

A game theory approach to selecting marketing-mix strategies

Game theory
approach

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Abstract

Purpose – Adopting efficient marketing strategies is a challenging task in a competitive market place involving complex marketing planning, techniques and mechanisms to identify the best course of action under these circumstances and finding optimal solutions or stable outcomes. Decisions and strategies of competitors in the market influence the selection of the appropriate marketing strategy. The main purpose of this paper is to develop a mathematical methodology based on the game theory approach for planning optimal marketing-mix strategies in dynamic competitive markets, taking into account strategic foresight and interaction effects.

Design/methodology/approach – The game theory approach, as a decision-making tool in conflict situations, is suggested for planning and adopting optimal marketing strategy. The main intellectual attraction of the game theory is essentially a question of how to act in gaming situations against highly rational opponents. A kind of static, finite and non-cooperative game analytics approach has been developed for this issue, and the proposed model has been implemented to design optimal marketing strategies for two top brands of the automotive parts market in Iran.

Findings – The findings of this study show that the optimal marketing-mix strategy for brand A is pricing and for brand B is the product strategy.

Practical implications – Game theory and the Nash equilibrium model can provide a practical approach to find and adopt the right strategy, know competitors' movements and strategies and get more profit.

Originality/value – The integration of the game theory approach into the marketing mix framework has been adopted as a generalized model for marketing strategy planning and analysis as well as to resolve some shortcomings of the marketing mix framework. The Nash equilibrium model has been used to analyze the results. The incorporation of game theory into marketing models has the potential to enrich the scope of marketing modeling.

Keywords Marketing mix, Game theory, Equilibrium, Competitive markets, Brand, Strategy

Paper type Research paper

1. Introduction

Emergence and development of new theoretical and practical concepts, exchange transaction, relationship marketing, information and communication technologies and consumer behavior expand the scope of marketing management. In competitive markets, selecting an appropriate marketing strategy is essential in selling more products, gaining more incremental revenues or profits and satisfying consumer's needs (Othman *et al.*, 2020). Undoubtedly, any organization that cannot make a living from the production and delivery of products and services to customers is doomed to failure and decline. Choosing the best



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marketing strategy requires a good understanding of the business environment, marketing setting, theoretical and practical domains of marketing, customer's needs and behaviors and knowledge of competitors' status and strategies in the market. This is where an organization can find the best sales strategy for making more money. One of the tools used to manage the effectiveness of marketing strategies is the marketing mix. The marketing mix is the cornerstone of marketing theory that combines different elements and tools of marketing to help organizations achieve their marketing goals (Venaik and Midgley, 2019). McCarthy (1960) introduced a classification of four components known as 4P that refers to product, place, price and promotion. Product refers to what the business offers for sale and may include products or services. Product decisions include the quality, features, benefits, style, design, branding, packaging, services, warranties, guarantees, life cycles, investments and returns. Price refers to decisions surrounding list pricing, discount pricing, special offer pricing, credit payment or credit terms. Price refers to the total cost to the customer to acquire the product and may involve both monetary and psychological costs such as the time and effort spent in the acquisition. The place is defined as the direct or indirect channels to market, geographical distribution, territorial coverage, retail outlet, market location, catalogs, inventory, logistics and order fulfillment. Place refers either to the physical location where a business carries out business or the distribution channels used to reach markets. The place may refer to a retail outlet, but increasingly refers to virtual stores such as "a mail-order catalog, a telephone call center or a website. Promotion refers to the marketing communication used to make the offer known to potential customers and persuade them to investigate it further." Promotion elements include "advertising, public relations, direct selling and sales promotions" (Blythe, 2009; Gordon, 2012). Marketing managers use these four components of marketing tools or a combination of them to tailor their marketing strategy to meet the needs of different market segments. Based on the chosen strategy, they design appropriate marketing plans. For example, if the promotion strategy is chosen, they design incentives such as discounts for more purchases in order to encourage their customers to buy their products. Paying attention to competitors, their products and the type of strategy they choose will undoubtedly depend on choosing the right marketing strategy (Vissak et al., 2020). Considering competitor movements in the market combined with the optimal 4P combination is important for effective marketing and selling of the product (Qian et al., 2019). But most companies choose their marketing strategies based on 4P components independently of their competitors, and it is less likely that two or more competitors in the market coordinate their marketing strategies before implementing them or examine competitor movements so that each company has its own share from the market. One of the decision-making tools for selecting optimal strategies in conflicting situations is game theory. The game theory seeks to achieve mathematical behavior through strategic or game conditions in which the success of one's choice depends on the choice of others (Sohrabi and Azgomi, 2020). A game consists of a set of players, a set of moves or strategies and a specific outcome for each combination of strategies. The players, strategies or moves available to the players and the payoffs (outcomes) associated with each strategic combination are three key elements of a game. The main assumption of a game-theoretical approach is that all players act rationally to maximize the minimum possible gain or maximize the security level which is called the mini-max principle. Winning every game is not just about helping luck; it has its own rules and principles. The rationale for applying game theory to marketing-mix strategy management is that it can provide an approach to modeling, describing and documenting the likely outcomes of the adoption of different marketing strategies. The main contribution of game theory to marketing decision-making is its consideration of rationality, on the part of both the decision-maker and competitors. In recent years, the game theory has been used as an analytical tool to gain strategic intelligence and insight into the competitive intentions and behaviors involved in managerial decision-making processes. In this study, a game-

theoretical approach was proposed to improve management decisions about marketing mix in situations of competition and variability as inherent characteristics of the business environment. The main significance of the present study is to develop a discrete game theory model to help corporate executives decide and optimize the marketing-mix strategies. To this end, a new approach to modeling and forming components of a game is presented by defining the profit and loss functions of each player in adopting a specific marketing strategy. The proposed model has been used to determine the optimal marketing strategies for two famous brands of the automotive parts market in Iran to demonstrate its feasibility. The rest of this article is organized as follows. [Section 2](#) reviews the literature and research background. [Section 3](#) discusses the proposed mathematical model, the case study and the process of data collection. [Section 4](#) provides the results. [Section 5](#) provides the theoretical contributions. [Section 6](#) provides the managerial implications. [Section 7](#) provides conclusions. [Section 8](#) discusses the limitations and future scope.

