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Game Theory: An Application to Tanners and 'Pomo' Wholesalers in Hides Marketing Competition in Nigeria

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Target audience: Policy makers, Researchers, Tannery operators

Abstract

This study was conducted in Kano State to determine the level of competition between the tanners and 'pomo' wholesalers in hides marketing competition in Nigeria. Kano State was used because over 85% of tanneries in Nigeria are found in Kano State. It is also the centre for hides purchase as 'pomo' by 'pomo' wholesalers. 'Two persons zero sum game' was used in determining the level of competition between tanners and 'pomo' wholesalers. Most often hypothetical data were used in game theory analysis. Agricultural economics is an applied social science so game theory was applied practically from a field survey to determine the level of competition between tanners and 'pomo' wholesalers in Nigeria. All the thirteen functional tanneries and the thirty registered 'pomo' wholesalers were used for the study making a total of forty three respondents. Primary data were collected through the use of structured questionnaire. The structure questionnaire was designed to elicit information from the tanners and 'pomo' wholesalers. The result of the analysis revealed that market share of hides was 30% to 70% for tanners and 'pomo' wholesalers respectively. There was relatively low competition between tanners and 'pomo' wholesalers in Nigeria. 'Pomo' wholesalers had larger share of market in hides marketing competition. There is significant difference in the quantity of hides purchased by tanners and that of 'pomo' wholesalers. It was recommended that livestock production should be supported by the various arms of government so that quality hides can be produced for tanning and 'pomo' consumption

Keywords: Game theory, tanners, '*pomo*' wholesalers, hides, competition, Nigeria.

Description of problem

Hides and skins are primarily produces as by-products of the meat packing industry, but the international trade in skins, hides and leather is more valuable than that of meat (1). Hides and skins are the main export income generators from the livestock sector in Africa. In the year

2000, Africa's share of total world production was only 5% of bovine hides, 14% of goat and kidskins and 8% of sheep and lambskins (2). The potential of Nigeria in the production of hides and skins may be assessed from the slaughter statistics. On the average, Nigeria produces over one million hides and about three million skins per year from the registered abattoirs and slaughterhouses (3). The hides and skins are flayed (from cattle, sheep and goats respectively) and sold to tanners and '*pomo'* wholesalers. Tanners processed their hides and skins into leather through a tanning process while the '*pomo'* wholesalers processed their hides to '*pomo*' for direct human consumption as meat supplement.

The term '*pomo'* in the Nigerian parlance, is a hide that has undergone some processing such as roasting and boiling for human consumption as meat supplement and delicacy. Usually, it is cowhides that are used as '*pomo*' in Nigeria. The process of removing hairs from hides to become '*Pomo'* is traditionally done by roasting or by tenderizing the hides in hot water, followed by shaving with razor blade or similar object. It is then boiled in water to soften the hides before it is used in soup or stew. It has low nutritional value but many Nigerians enjoy eating it as delicacy especially in the western Nigeria where '*pomo*' consumption originated from before it spreads all over the country.

A game is a competitive situation among N persons or groups, called players that are conducted under a prescribed set of rules with known payoffs. The rules define the elementary activities, or moves of the game. Different players may be allowed different moves available to the other players (4). There are various types of games, but for purpose of this study, '*Two Persons Zero Sum Game'* was used.

The theory of (5) is most complete for the class of games called two-person zero-sum games, i.e. games with only two players in which one player wins what the other player loses (6). According to (7) 'game theory' is the systematic study of two rational agents' behaviour in strategic situations, or in games where each must first know the decision of the other agents before knowing which decisions is best for him / her. A game of strategy is an abstract set of rules that constrains the behaviour of players and defines outcomes on the basis of the actions taken by the players.

However, some works have been documented on hides, skins and '*pomo'* utilization in Nigeria, but very little or no work has been done in determining the level of competition between tanners and '*pomo*' wholesalers in Nigeria. This work will therefore be very useful to policy makers and hides and '*pomo*' researchers in Nigeria in understanding the level of competition between tanners and '*pomo*' wholesalers. It will add to the existing knowledge about hides and '*pomo*' marketing in Nigeria.

