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A practical model for outsourcing bank services: The application of game theory

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A B S T R A C T

Objective: Banks tend to outsource their services to focus on their main task: collecting deposits and directing them toward investment. This research aims to identify a model that facilitates handing over services to the private sector and covering the interests of both parties in a win-win situation.

Method: In this study, 16 semi-structured interviews with experts from banks and payment service provider (PSP) companies were conducted to understand outsourcing strategies for card reader devices. Employing Strauss and Corbin's thematic analysis and game theory, the study identified key strategies and preferences, which were then modeled to resolve conflicts and derive joint interaction strategies. Over 4 million scenarios were calculated using Min-Max strategy, and strategies for both parties were suggested based on Nash equilibrium results.

Results: The qualitative data analysis resulted in identifying 22 strategies based on service marketing mix for parties and placing them in related groups (product, price, promotion, place, people, process, and physical evidence). The results of game theory and the balance point suggest the following strategies to the bank: diversity, quality, the latest device model, average account, number of agents, technical expertise, equipped workshop, and support equipment. The suggestion for the payment service provider (PSP) companies include brand, rent, transaction fee, discount, response hours, raffle, gifts, special privileges, appropriate treatment, type of cooperation, timely delivery, response speed, communication system, and location.

Conclusion: The final outcome suggested specific strategies for banks and PSP companies to focus on, based on the Nash equilibrium and other game theory results. These strategies included diversification, quality, device up-to-datedness, technical expertise, equipped workshop, support equipment for banks, and brand, rent, transaction fees, response hours, lottery, gifts, special privileges, timely delivery, response speed, communication system, and location for PSP companies.

Keywords: *outsourcing, marketing mix, game theory, Nash equilibrium*

1 Introduction

Organizations' motivation for outsourcing varies depending on their nature. In the past, outsourcing was used only when organizations could not perform certain tasks for various reasons, such as inability, lack of capacity, financial pressures, or technological limitations. However, even entirely successful organizations today use this tool to modify their organizational structure (Gantman, 2011).

The literature on modern organizational management has closely associated outsourcing with privatization and liberalization to increase competition and efficiency (Goldschmidt & Schmieder, 2017). Outsourcing, involving the external provision of goods and services, is a strategy employed by organizations to reduce costs, increase revenues, and focus on core activities, thus leading to higher productivity and income. Peter Drucker sees outsourcing as transformative for future global organizations (Drucker, 2002), emphasizing its role in reducing organizational size while increasing focus on activities aligned with organizational goals. Similarly, Peters advocates for organizations to outsource non-core activities to concentrate on what they do best. The practice, once common among organizations with financial or technological shortcomings, is now prevalent even among successful organizations to restructure and focus on key capabilities. Outsourcing can encompass a wide range of services including accounting, HR management, and procurement. It's viewed as a means to achieve flexibility, quality, and competitive advantage (Dehghani Poudeh et al., 2018).

In marketing, the concept of the marketing mix is critical for understanding customer needs and includes a variety of strategies and tactics. Originally consisting of 12 elements, the marketing mix was later distilled into the 4Ps: price, product, place, and propaganda (Borden, 1964). However, critiques have led to expansions and adaptations like Bennett's 5V model and Latterburn's customer-centric approach. The 4P model has been criticized for its product orientation and failure to consider customer behavior, leading to its extension to 7P in the service sector to include people, process, and physical evidence (Mason & Staude, 2007).

Game theory, a branch of applied mathematics, is utilized to predict the strategic moves of players in a game for optimal profit (Gibbons, 2001). It analyzes situations where players' actions are interdependent, considering the environment as strategic if there's mutual influence and reaction among individuals (Ebrahimpour Azbari et al., 2021). Its applications are vast, including economics, stock market behavior, and auctions. Game theory encompasses various types of games like static or dynamic, cooperative or non-cooperative, and zero-sum or variable-sum, with each having multiple dimensions and models. Notable game models include Nash's model, Stackelberg's model, the focused model, Bertrand's model, and the agreement model, each providing different strategic implications for players' interactions and outcomes (Abedian et al., 2022).

Some developed a model to bridge the gap between strategy formulation and implementation in public organizations, employing grounded theory for component classification (Ebrahimi et al., 2021). Moreover, Amiri et al. (2019) optimized outsourcing in the supply chain through a mathematical model using Markov chain theory and various algorithms (Amiri et al., 2019). Akbari et al. (2020) explored the impact of outsourcing on innovative performance in pharmaceutical companies, revealing significant effects on innovation performance (Akbari et al., 2020). Ebrahimpour et al. (2021) chose appropriate outsourcing strategies under uncertainty using TOPSIS and VIKOR methods, focusing on service quality, flexibility, and delivery (Ebrahimpour Azbari et al., 2021). Ghanbari et al. (2019) identified five main factors for outsourcing maintenance in police logistics using hierarchical analysis (Ghanbari et al., 2019). Honarvar and Rezaei (2018) utilized dynamic game theory for pricing in two-channel supply chains, achieving effective solution methods for the proposed model (Honarvar & Rezaee, 2019). Lok et al. (2021) assessed success factors of facilities management outsourcing in Hong Kong educational centers, concluding that outsourcing led to better working environments and sustainability (Lok et al., 2021). Nkonde and Phiri (2020) studied outsourcing of contact centers in banks, emphasizing its importance for customer relations (Nkonde & Phiri, 2020). Daryaei et al. (2020) presented a decision-making model for outsourcing in banking financial services, ranking different outsourcing activities (Daryaei et al., 2020). Hosseini and Dadashi (2021) investigated tax relations between government and companies using game theory to find a balance in tax avoidance conflicts (Hosseini & Dadashi, 2021). Mahmoudi and Sadeghi (2020) used game theory for pricing strategy and inventory control in competitive environments, focusing on perishable goods (Mahmoodi & Sadeghi, 2020). Hajesmailian and Nezamivand Chegini (2020) identified factors affecting strategic alliances using meta-analysis and fuzzy Delphi technique (Hajesmaeilian & Nezamivand Chegini, 2020). Raoufinia et al. (2019) analyzed competition in multilateral

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monopoly markets using dynamic game theory, focusing on price stickiness, advertisements, and substitute goods (Raoufinia et al., 2019). Liu et al. (2021) examined group bids in reverse auctions using an evolutionary perspective of the three-way game, creating a model predicting behavioral evolution and equilibrium point (Liu et al., 2022). Abedian et al. (2929) presented a new model for performance evaluation based on the balanced scorecard and game theory, determining the most appropriate combination of indicators (Abedian et al., 2022). Kohfi et al. (2020) evaluated the performance of bank branches using game theory strategies and satisfiability functions, suggesting improvements for inefficient branches (Kahfi et al., 2020).