2. Literature review

In the proposed model, game theory is used for marketing mix alignment of both competitors. This section introduces literature review of marketing mix and game theory.

2.1 Marketing-mix

The marketing-mix used by a particular firm will vary according to its available resources, market conditions and changing needs of clients. The importance of some elements within the marketing mix will vary at any one point in time. Decisions cannot be made on one element of the marketing mix without considering its impact on other elements ([Pheng and Ming, 1997](#)). As [McCarthy \(1960\)](#) pointed out that “the number of possible strategies of the marketing mix is infinite.” The marketing mix is a conceptual framework that managers apply in the process of marketing decision-making and planning to suit consumers’ needs and expectations as well as the dynamic nature of modern markets. Marketing can be seen as a process in which companies create value for their customers. The process of promoting merely involves understanding the market (including competitors), customer’ wants and wishes, coming up with a selling strategy, designing programs to suit customers and incorporating strategic foresight in their designing, which needs them to look forward and reason backward. Looking forward implies that every whole manager anticipates however different competitor brands square measure doubtless to create future choices then, by logical thinking, deduces one’s own best choices in response to the simplest choices to be created by all different brands ([Naik et al., 2005](#)). The marketing mix has been extremely influential in informing the development of both marketing theory and practice ([Möller, 2006](#)) and the improvement of both long-term strategies and short-term tactical programs ([Palmer, 2004](#)). The early marketing concept is based on the idea of action parameters presented in the 1930s by [Stackelberg \(1939\)](#). [Rasmussen \(1955\)](#) then developed the concept of parameter theory and proposed price, quality, service and advertising as four determinants of competition and sales. [Mickwitz \(1959\)](#) applies this theory to the merchandise life cycle idea. [Frey \(1961\)](#) divides the marketing variables into two parts: the offering (product, packaging, brand, price and service) and the methods and tools (distribution channels, personal selling, advertising, sales promotion and publicity). [Borden \(1965\)](#) used the term “marketing mix” for the first time to describe, what was proposed by [Culliton \(1948\)](#), a business executive as a “mixer of ingredients.” Borden’s original marketing mix consists of a set of 12 elements; product planning; pricing; branding; channels of distribution; personal selling; advertising; promotions; packaging; display; servicing; physical handling; and fact-finding and analysis. [Lazer and Kelly \(1962\)](#) consider the goods and services mix, the distribution mix and the communication mix as three elements of the marketing mix. [McCarthy \(1964\)](#) refined [Borden’s \(1965\)](#) idea further and defined the marketing mix as a combination of all of the factors at a marketing manager’s command to satisfy the target market. He regrouped Borden’s 12 elements into four elements or

4Ps, namely product, price, promotion, and place, at a marketing manager's command to satisfy the target market (McCarthy, 1964). A number of researchers propose a new "P" into the marketing mix. Judd (1987) proposes a fifth P (people). Booms (1981) adds 3 Ps (participants, physical evidence and process) to the original 4 Ps to apply the marketing mix concept to service. Kotler (1999) adds political power and public opinion formation to the Ps concept (Kotler, 1999). Magrath (1986) suggests the addition of 3 Ps (personnel, physical facilities and process management) (Magrath, 1986). In the 1990s, the model of 4 Cs (commodity, cost, channel and communication) was introduced as a more customer-driven replacement of the 4 Ps (Robins, 1991). Baumgartner (1991) suggests the concept of 15 Ps. Vignali and Davis (1994) suggests the addition of S (service) to the marketing mix. Goldsmith (1999) suggests that there should be 8 Ps (product, price, place, promotion, participants, physical evidence, process and personalization) (Ronald, 1999). Möller (2006) presents an up-to-date picture of the current standing in the debate around the mix as a marketing paradigm and predominant marketing management tool by reviewing academic views from five marketing management sub-disciplines (consumer marketing, relationship marketing, services marketing, retail marketing and industrial marketing) and emerging marketing (e-commerce). Some researchers and writers express serious doubts about the role of the mix as a marketing management tool in its original form, proposing alternative approaches, which is adding new parameters to the original mix or replacing it with alternative frameworks altogether. Yi (2017) also added the people, process and physical evidence components to the four main components of the marketing mix, but the four marketing components mentioned in 4Ps are present in almost every developmental research and can be claimed to be the most famous and lasting category (Gordon, 2012). Marketing mix has the potential to be used as a conceptual framework and pedagogic tool, especially for introductory marketing to be adapted to various marketing. On the other hand, it is based on physical evidence, and being static in nature, lacking integration between variables and lacking consideration of people, participants and process are mentioned as some disadvantages of this approach (Rafiq and Ahmed, 1995). Some researchers have also studied the impact of the mixed marketing components on customer behavior and the effectiveness of mixed marketing programs. The impact of product category on promotional choice has been studied (Banerjee, 2009). The influence of 7Ps of marketing mix on buying intention of music product in Indonesia has been investigated (Kusumawati *et al.*, 2014). The 7Ps marketing mix elements have been adapted as a service failure framework of hotels in Taiwan (Loo and Leung, 2018). Influences of environmental and hedonic motivations on the intention to purchase green products have been studied (Choi and Johnson, 2019). Dimensions of the service marketing mix and its effects on customer satisfaction have been studied (Khatab *et al.*, 2019). The effect of environmental awareness on purchase intention and satisfaction (Okada *et al.*, 2019) has also been analyzed. A new Bayesian statistical framework was developed to conduct a large-scale empirical investigation on the relationship between metric effectiveness, metric use and marketing-mix decision (Mintz *et al.*, 2020). The impact of sales promotion's benefits on perceived value has been studied (Sinha and Verma, 2020). The relationship among marketing mix, customer satisfaction and customer loyalty of Chinese tourists to the budget hotels of central Bangkok has been studied (Xie, 2020). A case study research was carried out to better understand the use of marketing mix practices and influencing factors in security contexts to identify factors that are internal (market segment diversification, type of ownership, magnitude of investments) and external (tourism promotion organizations, media coverage, tourist flow volume) to the firms as they affect their marketing mix implementation. The results showed that the pricing and communication tactics are employed more intensively, while product service and distribution channel actions are used to a lesser extent (Cruz-Milan, 2021). Mixed methods sequential explanatory design was employed to assess the perceived influence of pharmaceutical marketing-mix strategies on physicians' prescribing behaviors in two public and three private hospitals (Hailu *et al.*, 2021).