Many authors have applied game theory in many areas of endeavours both in Nigeria and beyond. There are several types of games, but the one mostly applied in Social Sciences is '*Two Persons Zero Sum Game*'. According to (8) this game can be presented either in extensive form or normal or strategic form. A strategic game consists of a set

of players, which may be a group of nodes or an individual node and a set of actions is available for each player to make a decision and to choose preferences over the set of action profiles for each player (9). If one player wins what another player loses, the game I called a "zero sum game". A "two - person" game is a game having only two players (or firms). Two - person, zero – sum games is called "matrix games". For instance, what player I loses is what player II gains, so the sum of their net gains equals zero (10). According to (9) game theory is used to explain the relationship between variables and a decision tree is usually drawn to understand the gains from any game. Hence the name "Zero - Sum Game". The assumptions of the model according to (10) are that the firms have a given, well – defined goal. The goal is maximization of the market share; each firm knows the strategies open to it and to its rival, or concentrates on the most important of those strategies; each firm knows with certainty the payoffs of all combinations of the strategies being considered. The actions chosen by the duopolists do not affect the total size of the market and each firm chooses its strategy 'expecting the worst from its rival. It is used for analysing how individual agents interact with each other and they may take into account how the other agents are choosing their strategy (11).

However, (12) applied game theory for security, a real world challenge problem for multiagent systems and beyond, he observed that in Los Ageles International Airport, the LAX police use diverse measures to protect the airport which include the vehicular checkpoints and police units patrolling with canines. Garba (13) applied game theory to explain the conflict when state, institution and market fail in Nigeria. Jibril (14) applied game theory to analyse the international versus domestic contest for resource control in the Niger Delta, Nigeria, and found that when oil producing communities are unable to find effective solutions from the government or from the international community, the likelihood of youth restiveness manifesting in armed struggle and hostage taking is high. Also, (15) used game theory to analyse the game of resources control and the political crisis of the Nigerian State and observed that the political economy of the oil at the international level does not favour the developing oil exporting countries and the host communities endowed with oil resources.

This study therefore discloses the level of competition between tanners and '*pomo'* wholesalers in hides processing and marketing in Nigeria using a game theory approach.

Materials and Methods

Study Area

This study was conducted in Kano State in 2011. Kano State was used because over 85% of the tanneries in Nigeria are found in Kano State and major '*pomo*' wholesalers that market '*pomo*' to other parts of the country are found in Kano State (16). Kano State lies between latitudes 10^0 35^1 and 12^0 40^1 N of the equator and between longitudes 7^0 42^1 E and 9^0 15^1E of the meridian. It has a

population of 9,383,682 (17). Kano State occupies a land area of 20,877 square kilometers and is mostly in the Sudan Savanna of the vegetation zone, bordering in the south, the Northern Guinea vegetation (18). The vegetation is characterized by Guinea grassland which has been brought about by intensive cultivation activities livestock production such as cattle, sheep, goats and donkeys. It is also a receiving region from within Nigeria and neighbouring Niger Republic. Kano has the largest tanneries and the largest hides and skins business in Nigeria.

Sampling Techniques and Sample Size

All the thirteen (13) functional tanneries in Kano State and all the thirty (30) known '*pomo*' wholesalers that buy hides from Kano and distribute to other parts of the country were used for this study. In all, a total of 43 respondents were used for this study. Due to the fact that the sample size of hides and 'pomo' available are few, all the sample frame were used for this study.

Data Collection Techniques

Primary data were used through the use of structured questionnaire to elicit information from tanners and '*pomo*' wholesalers about hides business in 2014. Data collected include the following:

I. Processing information: these include inputs used in processing of hides and skins, sources and quantities of inputs, labour types, number of hours used per day, data on processing operations, total output processed per day and type of technology used in the skin processing.

ii. Marketing information: such as costs involved in the procurement of the inputs including hides and skins, labour cost per day, cost of other related equipments used in processing, marketing and cost per unit of an average hides and skins processed, the period of highest and lowest prices of hides and skins in a year, and total sales per day.

iii. Financial information: including sources of credit and problems encountered.

iv. Price information: such as prices of hides and skins at different times of the year as well as the period of highest price and the period of lowest price.

Model Specification

The strategic (normal) form of tanners and '*pomo*' wholesalers of hides is presented in Table 1. The game theory analysis was practically applied from field survey. *'Two persons zero sum game'* was used to determine the level of competition between the hides used for leather (tanners) and the hides used as '*pomo*' ('*pomo*' wholesalers) in Nigeria.. For a two-person zero-sum game, the payoff function of Player II is the negative of the payoff of Player I.