The review of the outsourcing literature shows that researchers have usually considered the strategies and priorities of one party, i.e., the employer while ignoring the strategies of the other party. However, to ensure better fulfillment of the processes and better and longer cooperation, there must be joint interaction in which the interests of all parties are secured. The present research tries to find a win-win balance point for this joint interaction by identifying the strategies adopted by the outsourcing parties based on expert opinions.

Based on the literature review, there is a gap in the application of game theory in the field of marketing issues, which has been attributed by experts to various factors, such as the constraints of this theory in terms of the number of players, the number of strategies of each player, and the indiscernibility of the intentions of all market competitors in the real environment. On the other hand, the rationality of game theory has no place in marketing, because all marketing strategies emphasize intangible aspects and symbolic values that are the basis of customer choice.

By considering 22 strategies derived from interviews with experts and by calculating the consequences of 4,194,304 scenarios based on the strategies adopted by the parties, the present research tries to resolve the conflict and achieve joint interaction using game theory in which mathematical modeling of the outsourcing process is adopted to deal with the constraint of the number of strategies of actors in game theory.

2 Methods and Materials

A total of 16 semi-structured interviews were conducted with experts from both banks and PSP companies. These experts were composed of 5 women and 11 men with varying degrees of education and career length. The experts provided insights into the bank's and companies' preferences and practices in outsourcing. Interviews were utilized as the primary data collection method, with the aim to understand the various strategies and priorities from both banks and PSP companies' perspectives.

Strauss and Corbin's method of thematic analysis was employed to analyze the data gathered from the interviews.

Initially, 273 initial codes or open codes were derived. These were then continuously compared and categorized into 22 subgroups based on their similarity and relevance to the identified concepts. The main categories for these strategies included product, price, distribution, promotion, people, process, and physical evidence. The identified strategies and preferences were then modeled using game theory to resolve conflicts and achieve a joint interaction strategy.

Various scenarios (over 4 million) were calculated based on the strategies adopted by the bank and PSP companies. The Min-Max strategy, a decision-making method under uncertainty, was used to identify the best scenario for both parties. After identifying the strategies and priorities, weights were assigned to the indicators based on the experts' opinions using a pairwise comparison questionnaire and hierarchical analysis. This helped in quantifying the importance of each strategy and making the game theory application more precise.

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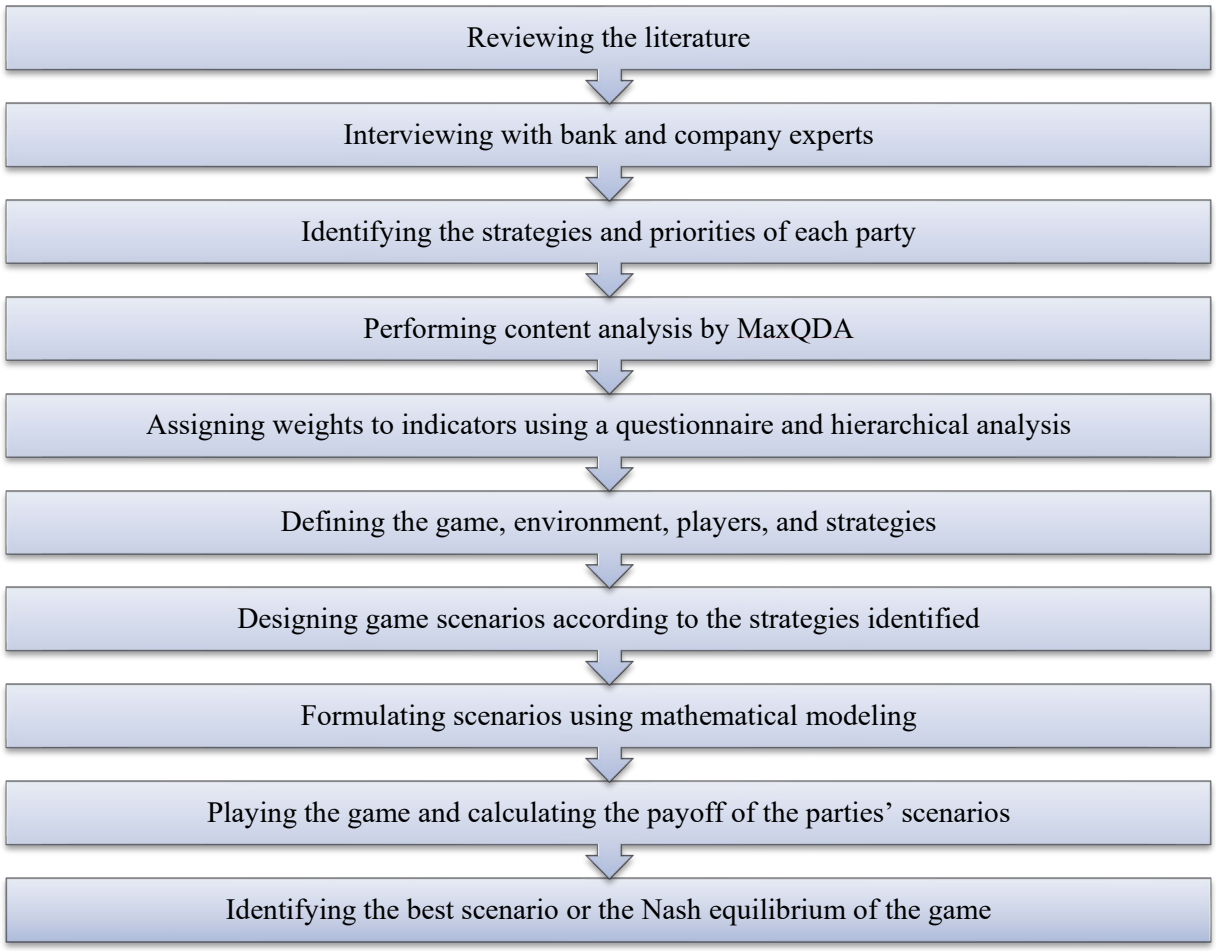
Figure 1

Steps to identify the best bank strategy in interaction with PSP companies



3 Findings and Results

To identify the bank's strategies and priorities in outsourcing card reader devices and to identify the company's strategies and priorities in accepting and convincing the bank to cooperate, the researchers conducted 16 semi-structured interviews with experts from PSP companies and the bank. The participants were composed of 5 women and 11 men in terms of gender. One participant was a Ph.D. candidate, 11 had master's degrees, and four had bachelor's degrees. In terms of career length, three participants had over 20 years of career, whereas it was 15-20 years for six participants, and <15 years for seven participants.