2.2 Game theory

Game theory was originally construed by [Von Neumann and Morgenstern \(1944\)](#) as an application of mathematics to social situations wherein rational individuals strive for the best possible outcomes under given circumstances. It can be defined as a collection of mathematical models formulated to study decision-making in situations involving conflict and cooperation for finding optimal solutions or stable outcomes ([Lucas, 1972](#)). The main intellectual attraction of the game theory is essentially a question of how to act in gaming situations against highly rational opponents ([Harsanyi, 1982](#)). The theoretical domain of game uses applied mathematics and economic logic to analyze the interplay of informed, calculating actors in a precise way. It can be interpreted as the investigation of human interaction in a vacuum. The practical domain of game theory concerns the application of its principles to actual human behavior and interactions. Game theory is a complex, dynamic elaboration of decision theory ([Murnighan, 2015](#)). It is an investigation of the interdependent interaction of rational decision-makers or highly strategic parties who are acting in their own best interests ([Bazerman et al., 2000](#)). More recently, it has expanded its goals toward the general analysis of potentially conflictual interactions ([Murnighan, 2015](#)). [Gibbons \(1992\)](#) identified the players (i.e. stakeholders), information (e.g. records and messages), action (i.e. applied strategy), process (i.e. a sequence of actions) and utility (i.e. payoff or profit) as five elements of the model. There are three ways to represent games: the extensive form, the normal form and the characteristic function form ([Laraki et al., 2019](#); [Lucas, 1972](#)). The choice among them stems out of the requirement of analysts and researchers. The extensive form focuses on the rules of the game to represent all possible outcomes for all possible plays of each player and to represent the sequential play of the game. The normal form focuses not on the rules of the game and the game tree, but on the strategies available to each player and the resulting payoffs. So a game in normal form is typically represented by a payoff matrix. The strategies available to each player appear as rows and columns of the matrix. The characteristic function form focuses on the formation of possible coalitions among players and the payoffs each coalition could obtain if the players agreed to cooperate ([Laraki et al., 2019](#)). Despite the growing amount of empirical literature concerning the application of game theory to study dynamic consumer behavior, little research has been undertaken with regard to the implications of choice dynamics for marketing decision-makers ([Bronnenberg, 2008](#)). The incorporation of game theory into marketing models has the potential to enrich the scope of marketing modeling and professional marketing practices and lead to new insights for organizational managers ([Mudambi, 1996](#)). Much important development made the game theory more desirable for the application to economic situations and the development of dynamic models of competition ([Shubik, 1972](#)). The game theory includes the concept of utility, which concerns a mathematical measure of player satisfaction ([Von Neumann and Morgenstern, 1944](#)). In games that involve a deterministic function between decision and outcome, there can be a utility value assigned to the outcome of each decision. Game theory is an applied branch of mathematics used in many domains such as economics ([Mendoza-Alonzo et al., 2020](#); [Zameer et al., 2018](#)), politics, management ([Prasad et al., 2019](#)), mathematics, engineering ([Mendoza-Alonzo et al., 2020](#); [Ahmadi-Javid and Hoseinpour, 2018](#); [Xiaohui et al., 2014](#)) and organizations ([Ahmadi-Javid and Hoseinpour, 2018](#); [Barari et al., 2012](#); [Hernández et al., 2014](#); [Mendoza-Alonzo et al., 2020](#); [Prasad et al., 2019](#); [Zameer et al., 2018](#)). The Nash equilibrium ([Nash, 1951](#)) concerns a situation when the game players cannot improve their payoff by independently changing their strategy. This means that it is the best strategy assuming the other game player has chosen a strategy and will not change it ([Froschauer et al., 2012](#)). The Nash equilibrium will be reached when the best rewards are obtained after the game occurs ([Neslin and Greenhalgh, 1983](#); [Torres et al., 2018](#)). The saddle point property is a game theory concept that concerns the choices of game players that lead to the same result ([Von Neumann and Morgenstern, 1944](#); [Ngendakuriyo and Taboubi, 2017](#)). A payoff matrix ([Dahlstrom et al., 2014](#)) visually represents the decision-making process involved in a game in a

