

Application of Game Theory to Business Strategy in Undeveloped Countries: A Case for Nigeria

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ABSTRACT A business strategy is the determination of how a company will compete in a given business and position itself among its competitors is an onerous task. It requires a strategic analysis. But from empirical evidence, while developed countries used a management science model such as the game theory. But in Nigeria and other underdeveloped countries, the determination of business strategies are based on highly subjective approaches which include intuitive anticipatory, opportunistic, formal – structured, incrementing and adaptive. The main aim of this paper therefore, was to examine game theory. The examination suggest that the model is desirable, if applied, it would no doubt; enhance the solving of business decision problems in businesses of undeveloped countries.

1. INTRODUCTION

The importance of business strategy for firms in underdeveloped countries like Nigeria need not be argued. A business strategy is the specific policy made by a company by taking into account the specific policy the competitors might take (Jehle and Reny 2000).

Business strategy can also be defined as “the determination of how a company will compete in a given business and position itself among its competitors” Business strategy, then, refers to the competitive strategy of a particular business unit (Hamermesh 1992).

A good summary of benefits, expected from a business strategy include (1) given rise to improved profitability; (2) provides a procedure for analyzing and rules to deal with competitors; (3) helps in the management of environmental problems facing an origination and (4) it contains specific policies that could be adopted to achieve organizational goals.

Business strategy is a central activity in organizations. According to Hamermesh (1992), the strategy wheel is a useful device for illustrating the degree of specialty and consistency that must be achieved in a business strategy. The business strategy has at its core the goals of the business and the concepts of how the business will compete (Hamermesh 1992). Of equal importance are precise definitions of key functional policies and that these policies be consistent with each other and with the objective of the business.

One fundamental issue is the approach to the

understanding of how business strategy undertaken has implications for organizational effectiveness. For this reason and other reasons, the theory of games has been developed to analyse business strategy where outcomes depend on the behaviour of all competitors (Gough and Hill 1979). Although this model was developed in 1953 by John Von Neumann (Mathematician) and Oskar Morgenstern (Mathematical Economist), and greatly in use in the field of Economics. But, on one hand, according to the empirical studies by Ledbetter (1997), Cox (1972), Effiraim (1972), and Waton (1971) game theory intends to be used with low frequency by corporate managers in the developed countries (Gough et al. 1991).

On the other hand, from surveys in underdeveloped country like Nigeria, corporate managers do not use the theory at all; moreover, most of the managers have little or no idea about the technique. Rather, some approaches that lack objectivity framework such as (1) intuitive, (2) anticipatory, (3) opportunistic, (4) formal –structured, (5) incrementing and (6) adaptive. It is also noted that these mentioned approaches are used jointly or severally (Osaze 1998).

The main objective of this paper, therefore, is to discuss some of the various ways in which business strategy can be more effective and efficient through the use of the game theory. In particular, the paper will look at theoretical/ conceptual issues of the paper and by way of illustrating the usefulness of game theory for business managers the paper will give a simplified hypothetical example.

This paper is divided into four sections.

Following this introduction is section two, will discuss theoretical/ conceptual issues. A simplified hypothetical example will be presented in section three to illustrate the usefulness of game theory while section four concludes the paper.

2. LITERATURE REVIEW

2.1 Current Approaches in Analyzing and Making Decisions in a Competing Environment in Nigeria

In a competitive market, a producer / seller (party) always need to weigh the expected response of their rivals. The issue is the approach adopted by each party to secure some competitive advantage. Mentioned above are some approaches that are currently used in underdeveloped countries like Nigeria. According to Osaze (1998), some approaches currently use in Nigeria for strategic management include hunch, intuitive and anticipatory, opportunistic, formal –structured, incrementing and adaptive. These approaches are briefly elaborated as follows.

- (i) *Hunch, Intuitive and Anticipatory Approach*: In this approach, the top management uses any strong feeling (variable) and guess to perceive as a strategy. The major set back of this approach is that it lacks objectivity and strategy varies circumstances.
- (ii) *Opportunistic Approach*: This approach is highly speculative in nature. In this approach strategy is passive based. The top management of the company is in constant waiting for an opportunity before responding to it rivals.
- (iii) *Formal–structured*: This approach follows a laid done organizational bureaucratic procedures. The top management uses the existing explicit procedures of the organization to deal with its rivals. This approach is very inflexibly and time consuming.
- (iv) *Incrementing*: The incrementing approach is more or less a democratic approach to business strategy. Here the stakeholders decide the how a business unit is to compete in its market.
- (vi) *Adaptive*: In adaptive approach the decision makers recognize the changing variables in the environment and apply any of the above approaches. Hence, it can be inferred that the approaches can be used jointly or severally.