First, 273 initial codes or open codes were derived. In the second step, by continuously comparing the created open codes, similar codes were grouped based on the similarity of the degree of compatibility with the discovered concepts. As a result, 22 subgroups were created and they were then categorized into seven main groups, including product, price, distribution, promotion, people, process, and physical evidence based on semantic, conceptual, and operational affinity. A summary of the identified codes is provided in Table 1.

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Table 1

A summary of the strategies of banks and PSP companies identified by content analysis

Main category	Subcategories	Open codes (concepts)
Price	Discount Transaction fees Account average	BANK: The rental of the device must be in accordance with the bank's standards. Devices with high transaction should have a discount. The only benefit of the bank in this interaction is the average account of the device. To avoid the collection of the device, the average account of the device is very important. PSP: The rental of the device should be proportional to the service and maintenance costs of the device. The status of the number of transactions of devices. The devices should be installed in commercial places with high number of transactions. According to the number of transactions, the profit received by the company increases.
Product	Device brand Variety of products Device quality Update of products	BANK: Company resume. Company's work history. The company's devices must be new and of a valid brand. The company's portal should be fast and easy to use. The models of the devices must be among the latest available devices. The software of the device must be able to update automatically. The company must be able to supply all types of terminals such as LAN, wireless, GPRS, touch, and Android. The devices should be of high quality in terms of construction, body, antenna, battery charging rate. PSP: According to the needs of the bank, the company can provide different types of devices in terms of telecommunication platform and service delivery method. Providing the most up-to-date and diverse products and services with the highest quality.
Place	Number of representatives Response time	BANK: The representatives of the company should be in accordance with the geographical location and the number of devices. The response time of the support staff should be consistent with the working hours of the device receivers. PSP: The increase in the number of support offices and backups should be proportional to the installed card readers. The increase in the response time of the support staff should be proportional to the working hours of the markets in the covered areas.
Promotion	Lottery Gifts Special privileges	BANK: Carrying out a lottery between the recipients of the POS device. Donation of advertising gifts to the owners of POS devices. Providing special services to POS device owners such as accounting software. PSP: At the end of each season, a festival is held for the device owners. The lottery is based on the transaction points of each device. Apart from that, promotional items such as gift card, flash memory, etc. Installing an accounting system on the sales terminal with the ability to connect the device to the company's accounting system, for special customers, chain stores, and companies that have customers outside the store.
People	Technical expertise Proper behavior Type of cooperation	BANK: The level of technical expertise of personnel, the company should use expert and experienced personnel. Maintaining customer respect. The proper treatment of company personnel and representatives with customers is very important for the bank. The type of cooperation agreement of the representatives influences how they do their work and commitment. PSP: Holding educational courses, employing expert staff, holding specialized courses, changing the status of representatives from daily wage to contract.
Processes	Response speed Timely delivery Tracking system	BANK: The interval between the notification of failure and the presence of the company representative should be standard. Defective devices must be replaced quickly. The interval between the registration of the request by the customer and the delivery of the device by the company should be standard. The device must be supplied upon the customer's request fast. The company should have a system to follow the process of doing things. PSP: The number of representatives and representative offices should be increased to quickly respond to registered requests. The company has the possibility of timely delivery of registered requests. Customers can track their requests through the company's portal.
Physical evidence	Location Equipped workshop Backup device	BANK: Checking the company's resume and reputation. The location of the company, company building. Company assets. The offices are equipped with technical equipment. The possibility of repairing devices in representative offices. The company must have backup equipment. PSP: Share of the bank market in the banking system of the province. Being in commercial places. Device installation locations. Increasing the number of backup devices to quickly respond to customers. The offices are equipped with repair equipment and backup devices.

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Figure 2

Codes and sub-codes segmented model of strategic priorities of PSP banks and companies (Source: research findings)

3.1 Assumptions identified from the interviews with bank experts and experts of PSP companies

Price: the total income and expenses that each device has for the parties during a month.

Rent: the cost that the bank pays to the company every month for the support of each sales terminal device.

Transaction fee: a fee that is deducted from the bank account for each transaction and a percentage of it is deposited into the PSP company account. Devices with higher transaction numbers are more profitable for the company.

Discount: Reducing the amount of rent, which can be in the form of non-payment of rent for several devices). For example, the discount for 5 thousand devices is the rent of one thousand further devices or a discount in the payment for the rent of high-transaction and high-cost devices.

Deposition of the device: Average monthly account connected to the sales terminal. Considering that the only profit of the bank comes from this place, this index is very important for the bank.

Product: the physical device to meet the needs and demands of the customers applying for the sales terminal.

Brand: model, company, and country of the device manufacturer

Product quality: including the quality of device hardware, antenna power, device charging time, device power-on speed, transaction speed, and customer receipt printing quality

Product diversity: providing different types of fixed, wireless, store card readers, etc.

The newness of the products: using the latest and most advanced models of card readers available in the market with the latest software versions.

Place: Everything related to registration, allocation, delivery, installation, and support of card reader devices

The number of representatives: the number of companies' support centers located in the main cities of the province or the number of support centers located in different regions of the province to respond to applicants and owners of sales terminals.

Response time: the time taken by the company's support staff to respond to customers.

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Promotion: the set of actions taken by the company to encourage the acceptors to use the bank's card reader devices.

Holding a seasonal festival and lottery: at the end of each season, the company organizes a lottery among device owners and awards them prizes.

Promotional gifts: the company gives gifts, such as flash drives, scales, wireless modems, etc., to customers.