grid structure. One axis of the payoff matrix represents one player's decision. The other axis of the payoff matrix represents the other player's decision. The cells within the payoff matrix represent the outcomes reached, depending on which decisions were made by the players concerned. For a general two-player zero-sum game, for a saddle point to exist, the payoff matrix would need to include an element that is both a minimum of its row and a maximum of its column (Jadlovská and Hrubina, 2011). Game theory concerns the mathematical study of the decision-making process and mathematical models of conflict and cooperation. It means that it can model how individuals may behave in specific circumstances that resemble simple types of games, allowing an examination of the relationships between decisions and outcomes. In games that involve a deterministic relation between decision and outcome, there can be a utility value assigned to the outcome of each decision. The game theory and Nash bargaining solution have been used in many types of research. The Nash bargaining game data envelopment analysis (DEA) model was applied to supplier evaluation because the traditional DEA method adopts varying weights in the evaluation and fails to consider competition among the suppliers (Wang and Li, 2014). The Nash bargaining model has been applied to find a compromise solution among agents, and linear programming and interval coefficients have been used to find the best and the worst Nash bargaining solution (Safari et al., 2018). An optimization fuzzy game model of three-player payoff affected by customer demands in a green supply has been proposed, and a practical solution to increase the players' confidence to choose green strategies is obtained (Chavoshlou et al., 2019). Della Vecchia et al. (2019) combined game theory with fuzzy sets theory and used the Nash equilibrium and evolutionary algorithm to optimize the player's payoff function in uncertain conditions of customer demand. They followed a multi-objective optimization approach, paying attention to the variables which mainly influence the objective functions intending to compare different optimization strategies in the aircraft design field (Della Vecchia et al., 2019). A mathematical model was employed to determine the equilibrium among the four perspectives of the balanced scorecard as four players in a cooperative game to specify the relationship among indicators in the Esfahan Steel Complex Company (Abedian et al., 2021). Game theory is the science of studying and analyzing the decision-making environment in terms of interacting with others, or studying conflicts of interest and partnerships between players is wise, according to which each player must act wisely whenever the utility, profit, benefit and whatever the individual (decision maker) is looking for are not only affected by the effort. Game information with two players A and B and k strategies has been illustrated in the matrix of Table 1. S_{A_j} illustrated in rows are the strategies (choices) of player A and S_{B_j} illustrated in the columns are the strategies of player B. Strategies per the matrix are recorded in terms of the outcome of player A, and the outcome of player B for selecting the strategies of the two players is recorded in the matrix. For example, a_{11} represents the profit if player A chooses S_{A1} and player B chooses S_{B1} while b_{11} mutually expresses player B in these conditions.

2.3 Game theory and marketing

Without the aid of decision-making tools, managers find optimal strategic reasoning an unnatural task (Urbany and Montgomery, 1998). There are some key criticisms against the

Table 1.
Doubles game
information in the
format payoff matrix

		Player B			
		S_{B1}	S_{B2}	...	S_{Bk}
Player A	S_{A1}	(a_{11}, b_{11})			(a_{1k}, b_{1k})
	S_{A2}				

	S_{Ak}	(a_{k1}, b_{k1})		...	(a_{kk}, b_{kk})

marketing mix framework (Lauterborn, 1990; Rafiq and Ahmed, 1995; Möller, 2006; Popovic, 2006). Möller (2006) highlighted that marketing mix does not consider customer behavior, interactions of actors and interdependence of all marketing activities. So, the integration of a game-theoretical approach to marketing mix, which is the main focus of the present study, has been offered to resolve some shortcomings of the marketing mix framework. The Nash theory of cooperative games was developed as a predictor of the outcomes of buyer-seller negotiations in an experiment in media purchasing Neslin and Greenhalgh (1983). A methodology for planning marketing-mix in dynamic competitive markets was developed by incorporating strategic foresight and interaction effects (Naik *et al.*, 2005). The notion of strategic foresight was defined as anticipating the likely decisions of competing parties and adapting the optimal strategy in response to the best decisions of all other parties. The marketing-mix concept requires managers to recognize that multiple marketing activities (e.g. advertising, promotion) not only affect market shares directly but also amplify or attenuate the effectiveness of marketing activities indirectly. Antagonistic games with and without complete information and non-antagonistic games techniques are applied to paired comparison, ranking or rating data for a firm and its competitors in the market (Lipovetsky, 2007). The product portfolio optimization problem of manufacturers has been modeled in the form of non-cooperative games (Sadeghi and Zandieh, 2011). The imperfect or incomplete information that each of the game player possesses is a key ingredient of any game-theoretical model (Thomadsen *et al.*, 2012). A game theory approach was adopted for empirical analyses of bank and corporate customer relationships (Dahlstrom *et al.*, 2014). It has been used to study the mechanism of the electricity market (Vasin, 2014). The interactivity between actions and outcomes has been used to model consumer behavior (Kim *et al.*, 2014). Game-theoretical models have been built to investigate the implications of one manufacturer's two retailer supply chains (Qi *et al.*, 2015). The short-term and long-term behavior of agents in implementing the appropriate collecting strategy in a two-echelon closed-loop supply chain (CLSC) was studied (Esmaeili *et al.*, 2016). A game theory view of retail consumer behavior can involve viewing consumer purchases as a series of strategic decisions made by the consumer (Jiang and Srinivasan, 2016). A dynamic game-theoretical approach was conducted to study the pricing strategies of complementary products in distribution channels (Ngendakuriyo and Taboubi, 2017). A game theory model of forming enterprise development strategy in market environment uncertainty is proposed to increase enterprise market share (Mednikov *et al.*, 2017). Khanizad and Montazer (2018) used game theory to examine the impact of banks' cooperation on decisions not to cooperate. Their research results show that as banks cooperate in decision-making, their operating costs are reduced (Khanizad and Montazer, 2018). Gámez *et al.* (2018) suggested the use of game theory to cooperate with fishermen in cooperatives to safeguard the resources of the fish at sea and ensure the benefit of all members (Gámez *et al.*, 2018). Using optimization in economic-based game theory, the complexity of the pricing strategies and interaction and/or possible coordination within the cruise value-added chain were studied and offered benefits to both cruise passengers and service suppliers (Wang *et al.*, 2018). The dynamic game theory of incomplete information is presented to provide a theoretical basis to control brand counterfeiting and a mechanism to enhance brand revenue (Zameer *et al.*, 2018). A management model based on game theory is proposed to estimate the quantity of online generated leads and the online contracts gained in a given period of time based on the strategies of the rival firms as a set of reliable possible decisions (Zutshi *et al.*, 2018). A game theory approach was developed as a management model for estimating the quantity of online lead generation for oligopoly markets in terms of contracts gained in the most effective and efficient way possible (Zutshia *et al.*, 2018). Results showed significant effectiveness and efficiency of the decisions, which were unlike the notion argued by Viscolani (2012) that the advertising levels of one firm have (negative) implications on the rival firms' sales and its own