2.1.1. Strengths and Weaknesses of the Current Approaches

No doubt, depending on the user, the current approaches discussed above, have been giving accurate determination of how a business unit is to compete in its market. However, the significant weaknesses are:

One, the approaches tend to incorporate diffuse, hard – to – quantify and consideration that pattern to individual taste and disposition.

The second weakness is that the approaches composed of little or no objectives and constraints. They lack reliability and validity qualities.

The third weakness, apart from the adaptive approach, other current approaches applied mental factors rather than environment. Mental factors are usually not explicit, therefore difficult to criticize or challenge or subscribe to because such approaches could be ambiguous.

2.2 Game Theory: Concepts and Rationale

Game theory is a probabilistic model which as already mentioned is used in analyzing, and driving rules for making decisions when two or more people are competing for some objectives. Game theory attempts to look at the relationships between participants in a particular model and predict their optimal decisions (Investopedia 2010).

According to Wikipedia (2010), economists and business professors suggest two primary use of game theory: *descriptive* and *prescriptive*. In the descriptive use, game theory has been used to study a wide variety of human and animal behaviors; thus when finding the equilibrium of games we can predict how actual human prediction can be understood. One frequently cited example of descriptive use of game theory is the Nash equilibrium (see Investopedia 2010; Stanford Encyclopedia 2010). In the prescriptive (normative) use, game theory has also been used to attempt to develop theories of ethical or normative behavior. That is an attempt to look economic and human practices as they ought to be, talking about judgment and looking at what is right and what is wrong. One frequently cited example of descriptive use of game theory is the prisoner's dilemma (see Investopedia 2010; Stanford Encyclopedia 2010).

Game theory bridges mathematics, statistics, economics, and psychology to model conflict between two or more rational decision-makers

(Google 2004). In business, examples of such competitive situations are numerous. In case of a perfect competitive market, where there are many buyers and sellers, each seller plans his own strategies on the expectation of what others will do. Thus, game theory was developed to handle such competitive situations.

2.3 Evolution of Game Theory

The first known discussion of game theory occurred in a letter written by James in 1713. In this letter, Waldegrave provides a minimax mixed solution to a two-person version of the card game Wikipedia (2010). The use of game theory was paramount in an extensive research conducted by the management science school during the World War II (1942-1945) when the management school began to investigate the applicability of quantitative methods to military and logistical problems. Some of the projects included methods of increasing bombing accuracy, development of search procedures to locate enemy submarines, and the transportation of supplies and equipment needed location. Most of the research projects were conducted with the use of interdisciplinary teams, culled from such fields as engineering, mathematics, statistics, economics, psychology, and political science (Richard et al. 1982; Aigbokhaevbolo 2006). After the war, many individuals recognized that there was great potential for the newly developed in the industrial world (Seilagyi 1981).

For instance, as mentioned earlier, John Von Neumann (mathematician) and Oskar Morgenstern (mathematical economist) provided the use of Game Theory to deal with decisions in which two or more intelligent opponents have conflicting objectives (Mcain 2004).

According to McCain (2004), since the work of John Von Neumann, game theory has been used in the field of bankruptcy; barbarians at the gate, battle of the network, *caveat emptor*, recruitment, coordination, escape, majority rule, market niche, mutually defense, prisoner's dilemma. Subsidized small business; tragedy of the commons ultimatum; and video system coordination.

2.2.3 Strengths and Weaknesses of Game Theory

2.2.3.1 Strengths Game Theory

(1) Game theory is a model type, which are

generally explicit and unambiguous in nature. For this reason, solution to game theory are easy to criticize or subscribe to.

- (2) Game theory as model if applied it provides a limited representative of reality and for this reason a solution to game theory is a solution to a "surrogate" for the real problem.
- (3) A solution to game theory is objective. For this reason the solution can easily be manipulated, augmented and eliminated.
- (4) There are always consistencies in solution to game theory (reliability).
- (5) Game theory can give a decision maker an opportunity of knowledge to acceptance or rejection of a hypothesis.
- (6) Game theory is applicable to a close system because the payoffs of the all participants are added up to be zero (winning = (+) and loses = (-) then the game is called zero-sum game. Otherwise, it is known as non-zero-sum game

2.2.3.2. Weaknesses of Game Theory

- (1) For practical considerations, game theory always imposed constraints because it is the only correct way to formulate the problem.
- (2) Game theory is based on the assumption that the parties are rational and few in numbers.
- (3) It is based on the assumption that each player knows the objectives of his opponent.