Special privilege: The company assigns special privileges to VIP customers, including membership in the customer club, special discounts, connection between the company's accounting system, and the card reader.

Physical evidence: the physical location of the company's office, hardware equipment, and other visible assets of the company.

Location and property of the company: location, size, and interior decoration of the location of the company's office, as well as the company's physical property.

Equipped workshop: the company must have an equipped workshop for specialized repairs of sales terminals.

Back-up equipment: the number of devices and hardware equipment that the company has in its possession, apart from the device supply contract, to replace defective equipment.

People: the personality and behavior of the company's personnel with customers, the level of expertise, and the type of employment of the company's personnel

How to deal: personality and type of interaction of company personnel and representatives with customers.

Knowledge and experience of personnel: the level of expertise and experience of company representatives in solving hardware and software problems.

The type of cooperation of the company's personnel: Considering that the correct implementation of the support process and installation of sales terminals by the company's representatives is important for the bank, the type of their employment can be important in official, contractual, or hourly terms.

Process: includes customer services from the time of the request, information registration, allocation, installation, and support of sales terminals.

Timely delivery and installation of the sales terminal: one of the important goals of banks in their contracts with PSP companies is to standardize the delivery and installation time of the device from the time of registration in the company's portal to the time of delivery to the customer. The correct performance of this process has a special role in customer satisfaction and attraction.

Response speed: the response time of the company's personnel and representatives to requests, resolving discrepancies and cases of failure announced by customers, which should be a standard time.

Communication system: the company's communication system must be able to access and log in quickly and easily for the receivers to register, monitor, and follow up on requests related to sales terminals.

Table 2

The rate of repetition of concepts identified in the interviews with experts

Main concepts	Identified strategies	Repetition rate	Percentage of repetitions from the total	Repetition by banking experts	Repetition percentage	Repetition by company experts	Repetition percentage
Process	Response speed	38	10.30	22	11.64	16	8.89
People	Technical expertise	28	7.59	18	9.52	10	5.56
Place	Number of representatives	26	7.05	14	7.41	12	6.67
Price	The monthly rental amount of each device	24	6.50	5	2.65	19	10.56
Product	Brand	24	6.50	13	6.88	11	6.11
Product	Quality of products	22	5.96	14	7.41	8	4.44
Physical evidence	Backup device	20	5.42	12	6.35	8	4.44
People	Proper behavior	19	5.15	12	6.35	7	3.89
Promotion	Special privileges	18	4.88	7	3.70	11	6.11
Price	Transaction fees	18	4.88	2	1.06	16	8.89
Place	Response hours	16	4.34	5	2.65	11	6.11
Physical evidence	Equipped workshop	15	4.07	7	3.70	8	4.44
Product	Variety of products	15	4.07	6	3.17	9	5.00
Promotion	Promotional gifts	13	3.52	9	4.76	4	2.22

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Process	Timely delivery of the device	13	3.52	8	4.23	5	2.78
Promotion	Holding a festival and lottery	12	3.25	6	3.17	6	3.33
Process	Tracking system	11	2.98	5	2.65	6	3.33
Physical evidence	Location	9	2.44	3	1.59	6	3.33
Price	Account average	9	2.44	9	4.76	0	0
Product	Update of products	9	2.44	5	2.65	4	2.22
Price	Discount	6	1.63	5	2.65	1	0.56
People	Type of cooperation	4	1.08	2	1.06	2	1.11

As shown in Table 2, the strategies of response speed, technical expertise, number of representatives, rental amount, and brand were most repeated in the interviews of the parties. The bank's experts emphasized the speed of response, technical expertise, the number of representatives, and the quality of products, and the experts of the company emphasized the rent, the speed of response, and the transaction fee. In the interview with the company's experts, the average account was not mentioned.