advertising levels; the present study reveals something entirely different. Torres *et al.* (2018) examined the use of game theory for e-mail marketing strategies (Torres *et al.*, 2018). The maxi-min mathematical model of game theory was used for selecting the appropriate marketing strategy with respect to rival's strategies for two brands of beverage manufacturer (Baradaran, 2019). A game-theoretical model with two strategies is developed to support the small-scale e-tailer in assortment planning (AP) decision-making (Saber *et al.*, 2019). The first strategy offers the product with supreme quality by procuring it from the main powerful supplier as a non-cooperative Stackelberg supply chain model in which the supplier plays a leader and the e-tailer is a follower; the second strategy offers the product from a less popular brand as an assortment planning problem model while considering utility degradation of providing alternative brand to the customers. The long-term market competition evolution of two-channel retail pharmacies under the network external environment is studied to obtain higher profits; two-channel retail pharmacies prefer to choose profit maximization marketing strategy or market share maximization marketing strategy (Li and Huang, 2019). The game theory combined with Monte Carlo simulation modeling is used to analyze different retail marketing strategies, in particular, using payoff matrices for modeling the likely outcomes from different retail marketing strategies (Taylor *et al.*, 2019). The relative impact of asset disposal and share buyback (ADSB) strategies on the performance and stability of international hotel chains was studied during a period of economic recovery (Bourke *et al.*, 2020). A review of previous studies indicates that there is a gap in carrying out more research. The integration of the game theory approach into a mixed marketing framework has as a generalized model for marketing strategy planning, and analysis can be advantageous in producing new knowledge.

3. Methodology

The present study develops and applies a practical management model to obtain the best marketing strategy in the competition between two major manufacturers of automotive products. The methodology in this research is based on the process of solving game-theoretical marketing mix optimization problems including problem expression, game component definition, modeling and analysis of results.

3.1 Problem statement

One of the markets in which the competition for selling its products is extremely intense is the automotive parts manufacturing market since it produces goods such as car spare parts that have a short lifespan and need to be replaced over the course of a day, week or month (Stark, 2015). High demand for these products daily, low-profit margin, the need for an extensive distribution network, high distribution costs, the existence of very potential producers and diversity of popular brands are some factors that make the importance of the marketing issue and the choice of appropriate marketing strategies more significant in this field.

Manufacturers of high-demanding products such as automotive parts have double trouble if they do not take into account competitors' considerations, movements in the production level, distribution of their products and application of appropriate marketing strategies in advance. So choosing proper marketing strategies before manufacturing and distributing new products increases the chance of success of companies. On the other hand, since there are constant changes in the market, it is assumed that decisions are made only at a specific period of time to choose the most important marketing mix component. These assumptions are somewhat in line with what is actually happening in this market.

3.2 Problem modeling

Before solving the game theory problem, it is necessary to identify the components of the game. These components include players, player's strategies and the game's targets and

objectives. In the present study, two players represent two brands of two companies producing automotive parts in Isfahan. According to the marketing mix theory, each brand as a marketing player can adopt many 4P-based marketing-mix strategies. Based on expert opinions in the high-end products market, four 4P marketing-mix strategies based on Table 2 are defined to facilitate modeling. This means that each player can focus on one strategy of Table 3 as their major marketing strategy.

For example, the first manufacturer ($i = A$) can produce its own products according to its major marketing strategy that is offering a better price than its competitor and is defined as “Price” strategy with the symbol S_{A1} . Choosing a pricing strategy does not mean that the manufacturer is only working on that strategy, but it means that it should focus more on it as an optimal strategy. Designing and producing various products with specific characteristics that meet the needs of the market and consumers are related to “product” strategy. Similarly, the supply of products in different locations and designing and executing promotional and advertising campaigns are labeled as “location” and “promotion” strategies, respectively. So the result is the matrix depicted in Table 4 with four rows and columns ($K = 4$). In the last part of the game, the payoff of the game for each player must be determined. The payoff of each player is defined as the willingness of the product buyers concerned with the player’s marketing strategy. If customers are more interested to buy automotive parts of brand A, it implies that they are less interested to buy automotive parts of brand B. So any gain for brand

