting the new offer by player 1. This is true in most cases since convex utility functions are associated with risk-loving behavior. Here there is a positive incentive for player 1 not to pay the proposed

wage and see if player 2 can succumb or if further negotiation will produce better result for him.

Also since q(t)'' > 0 and is also a convex utility function there is also a positive incentive for player 2 to embarking on a strike to see it player 1 will comply fully to the proposed wage /agreement reached by both party.

Application of the Equilibriums to Government /Labour Minimum Wage Conflict

Considering the Four Conditions:

- If f(t) >0 as t →t*
- If f(t) =0 as t →*t**
- If f(t) < 0 as t →*t**
- If f(t) = 0 as t → ∞

Condition I: If f(t) >0 as t →*t**: here u < v

Here no matter the strategy of player 2 to minimize its cost v over time t, player 1 looks for dominant strategies to increase such cost and in turn tries to keep its own cost reduced it. Since player 2 will play rational since incur more cost, might be harmful and hence might give up the fight.

The above situation shows that since Labour (player 2) cost of winning is very high related to that of government (player 1). They are likely going to suspend strike and still go home with the old wage □. This is the first equilibrium.

Condition II: If f(t) =0 as t →t* :here u = v

Here both players cost of winning is the same. Hence their payoff will equally be the same. What happens here is that over a period (t), whatever strategy player 2 adopts to minimize its cost and increasing that of player 1. Player 1 will diverse for a strategy that will annul such, if this continues and neither of the players is able to adopt a winning dominant strategy over the other, this will give room for a compromise and renegotiation. Player 1 (Government) might call for a re-negotiation, which player 2 will accept. Here, both players is likely going to agree on a new wage of Ø, where □ < Ø < β.This is the second equilibrium

Condition III. If f(t) = 0 as t →*t** :Here u > v

Under this condition, player 1 is always conscious of his strategies as he knows that player 2 is ever determine to counter it with a strategy that will minimize his own cost (Player 2) and maximize the cost of player 1. If player 2 strategy is always dominant no matter the strategy path of player 1.if this happened, that is u > v, Player 1 will be left with no choice other than to accept to paying β_0.

Condition iv. If the strike continue for a long time (t →∞)

In this instance, the conflict has been prolonging for a long period. The parties (labour and Government) in the conflict have exacted all available strategies, yet none of the players strategy has been dominant over the other. Here the pay off of each of the players is zero. In this situation a dialogue if inevitable.

The above assumptions of equilibrium are based on both players adopting a rational strategy. It also depends on how each player valued the so called "**cost of winning".** i.e the importance attached to such cost by the players. The game should be more of a cooperative game that a zero-sum game.

Summary of Findings: This paper gives a detailed insight in the game theory definition, classifications and applications of games in conflict resolution with emphasis to labour dispute.. Some important popular game like prison dilemma and the battle of the sexes were discussed in details, showing different strategies from the players and discussing the expected outcome of such games. Nash equilibrium and p are to efficient terms were discussed in details with detailed examples.

Moreover, some important bargaining models were discussed. We equally developed a bargaining model; this model was used to show the possible parts to be taken by labour and government during minimum wage negation and the reasons why parties sometime deviate from original agreement reach. The model was also used to establish the reason why strike is inevitable during minimum wage negotiation. Four possible equilibrium positions were established.

Finally this study concerns only one two actors (labour and government), but its findings have limited but important implications for healthy employee/employer relationship during new wage negotiation.

CONCLUSION

It is only natural that people some time behave rational when there is gain to be made and irrational if such rationality will bring loss to them. Game theory has been able to provide us with tools to balance such choices (rational and irrational).

Concept from game theory has shown us that wage bargaining should not be seen as a zero-sum gain in which each player tries to maximize its payoff at the expense of the other. It should be more of cooperate game. The Varian metaphor was able to shown us that cooperation pays better during negotiation.

The concept from game theory was equally used to show why parties even after an agreement has reached will still go ahead to bridge it. Especially from player 1(Government/Employers)

Finally, we were able to establish four equilibrium conditions that can be attained in the cause of both players trying to force the other either to accept a new deal which is less than the one agreed earlier or the other forcing the letter to implement all the earlier agreement or both party reach out for a new contract which might be greater or equal to the new proposed by one player but less than the original contract agreed upon. The direction of the equilibrium depends on each player's value of cost and his ability to play rational.

Recommendations: Based on the present work; we used complete information and sequential bargaining procedure where the preferences of the government and the labour vary in time. Varying discount factors will likely give more possibilities for the characteristics of the parties and would have made the model more realistic.

The models might have provided useful information that might be used to forecast the outcomes likely to result during wage bargaining. Modal forecasts from simulated interaction method would be more accurate for all but one conflict.

Furthermore, we advocate the application of this model to one of the important economic issues – market price equilibrium (price determination). Although the market equilibrium is more complex, applying our model to market price determination negotiations would help to get a deeper insight into such negotiations.

REFERENCES

1. Altman, E., R. El Azouzi and T. Jimenez, 2003. Slotted aloha as a stochastic Game with partial information. In Proceedings of WiOpt'03, 2003.
2. Bilbao, J., J. Fernandez, N. Jimenez and J. Lopez, 2002. Voting power in theeuropean union enlargement. European Journal of Operational. Research, 143: 181-196.
3. Fudenberg, D. and J. Tirole, 1991. Game Theory, MIT Press, Cambridge, MA.
4. Crowcroft, J., R. Gibbens, F. Kelly and S. Östring, 2003. Modelling incentives for collaboration in mobile ad hoc networks. In Proceedings of WiOpt'03, 2003.
5. Douligeris, C. and R. Mazumdar, 1988. User optimal flow control in an integrated environment.In Proceedings of the Indo-US Workshop on Signals and Systems, 1988.
6. Fent, T., G. Feichtinger and G. Tragler, 2002. A dynamic game of offending and law enforcement. International Game Theory Review, 4(1): 71-89.
8. http://www.ietf.org/html.charters/manet-charter. html. [cited 20th October 2016].