Figure 3

Steps to identify the best bank strategy in interaction with PSP companies

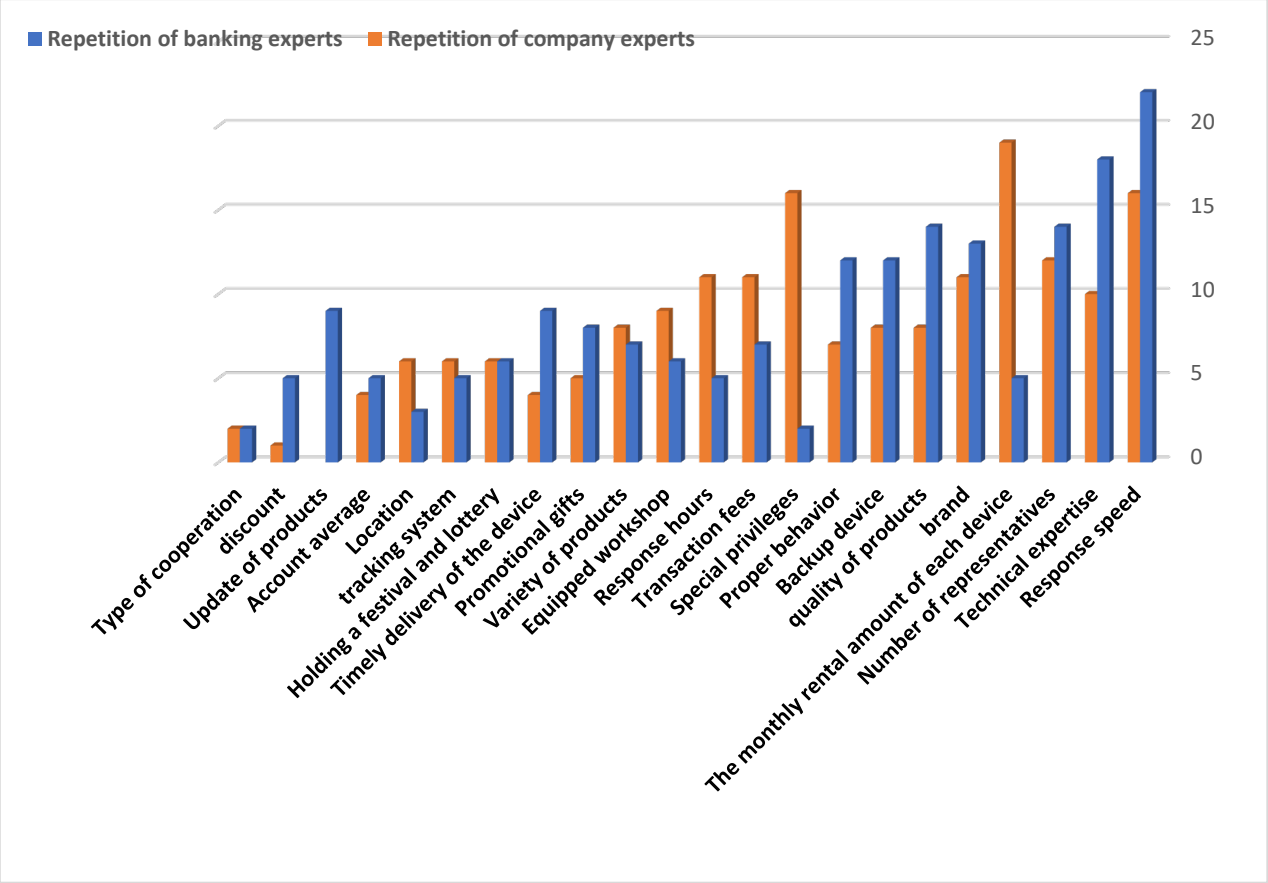

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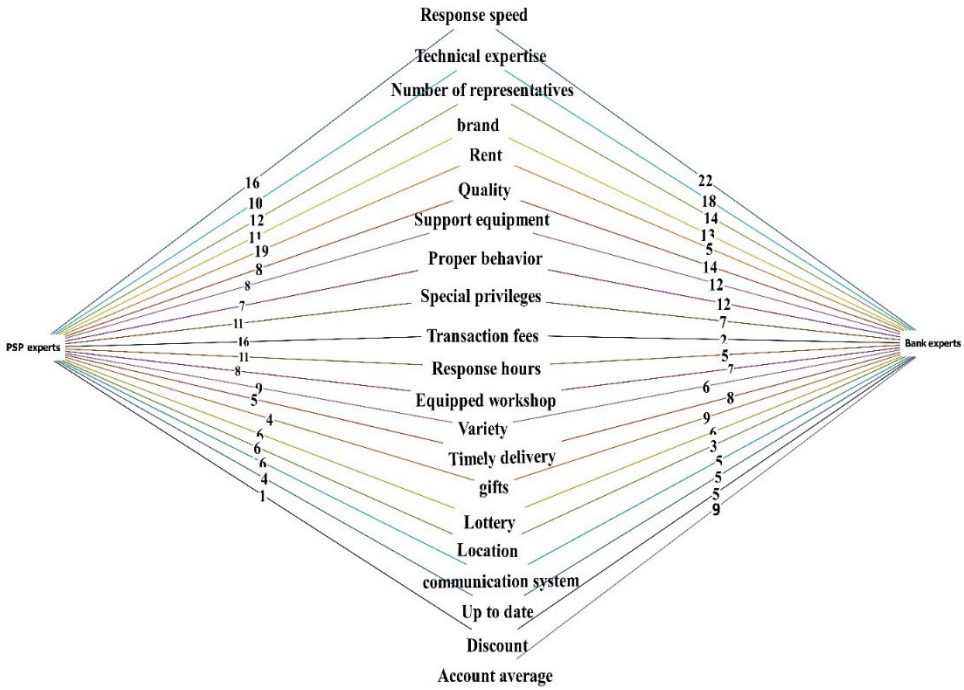
Figure 4

The level of emphasis of the bank experts on the identified strategies compared to the company experts



3.2 Weight assignment to the identified strategies

After identifying the strategies and priorities of the bank and PSP companies, since the concepts identified did not have the same importance for the parties, the indicators needed to be assigned with weights. For this purpose, a pairwise comparison questionnaire was used to collect the opinions of the experts about the value of the seven main product indicators, including price, distribution, promotion, personnel, process, and physical evidence, and their sub-indices. The questionnaires are attached.

After collecting the questionnaires based on the scores and prioritization of the variables, a pairwise comparison matrix was formed, and the weights of the indicators were determined using hierarchical analysis. The weight and inconsistency ratio of the identified indicators are presented in Table 3.

Table 3

The weight of the identified indicators based on the opinions of the experts

Main indicator	Symbol	Bank weight	Inconsistency Ratio	The weight of PSP companies	Inconsistency Ratio
Product	P_t	0.328	0.064	0.212	0.046
Price	P_y	0.23		0.383	
Promotion	P_n	0.036		0.054	
Place	P_s	0.142		0.126	
People	P_l	0.081		0.056	
Process	P_c	0.107		0.049	
Physical evidence	P_v	0.075		0.119	

The most important concepts identified were product, price, and distribution from the point of view of the bank experts and price, product, and distribution from the point of view of the company experts. As indicated in Table 4, the calculated inconsistency ratio is less than 0.1 in all cases, reflecting the reliability of the questionnaire.

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Table 4

The weight of the indicators identified based on the opinions of the experts

Main index	Sub-index	Symbol	Bank weight	Inconsistency ratio	The weight of PSP companies	Inconsistency ratio
Product	Brand	P_{t1}	0.100	0.090	0.166	0.028
	Variety	P_{t2}	0.368		0.404	
	Quality	P_{t3}	0.358		0.300	
	Up to date	P_{t4}	0.173		0.130	
price	Rent	P_{r1}	0.166	0.064	0.302	0.08
	Transaction fees	P_{r2}	0.074		0.583	
	Account average	P_{r3}	0.693		0.045	
	Discount	P_{r4}	0.067		0.069	
Promotion	Lottery	P_{n1}	0.497	0.008	0.455	0.0043
	Gifts	P_{n2}	0.181		0.289	
	Special privileges	P_{n3}	0.322		0.256	
Place	Number of representatives	P_{e1}	0.230	0.096	0.370	0.88
	Response hours	P_{e2}	0.360		0.330	
People	Proper behavior	P_{l1}	0.407	0.002	0.533	0.0241
	Technical expertise	P_{l2}	0.510		0.368	
	Type of cooperation	P_{l3}	0.083		0.099	
Process	Timely delivery	P_{c1}	0.565	0.024	0.565	0.0486
	Response speed	P_{c2}	0.300		0.269	
	Communication system	P_{c3}	0.135		0.166	
Phisical evidence	Location	P_{v1}	0.209	0.076	0.302	0.0486
	Equipped workshop	P_{v2}	0.357		0.244	
	Support equipment	P_{v3}	0.434		0.455	

3.3 Implementation of the problem in game theory

3.3.1 Game elements

Players:

- First player: Bank
- Second player: PSP companies

Player's strategy:

Based on interviews with experts, 22 strategies were identified based on the 7P marketing mix for each player. Accordingly, each player can choose his strategy based on these 22 strategies. Players are free to choose as many strategies as they want provided that the priorities and choices of both parties are not the same. This means that the strategy that is chosen as a priority for one side cannot be chosen by the other side.