Brand	B	Question
Brand A		In one store, A and B are two brands of automotive parts (two similar products) that are located on the same shelf (two similar locations) and have the same price but less than other competitors in the market, and you have no mind about advertising the two brands unlike others (equal conditions of promotion). Which brand is your desire and to what extent?
	5 4 3 2 1 0 1 2 3 4 5	
	Brand B	Suppose that brand A manufacturers produce a variety of products with specific shapes, but their price is similar to that of other competitors. On one shelf Brand A and B are located side by side (two similar locations), but the price of Brand A is lower than Brand B which its manufacturers produce only one type of this part with a specific packaging shape. It is assumed that the advertising of two brands will not affect your choice (Equal Promotion Terms), which brand is your desire and to what extent?
Brand A	5 4 3 2 1 0 1 2 3 4 5	

Table 2.
An example of a questionnaire question in a case study

Symbol	Strategy	Symbol	Strategy
S_{11}	Price	S_{12}	Promotion
S_{13}	Product	S_{14}	Place

Table 3.
Mixed marketing strategies

A leads to a loss for brand B. A questionnaire was used in this study to measure the tendency of customers to choose between these two brands. For each entry of the matrix, a question was designed in the questionnaire to measure the customers' tendency and preferences to buy products of brand A or B which is a kind of strategic decision.

Table 2 shows two examples of the two matrix questions in Table 1.

In the first question, both companies (in the original questionnaire the brands are mentioned, but in this article we will avoid mentioning them) have chosen a price reduction strategy, provided that they are the same in other location, promotion and product strategies. In this case, the customer's willingness to make a choice between two brands with a score of 0–5 is measured.

For example, the second question in the figure measures the customer's willingness to choose one brand; if Brand A has chosen the "product" strategy and the other the "price" strategy provided that other strategies for each one of two brands are the same, score 0 represents customer's indifference and score 5 represents customer's total desire of a brand. Any gain for brand A implies a loss for brand B.

The validity of the questionnaire was evaluated using the opinion of academic staff. To enhance the reliability of the questionnaire, the researcher was present at the time of completion of the questionnaires by responders and assisted them in understanding the questions of the questionnaire and accurate recording of information.

A total 384 questionnaires were calculated. In the following equation (1), n denotes sample size, p success probability ratio and an e error value. A total of 400 respondents were randomly selected at the large and medium-sized stores of Isfahan city to fill the questionnaires in summer 2019 during a period of 10 months. From these, correct and useful questionnaires were collected, totaling 390.

$$n = \frac{Z_{\frac{\alpha}{2}}^2 \times P(1 - P)}{e^2} = \frac{1.96*1.96*0.5*0.5}{0.05*0.05} = 384 \quad (1)$$

Finally, the components of the game are summarized in Table 3. The first number in each matrix represents the profitability of player A, and the second number represents the sum of the weighted tendencies for brand B. Games like in Table 3 matrix are called symmetric games in which the players' strategies are the same and a_{ij} is equal to b_{ji} .

The security levels demonstrate the payoffs determined for the players without cooperation, so the security status quo can be defined as a starting point for interaction between the players. Nash suggested an effective and convenient approach to bargaining model that is based on the following six axioms: rationality (the arbitration scheme should lead to a solution at least as good as the status quo), feasibility (the solution belong to the payoff polygon and its borders), Pareto optimality (the solution cannot be outperformed by another feasible point), independence of irrelevant alternatives (if the status quo point remains unchanged, adding new feasible outcomes cannot change the solution), invariance to the utility linear transformation (any change of the units of measurement should not have any impact on the solution) and symmetry (for the players who are located in symmetric positions

Table 4.
Payoff matrix of two-
person game theory

		Brand B			
Brand A		S_{B1}	S_{B2}	S_{B3}	S_{B4}
	S_{A1}	(2, 3)	(3, 4)	(4, 5)	(1, 3)
	S_{A2}	(4, 3)	(3, 3)	(2, 4)	(2, 2)
	S_{A3}	(5, 4)	(4, 2)	(2, 3)	(3, 4)
	S_{A4}	(3, 1)	(2, 2)	(4, 3)	(2, 2)

the arbitrated outcome should demonstrate equal payoffs). These six axioms unambiguously outline the best bargaining resolution within the maximization of the equilibrium condition:

$$\begin{aligned} \max Z &= \prod_{i=1}^N (f_i - d_i) \\ \text{s.t} & \\ f_i &\geq d_i \quad i = 1, \dots, N \\ f_i &\in F_i \end{aligned} \tag{2}$$

Where f_i is the utility of player i , F_i is feasible set of the model and $d = \{d_1, \dots, d_n\}^T$ indicates the minimum required levels of utility (or dis-agreement utility); the inner points of this model are considered as a solution.

Nash model has been developed for a number of available effective and discrete solutions:

Using the Harsanyi Nash method, q number of reasonable solution of the finite vector F_l was considered. The following model is a mixed and conditional n -player planning in order to access the agreed solution of q number of obvious solutions:

$$\begin{aligned} \max Z &= \sum_{i=1}^N \text{Ln}(f_i - d_i) \\ \text{s.t} & \\ f_i &\geq d_i \quad i = 1, \dots, N \\ f_i - M_l t_l &\leq f_i^l \quad l = 1, \dots, q \\ \sum_{l=1}^q t_l &= q - 1 \\ t_l &= 0 \text{ or } 1 \\ f_i &\in F_i \end{aligned} \tag{3}$$

f_i^l refers to the obvious value of objective i th in the obvious solution F^l , M_l is equal to a large value (compared to existing coefficients of problem), and d_i is the minimum required level of utility for the player i th and d_i is chosen in a way that it does not make the problem unpractical.