3. GAME THEORY: HYPOTHETICAL PRACTICAL PROBLEM

As started above, game theory provided a promising approach to understanding strategic problems of all sorts. According to Taha (2000), in game conflict opponents known as player will each have a number of alternatives known as strategies. Game may be classified according to the number of alternatives or strategies. For example, finite (definable bounds) or infinite (not definable bounds). A (4x5) game (finite) denotes that one of one player has four strategies available to him and the other player has five strategies available associated with each pair of strategies is a payoff that one player pays to the other (the payoffs are the amounts of money which change hands when the payers choose their respective strategies). Payoffs (utilities) are usually shown in a table called the payoff matrix such that in Table 1.

Table 1: A 3x 3 payoff matrix: a 3 – player, 3- strategy game

B for j	a_{11}	a_{12}	a_{1n}
A for i	a_{21}	a_{22}	a_{2n}
	a_{n1}	a_{n2}	a_{nn}

Table 1 representative, indicates that if A uses strategy I and B uses strategy j, the payoff to A is a_{ij} which means that the pay off to B is $-a_{ij}$.

No doubt, most modern businesses operate in oligopoly condition. Changes in the pricing, output, product or advertising (promotional) policies made by one firm will usually have direct effects on the sales of particular competitors who may be expected to react strongly such changes (Savage and Small 1966; Olaloye 1996). For our illustration consider the two – persons (duopoly [two – firm] Zero – Sum Game situation). Two persons or two firms A and B are involved competing for a given market; zero –sum means that what ever one player gains, the other players loses. Considering the advertising rates to the market are ₦4, 000, ₦ 8, 000 and ₦12, 000. With an advertising expenditure of ₦12, 000, full coverage is obtained and expenditure beyond this yield no further gain. Each firm, therefore, has three possible strategies available. For each combination of strategies we may estimate, based on past experience the share of the market gained or lost by the respective forms. The estimates are given in Table 2.

Firm A has strategies i, ii, and iii available to it; firm B has strategies 1, 2, and 3 to it. To determine the optimum strategy for A we examine each row for the minimum value. For strategy i, the row minimum is -45%, while for strategy ii, the row minimum is - 20 and for strategy iii, the row minimum is 0%. The maximum of the minimum for firm A is therefore 0%.

To determine the optimum strategy for firm B we examine each row for the maximum value. For strategy 1, the maximum is 45%, for strategy 2, the maximum is 20%, for strategy 3, and the

Table 2: A 2x 3 payoff matrix: a 2 – player, 3- strategy game

Firm B strategies/ Firm A strategies	1 = ₦ 4,000	2= ₦ 8,000	3= ₦ 12,000
I= ₦ 4,000Advt. expd.	0 %	- 20 %	- 45%
Ii= ₦ 8,000Advt. expd.	+ 20%	0 %	- 20%
Ii= ₦ 12,000Advt. expd.	+ 45%	+ 20%	0 %

Table 3: Payoff matrix of a 2 – player, 2- strategy game

a	B
C	D

The value of the game is given by formula
 $V = \frac{ad - bc}{a - b - c + d}$

maximum is 0%. The minimum of the maximum for firm B is therefore 0%. The value of the game is 0%. This is the point at which the minimum loss firm A is prepared to tolerate coincides with the maximum gain firm B is prepared to accept. This means when Firm A adopts strategy iii it will lose no share to Firm B. Strategies iii and i are optimum minimax, strategies iii and i are optimum maximax. The equilibrium point, 0 %, is called *Saddle point* (the value of the game) (Table 3).

At times, a game may not be strictly determined (non – strict determined game), that is it does not have a saddle point. In a non-strict determined game, optimal play involves preventing one rival from knowing what strategy is to be used in a given move. In that case, each player attempts to mix his selected pattern by introducing some element of chance that is choosing the strategy to be employed on each occasion at random. For example, a non –strict (2x2) determined game

4. CONCLUSION

This paper has discussed the concepts and rationale of business strategy and the current approaches adopted by Nigerian and other underdeveloped countries corporate managers in determining business strategy. Also discussed are the concepts and rationale for game theory through hypothetical examples. At the end as we have observed game theory is a good technique for analyzing action of manager's decision when dependent on the decision made by a competitor.

5. RECOMMENDATIONS

In view of the theoretical usefulness of game theory technique in business management this study therefore recommends the following:

- (1) Game theory is can be applied to two –person and more persons in both deterministic and adaptive or cybernetic environment.
- (2) Game theory is applicable in a game of strategy

rather than a game of chance. Therefore, the users of game theory must acquire the necessary skill to apply game theory because the outcome of the game depends on the skill and strategy adopted by the participants.

- (3) For easy application of game theory, matrix algebra is found useful device, therefore a theory game problems should be set up in form of game matrix otherwise known as payoff matrix.
- (4) There is need for integration of game theory with the existing management techniques in organizations in Nigeria to enhance decision taking in strategic management.

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