Table 5

An example of the players' strategies

Bank strategies						Company strategies				
scenario	Pt1	Pt2	Pt3	Pt4	…	Pt1	Pt2	Pt3	Pt4	...
1	0	1	1	0		1	0	0	1	
2	1	0	0	1		0	1	1	0	
3	1	0	1	1		0	1	0	0	
4	1	1	1	0		0	0	0	1	
5	0	0	0	1		1	1	1	0	
...										

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Based on this, the players' strategies will be as follows.

The first player's strategy:

$S1=w_tP_t+w_rP_r+w_nP_n+w_eP_e+w_lP_l+w_cP_c+w_vP_v$

$P_t= w_{t1}P_{t1}+w_{t2}P_{t2} + w_{t3}P_{t3}+w_{t4}P_{t4}$

$P_r= w_{r1}P_{r1}+w_{r2}P_{r2} + w_{r3}P_{r3}+w_{r4}P_{r4}$

$P_n= w_{n1}P_{n1}+w_{n2}P_{n2} + w_{n3}P_{n3}$

$P_e= w_{e1}P_{e1}+w_{e2}P_{e2}$

$P_l= w_{l1}P_{l1}+w_{l2}P_{l2}+w_{l3}P_{l3}$

$P_c= w_{c1}P_{c1}+w_{c2}P_{c2} + w_{c3}P_{c3}$

$P_v= w_{v1}P_{v1}+w_{v2}P_{v2} + w_{v3}P_{v3}$

$S1=w_t(w_{t1}P_{t1}+w_{t2}P_{t2} + w_{t3}P_{t3}+w_{t4}P_{t4})+w_r(w_{r1}P_{r1}+w_{r2}P_{r2} + w_{r3}P_{r3}+w_{r4}P_{r4})+w_n(w_{n1}P_{n1} + w_{n2}P_{n2} + w_{n3}P_{n3}) + w_e(w_{e1}P_{e1}+w_{e2}P_{e2})+w_l(w_{l1}P_{l1}+w_{l2}P_{l2}+w_{l3}P_{l3})+ w_c(w_{c1}P_{c1}+w_{c2}P_{c2} + w_{c3}P_{c3})+ w_v(w_{v1}P_{v1}+w_{v2}P_{v2} + w_{v3}P_{v3})$

The second player's strategy:

$S2=w`_tp`_t+w`_rp`_r+w`_np`_n+w`_ep`_e+w`_lp`_l+w`_cp`_c+ w`_vp`_v$

$P_t= w`_{t1}p`_{t1}+w`_{t2}p`_{t2} + w`_{t3}p`_{t3}+w`p`_{t4}$

$p`_r= w`_{r1}p`_{r1}+w`_{r2}p`_{r2} + w`_{r3}p`_{r3}+w`_{r4}p`_{r4}$

$P_n= w_{n1}p`_{n1}+w_{n2}p`_{n2} + w_{n3}p`_{n3}$

$P_e= w`_{e1}p`_{e1}+w`_{e2}p`_{e2}$

$P_l= w`_{l1}p`_{l1}+w`_{l2}p`_{l2}+w`_{l3}p`_{l3}$

$P_c= w`_{c1}p`_{c1}+w`_{c2}p`_{c2} + w`_{c3}p`_{c3}$

$P_v= w`p`_{v1}+w`p`_{v2} + w`p`_{v3}$

$S2=w`_t(w_{t1}p`_{t1}+w`_{t2}p`_{t2} + w`_{t3}p`_{t3}+w`_{t4}p`_{t4})+w`_r(w`_{r1}p`_{r1}+w`_{r2}p`_{r2} + w`_{r3}p`_{r3}+w`_{r4}p`_{r4})+w`_n(w`_{n1}p`_{n1} + w`_{n2}p`_{n2} + w`_{n3}p`_{n3}) + w`_e(w`_{e1}p`_{e1}+w`_{e2}p`_{e2})+w`_l(w`_{l1}p`_{l1}+w`_{l2}p`_{l2}+w`_{l3}p`_{l3})+ w_c(w_{c1}p`_{c1}+w_{c2}p`_{c2} + w_{c3}p`_{c3})+ w`_v(w`_{v1}p`_{v1}+w`_{v2}p`_{v2} + w`_{v3}p`_{v3})$

3.4 *Calculating the payoff*

The goal of playing the game is to find the best strategy for each player. P_{ij} and $P`_{ij}$ have values 0 or 1 and we know that $P_{ij} \neq P`_{ij}$ and $P_{ij=\{0,1\}}$, and $i * j = 22$. Accordingly, for the first player, we will have 4,194,304 scenarios. Similarly, the scenarios of player 2 will amount to 4,194,304. Using equations, we calculate the outcome of all possible scenarios. An example of the calculation is shown in Table 6.