4. Research results

In this research, the optimal selection of marketing strategies and customers' preferences for two brands of automotive part products in Isfahan has been investigated. A game theory approach to marketing mix was adopted to study player's behavior, marketing strategies and competitive interactions and preferences. Two brands of automotive part products were considered as players of the game and four elements or 4Ps, namely product, price, promotion and place of marketing mix model of McCarthy (1964), were considered as the four strategies of the game. The purpose of designing a game is to predict or explain how players behave in a given situation. As noted, if a strategy pair is included in the matrix of Table 1 to optimize the outcome of each player without knowing the opponent's move, they are called the Nash or saddle equilibrium point. Table 4 and model 3 were used to obtain this point. We used Games software to solve Model 3. A payoff matrix is a visual representation of all the possible outcomes that can occur when two individuals make a strategic decision. One axis of the payoff matrix can represent the brand A strategic decisions. The other axis of the payoff matrix can represent the strategic decisions adopted by brand B. The cells within the payoff matrix can represent the outcomes that depend upon strategic decisions made by brand A

and brand B as the main players of the game. Given that two brands have four strategic choices, a total of 16 choices were obtained.

By choosing the minimum level of utility $d_1 = 3$, $d_2 = 4$ and solving Model 3, the results obtained from the questionnaires were analyzed.

The results show that the best decision for brand A is to focus on the marketing strategy of the price, and brand B must choose a product strategy to maximize its payoff. It means that the optimal marketing strategy for company A (brand A) is the “price strategy” and the optimal marketing strategy for company B (brand B) is the “product strategy” to maximize their payoffs. Also, choosing a strategy from the 4P components is not the pure application of that specific strategy, but it is about focusing on that proposed strategy to gain more profit.

In game theory terms of Nash equilibrium, the concept of a saddle point is the most appropriate combination of strategies for players so as not to benefit the general well-being of players (Taylor *et al.*, 2019). This simplification, however, does not take branding or other marketing issues into consideration in game theory terms, and this is when the A company wins over a set of consumers, or wins over competitors of company B. In a situation where there is no pure strategy for players, there is no equilibrium, and brands are unaware of the competitors action, calling the game a complex optimization strategy, which calculates the probability of choosing p_i and q_j for each player and the available strategies to him/her to maximize the minimum mathematical expectation (8 expected values) of his interest. However, not all marketing mix situations may have saddle points, since consumers may not respond to particular 4p approaches.

5. Theoretical contributions

Empirical research and studies can be considered as a cycle of theory and model building and development by providing operational insights and having an impact on practice. The empirical results of the present study may provide some general insight and help for marketing modelers and practitioners who are working in the area of game theory and marketing to specify the type of model most useful for a specific competitive situation. Game theory is a theoretical investigation of the optimal strategies of rational actors for decision-making in conflict situations in which parties' outcomes are interdependent (Kahan and Rapoport, 2014). Since issues of interaction, mutual outcomes, conflict and interdependence are pervasive in organizational, commercial and social life, game theory's domain might appear universal and far-reaching. Mathematical models of game theory were formulated to study decision-making in situations involving conflict and cooperation in which two or more parties are involved, pursuing different goals to obtain the greatest gain for themselves when resolving a conflict situation. The present study contributes to the literature in several aspects. The first contribution of this study lies in the adaption of a game theory approach to the marketing mix as a decision-making tool in an industrial sector for planning and adopting optimal marketing strategies as well as customers' preferences. The game theory and the Nash equilibrium model can provide a practical approach to find and adopt the right strategy, know competitors' movements and strategies and get more profit which is of great importance in today's competitive environment. Second, a game theory approach to marketing mix was adopted to study player's behavior, marketing strategies and competitive interactions and preferences, which can support the development of marketing strategies and modeling. A game theory can provide an approach for analyzing problems of competition and negotiation in marketing settings. On the other hand, the empirical focus of marketing science can provide the necessary tests required to evaluate alternative concepts of equilibrium and to assess the descriptive soundness of game-theoretical models (Chatterjee and Lilien, 1986). Third, as a practical application of game theory in marketing management, this model gives managers a better opportunity for logical decision-making by determining the equilibrium point in the strategic map of an organization and investing limited resources in the areas that

need more improvement. Fourth, the present study also contains a practical example of the application of the proposed model to real company practice. Fifth, the game theory approach of the present study is flexible enough to change the conditions of the game, the composition of players and so forth, which makes game models more appropriate to the real situation. Furthermore, many game models can be easily formalized and implemented at the software level to search for optimal solutions for games in the interpretative mode. Thus, the game-theoretical approach of the present study to marketing mix strategies of an industrial enterprise can be considered justified.