The strategies employed by the players or the firms were:

i. Demand for hides at higher price and

ii. Demand for hides at lower price.

However, this was treated in relation to the level of income and level of satisfaction derived by the two players as shown in Table 1.

Table 1. Strategic (normal) form of tanners and '*pomo*' wholesalers of hides

		Tanners (I)		
		Higher price	**Lower price**	***Implication***
***'Pomo'* wholesalers (II)**	Higher price	β β	β β	
	Lower price	β β	β β	
Implication				

Where:

β = the quantity of hides that '*pomo*' wholesalers got when both of them bought at higher price

β = the quantity of hides that tanners got when both of them bought at higher price

β = the quantity of hides that '*pomo*' wholesalers got when they bought at higher price while tanners bought at lower price.

β = the quantity of hides that tanners got when they were only ready to buy at lower price while '*pomo*' wholesalers bought at higher price.

β = the quantity of hides that '*pomo*' wholesalers got when they were only ready to buy at lower price while tanners bought at higher price.

β = the quantity of hides that tanners got when they are ready to buy at higher price while the '*pomo*' wholesalers bought at lower price

β = the quantity of hides that '*pomo*' wholesalers got if both of them are only ready to buy at lower price

β = the quantity of hides that tanners got when both of them bought at lower price

The level of competition was determined at the point of 'Nash Equilibrium', where no player desires to alter behaviour or strategy choice again.

Results and discussion

The game theory analysis revealed that the level of competition between the two players ('*pomo*' wholesalers and tanners) was relatively low (Table 2). The study also showed that when both tanners and '*pomo*' wholesalers bought hides at higher price, the '*pomo*' wholesalers of hides got 318 pieces of hides as their payoff while the factory users of hides (tanners) got 101 pieces of hides as their payoff. A piece of hide is one whole flayed hide from cattle and the number of pieces presented in Table 2 is measured in thousand pieces ('000). In the same manner, when the '*pomo*' wholesalers bought at higher price while the tanners were only ready to buy at lower price, the '*pomo*' wholesalers got 318 pieces of hides and the tanners got 210 pieces of hides. Then when the tanners bought hides at higher price while the '*pomo*' wholesalers were only ready to buy at lower price, the '*pomo*' wholesalers got 388 pieces of hides as their payoffs and the tanners got 101 pieces.

However, when both '*pomo*' wholesalers and tanners bought hides at lower price, the payoff for '*pomo*' wholesalers and tanners were 205 and 388 respectively. The difference in the quantity of hides purchased by tanners and wholesalers was tested using Z test and it was

significant at 5% level of probability. At the Nash equilibrium, the percentage of the sum of the payoffs of the individual player divided by the total gives the level of competition of each player. The level of competition between the tanners and '*pomo*' wholesalers in the study area were 30% and 70% respectively. This implies that the market share of hides between the tanners and the '*pomo*' wholesalers was 30% and 70% respectively. However, the reason for the tanners having a lower share of the market may be attributed to the fact that tanners processed more of skins into leather than hides. Very large quantities of skins are processed in most tanneries with less of hides while the '*pomo*' wholesalers processed mainly hides into '*pomo*' for human consumption. 'Pomo is consumed in all parts of Nigeria but the consumption is higher in the South West Nigeria.

Table 2. Strategic (normal) form of tanners and ' *pomo*' wholesalers of hides at Nash Equilibrium

		Factory users of hide (Tanners) (I)		
		Higher price (000' pieces)	**Lower price**	***Implication***
***'Pomo'* users of hides (wholesalers) (II)**	**Higher price**	318, 101	318, 210	636 >311
	Lower price	388, 101	388, 205	776 > 306
Implication		706 > 202	706 > 415	II > I

Conclusion and application

Game theory approach was applied practically to emphasize the reaction of rival firms (Tanners and '*pomo*' wholesalers) in hides processing and marketing in Nigeria.

1. Kano State is one of the main source of hides for both tanners and '*pomo*' wholesalers in Nigeria.
2. The study revealed that hides used for tanning had 30% share of the market while the one used for '*pomo'* had 70%.
3. Based on the findings, it was therefore recommended that as hides processing and marketing is a lucrative business in Nigeria, livestock production should therefore be supported by the various arms of government so that quality hides can be made available for tanning and '*pomo'* consumption in Nigeria.

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