Table 6

An example of the outcome of the execution of scenarios of the bank and PSP companies

	BANK						PSP				
Strategy	Pt1	Pt2	Pt3	Pt4	...		Pt1	Pt2	Pt3	Pt4	....
weight	0.033	0.1208	0.1177	0.057	pay off bank	pay off company	0.0353	0.0855	0.064	0.0276	
Scenario 1	0	0	0	0	0	1	1	1	1	1	
Scenario 2	0	0	0	0	0.0354	0.9746	1	1	1	1	
Scenario 3	0	0	0	0	0.0261	0.9864	1	1	1	1	
Scenario 4	0	0	0	0	0.0615	0.961	1	1	1	1	
Scenario 5	0	0	0	0	0.0137	0.9832	1	1	1	1	
Scenario 6	0	0	0	0	0.0491	0.9578	1	1	1	1	
Scenario 7	0	0	0	0	0.0398	0.9696	1	1	1	1	
...											
...											
..											
Scenario 4,194,304	1	1	1	1	1	0	0	0	0	0	

After performing the calculations and identifying the payoff of the game, to identify the best scenario for both parties, we use the Min-Max strategy, which is one of the decision-making methods in conditions of uncertainty. Based on the results, the 1,884,891 scenarios with a payoff of 0.6641 for the bank and 0.6631 for the company are introduced as the best scenario and game result. In the selected scenario, which is introduced as the result of the game, product diversification strategies, quality, up-to-datedness, average account, number of representatives, technical expertise, equipped workshop, and support equipment are suggested for the bank. Brand, rent, fee, discount, response hours, lottery, gifts, special privileges, approach, type of cooperation, timely delivery, response

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speed, communication system, and company location are suggested for the PSP companies.

The selection of these strategies does not mean the elimination of the other strategies, but it means that more focus should be made on these strategies. The Nash equilibria of the game and the result of the game are shown in Table 7.

Table 7

The best-identified scenarios and game result

Rank	Game result	2	3	4	5	6	7	8
Pay off bank	0.6642	0.6617	0.6709	0.6684	0.661	0.6564	0.6558	0.6585
Bank strategy	Variety	Variety	Variety	Variety	Variety	Variety	Variety	Variety
	Quality	Quality	Quality	Quality	Quality	Quality	Quality	Quality
	Up to date	Up to date	Up to date	Up to date	Up to date	Up to date	Up to date	Up to date
	Account average	Account average	Account average	Account average	Account average	Account average	Account average	Account average
	Number of representatives	Number of representatives	Number of representatives	Number of representatives	Number of representatives	Number of representatives	Number of representatives	Number of representatives
	Technical expertise	Proper behavior	Technical expertise	Proper behavior	Technical expertise	Special privilege	Proper behavior	Technical expertise
	Equipped workshop	Technical expertise	Type of cooperation	Technical expertise	Response speed	Technical expertise	Equipped workshop	Type of cooperation
	Support equipment	Equipped workshop	Equipped workshop	Type of cooperation	Equipped workshop	Type of cooperation	Support equipment	Location
	Brand	Brand	Support equipment	Equipped workshop	Brand	Support equipment	Brand	Support equipment
Company strategy	Rent	Rent	Brand	Brand	Rent	Brand	Rent	Brand
	Transaction fees	Transaction fees	Rent	Rent	Transaction fees	Rent	Transaction fees	Rent
	Discount	Discount	Transaction fees	Transaction fees	Discount	Transaction fees	Discount	Transaction fees
	Response hours	Response hours	Discount	Discount	Response hours	Discount	Response hours	Discount
	Lottery	Lottery	Response hours	Response hours	Lottery	Response hours	Lottery	Response hours
	Gifts	Gifts	lottery	lottery	Gifts	lottery	Gifts	lottery
	Special privilege	Special privilege	Gifts	Gifts	Special privilege	Gifts	Special privilege	Gifts
	Proper behavior	Type of cooperation	Special privilege	Special privilege	Proper behavior	Proper behavior	Technical expertise	Special privilege
	Type of cooperation	Timely delivery	Proper behavior	Timely delivery	Type of cooperation	Timely delivery	Type of cooperation	Proper behavior
	Timely delivery	Response speed	Timely delivery	Response speed	Timely delivery	Response speed	Timely delivery	Timely delivery
	Response speed	Communication system	Response speed	Communication system	Communication system	Communication system	Response speed	Response speed
	Communication system	Location	communication system	Location	Location	Location	communication system	communication system
	Location	Support equipment	Location	Support equipment	Support equipment	Equipped workshop	Location	Equipped workshop
Pay off company	0.6631	0.6622	0.6582	0.6573	0.6564	0.6579	0.655	0.655

The proposed model of the best scenario of the bank's interaction with PSP companies, based on game theory, is shown in Figure 5.

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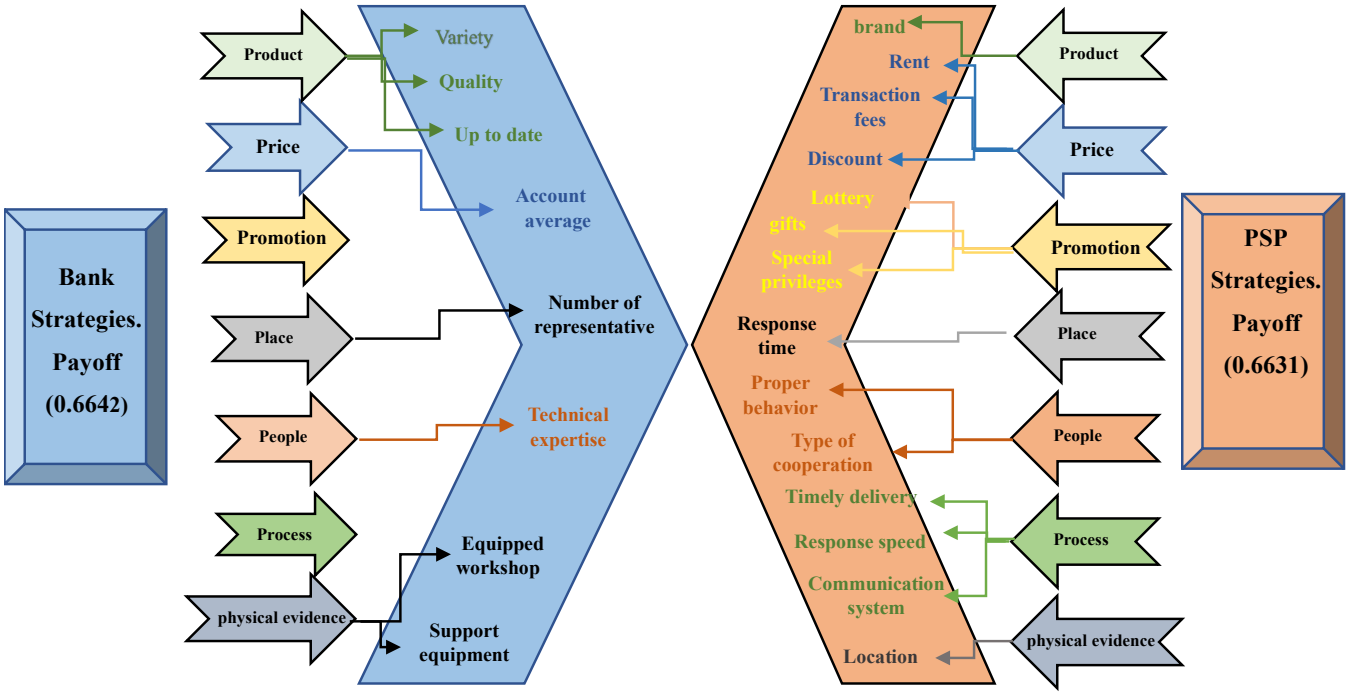
Figure 5