6. Managerial implications

Game theory has been traditionally applied to the simulation of competition on the battlefield and the adoption of military strategies (Simaan and Cruz, 1975; Bacharach, 2019). Then game theory approach was developed by Von Neuman and Morgastern (1944) to solve conflicting problems, analyze interdependences and the effects of competitors' interactions and predict the competitive behavior of players in economics and marketing science. An important contribution of game theory to marketing decision-making is its consideration of rationality for actions of decision-maker and behaviors of competitors. The application of game theory into marketing mix is suggested in the present study as a framework to help firms predict future competitive behaviors with better accuracy and probably improve the quality of decision-making in the face of unforeseen competitive action. A game theory approach to analyzing marketing- mix strategies and objectives in a competitive setting is a reasonable supplement to the traditional methods of managing marketing. It may be applied to handle the problem of competition in a more satisfactory manner and improve the quality of conscious and goal-oriented decision processes (Shubik, 1972; Di Benedetto, 1986; Myerson, 1992; Farris *et al.*, 2010; Taylor *et al.*, 2019) for scholars, top executives and managers who have difficulty in deciding which strategies to employ for a particular decision among all the possible ones (Lehmann and Reibstein, 2006). Di Benedetto (1986) pointed out that the choices about marketing mix taken by middle management coincide with the ways of player's action in a game; player's preferences correspond to the product's objective decided by top management; relations and results depend on competitors' choices in the market; and the best information optimizes the decision process. Game theory explains the rationality of decision-making and strategic preferences of stakeholders to get a better deal in competitive situations that influence the interests of others (Myerson, 1992). The present study takes a game-theoretical approach to the marketing mix to analyze the likely outcomes resulting from different marketing strategies adopted by an organization. The rationale for applying game theory to marketing mix strategy management is that it can provide an approach to modeling, describing and documenting the likely outcomes of the adoption of different marketing strategies. It provides a mathematical methodology based on the game theory approach for planning optimal marketing-mix strategies in dynamic competitive markets, taking into account strategic foresight and interaction effects in the marketing planning, which requires looking forward and reason backward in making optimal decisions. However, as stated, the most basic game theory concepts, such as the zero-sum game, which describes conditions in which each gain by one player produces an equal and corresponding loss for the other, may have limited applicability to marketing (Anderson, 2010).

7. Conclusions

In this paper, the use of the game theory approach for analyzing marketing-mix strategies regarding competitors' behavior is suggested. For this purpose, the static, uncooperative, symmetrical games are considered to apply. Every brand manufacturer is trying to select

appropriate marketing strategies to get the attention of more customers, sell more products, gain more profits and gain a stable position in the competitive marketing environment. So in analyzing these games, each brand needs to study the competitor's reaction and behavior in the market to choose its optimal strategy based on knowledge. One approach to finding and adopting the right strategy is to know competitors' movements and strategies in a competitive market that all parties strive in order to get more profit. In this study, the problem of optimal marketing strategy choice between two well-known brands of automotive products in Isfahan has been studied. The mixed components of marketing and theoretical game strategic options are provided for each player, which can be extended to binary strategies or triple combinations, and more. The creative approach of this study is to use a questionnaire to measure the payoff of each brand by selecting different marketing strategies. Once the game matrix has been formed (including game components), each brand can make strategic decisions by knowing the strategy of the other party. In the absence of information about other brands, each brand is trying to end the game with a cell that will generate the most revenue. So there may be a pair of pure strategies for both brands that are ideal for the game. If both brands attempt to maximize their benefits without imposing any losses to their opponents, there are often no optimal net strategies in game theory. Thus, under these conditions, the possibility of choosing each strategy as a mixed strategy is raised. The results of solving the proposed model as well as data collection and analyses demonstrated that the optimal marketing strategy for company A (brand A) is the "price strategy," and the optimal marketing strategy for company B (brand B) is the "product strategy" to maximize their payoffs. Adoption of a strategy as an optimal strategy does not imply the mere application of that specific strategy; it is about focusing on that proposed strategy to maximize the payoff, gain more profits and find optimal solutions or stable outcomes. The proposed model of the present study can provide a more formalized mechanism for examining how competitors and consumers may respond to the different marketing-mix strategies in a practical manner that can be applied in professional practice (Taylor *et al.*, 2019). Game theory has been used to analyze the actions and outcomes of consumers in terms of the likelihood of being willing to pay for a given product when different temporary options are available. By analyzing the consumer's actions, consumer's behaviors and preferences, as well as competitors' reactions and interactions over a period of time, analytical models to different approaches can be developed and multiple marketing strategies and approaches for estimating the likelihood of organizational success can be designed (Doherty and Delener, 2001).

8. Limitations and future scope

In this section, several limitations of the present study which create avenues for future research have been identified. First, the proposed model of this study should be replicated across multiple samples. This framework is based on the Iranian community and experts' viewpoints; therefore, different results may be obtained if it is applied elsewhere. In addition, since the data are collected in a specific period of time, the results cannot be extended to other periods of time.

Second, the analysis is limited to two manufacturing firms, and more organizations and participants can improve the quality of empirical analyses and results. Third, managers in practice may not be able to consider the 4P marketing-mix strategies as a static reference, adding new parameters to the original mix or replacing it with alternative frameworks altogether. Some of the strategies included in this study may be more or less relevant to managers' businesses. However, the proposed model is flexible enough so that a manager or researcher could substitute their objective performance measures and strategies instead of ours to examine more organizations and participants. It is important to note that some games may not have a saddle point or may not have access to the most appropriate strategies for

many reasons such as (1) the true value of utility functions is often unclear; (2) the importance of weights of players and decision criteria are unclear; (3) effective solutions on efficient frontier are numerous; (4) decision criteria for players may not be similar; and (5) incomplete information may be available for a given game.

It is recommended that Bayesian equilibrium point (NEMS) be used for future work and to solve the above problems using the expected utility. Evolutionary games can also be used as examples. Given that product prices in the market fluctuate based on supply and demand, each manufacturer's strategy involves the production volume at a given time, and the equilibrium point can be obtained and analyzed by examining the conditions of an oligopoly game with a practical example and considering dynamics of the system. The 7P strategies, 15P strategies and 4C strategies can be used in future studies. The underlying assumptions of game theoretical models about available knowledge, the descriptive nature of market equilibrium or the objectives of competitive rivals may bear little resemblance to real marketing situations. Game theory analyzes the behavior of rational players while irrational factors prevail in the real marketing context, human behaviors and consumers' choice (Harsanyi, 1982). So, more investigations and advances in the area of dynamic games are required to enrich the theory of game and make it more applicable to the modeling of the real-world competitive strategies.

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