The proposed model for bank cooperation with the PSP companies



4 Discussion and Conclusion

The significance of the present research is that, in addition to the mathematical modeling of the managerial process of outsourcing the organization's activities, it examined this process from a perspective different from the studies conducted in this field. Research on outsourcing usually examines only the strategies and priorities of the organization delegating the activities, while the priorities and strategies of the organizations involved are not considered, which, in many cases, causes problems for the parties in the post-outsourcing phases. Although this problem can be solved by changing the contractor, it will impose a lot of costs on the assigning organization (Behesht Aeen & Anvari, 2018; Ebrahimpour Azbari et al., 2021; Gantman, 2011; Goldschmidt & Schmieder, 2017; Honarvar & Rezaee, 2019; Meričková et al., 2020; Nkonde & Phiri, 2020; Samadzadeh et al., 2020). In this research, we tried to identify not only the priorities and strategies of the organization delegating activities and services, but also the goals and strategies of the companies applying for these activities.

In these types of cooperation, most of the strategies are usually the same, and only their weight and importance differ for the parties. This research took this fact into account as well. Finally, since decisions should be made in conditions subject to conflict and cooperation, we used game theory. Game theory deals with the mathematical study of the decision-making process and mathematical models of conflict and cooperation. This means that it can model the behavior of people in certain conditions and allow us to examine the relationships between decisions and results.

In this research, we developed a model of the bank's interaction with PSP companies in outsourcing the supply and support of sales terminals based on the strategies of the parties to reach the equilibrium point using game theory, a non-cooperative model, and based on complete information.

First, the interviews with bank experts and company experts were analyzed using content analysis, and 22 strategies were identified. Then, a questionnaire and hierarchical analysis were employed to determine the weight and importance of strategies for the bank and companies. The parties had no restrictions in choosing the number of strategies provided that the selected strategies were not the

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same. Based on the results, 4,194,304 scenarios were identified for each side. After performing calculations and obtaining the consequences of possible scenarios, the best scenario was selected as the result of the game using the Min-Max function.

In the selected scenario, the bank emphasized the strategies of diversity, quality, up-to-dateness, average account, number of representatives, technical expertise, a well-equipped workshop, and support equipment. For the bank, it is very important to have a remarkable presence in the market and increase the market share of sales terminals among the banking networks. The quality of the offered product and the possibility of providing various and new types of these devices according to the needs of customers can be very effective in achieving this goal. The number of representatives, technical expertise, well-equipped workshop, and supporting equipment are also considered to be effective factors in providing favorable services, which, along with the quality, variety, and the latest model of the product, will make customers more satisfied. In terms of financial benefits, the average device account is considered the only benefit of the bank in this interaction. These factors are interdependent, and the financial benefits of the bank cannot be obtained without customer satisfaction. Customer satisfaction can be achieved by providing quality products with the latest technology, fast service delivery, increasing the number of agents, the expertise of support personnel, quick troubleshooting of the device and, if necessary, replacing it.

In the selected scenario, PSP companies have emphasized brand strategies, rent, fee, discount, response time, lottery, gifts, special privileges, appropriate treatment, type of cooperation, timely delivery, response speed, communication system, and location. Considering that a part of the credit of the companies is based on the name and brand that they represent, the device brand has special importance in advertising and marketing of the companies. The financial interests of the company are from the rent and fees received from device transactions, and by choosing these strategies, the company's financial interests are secured. Lottery, gifts, and special privileges have costs for the company, but they are justifiable because they are only for special customers who usually have high transactions, and a percentage of the commission of these transactions is deposited into the company's account. Appropriate treatment, number of agents, response time, follow-up system, response speed, and timely delivery are considered competitive advantages that the bank emphasizes when outsourcing sales terminal services. Companies without these factors will not have a chance to start this interaction.

By examining the interviews and opinions of banking experts, the following factors were ranked from first to sixth: the average account, product variety, quality, number of representatives, having the latest technology, and technical expertise of the representatives. The support equipment was in the tenth rank, and the equipped workshop was in the fourteenth rank.

According to the company's experts, transaction fees and rent are the first and second priorities, respectively. Timely delivery is the fifth priority, response time is the seventh priority, and response speed is the ninth priority. The remaining strategies are ranked next.

It may seem that in the selected scenario, some strategies are not the priorities of the parties, and even choosing some of them is considered a privilege for the other party. It is, however, important to mention that this research did not seek to find the best strategy for banks or PSP companies. The main goal was to find the equilibrium scenario or the Nash equilibrium so that by choosing it, the parties could enter into mutual and long-term cooperation.

The study, while comprehensive, acknowledges certain limitations. First, the reliance on a limited number of experts from banks and PSP companies might not capture the full spectrum of outsourcing strategies or industry challenges. Second, the use of game theory, while innovative, assumes rationality and may not account for all real-world complexities and unpredictable behaviors in the outsourcing process. Additionally, the specific focus on card reader devices may limit the generalizability of the findings to other aspects of bank outsourcing.

Future research should expand the scope to include a broader range of experts and outsourcing services to enhance the applicability of the findings. Investigating the application of game theory in other dynamic and less predictable market conditions could also provide deeper insights. Researchers might also explore the integration of behavioral economics to account for irrational decision-making patterns. Additionally, longitudinal studies could assess the long-term impact and sustainability of the identified strategies. The implications of this research are profound, suggesting that banks and PSP companies can significantly benefit from structured decision-making frameworks, leading to more effective and mutually beneficial outsourcing agreements.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Authors Contributions

Jafar Golzar: Conceptualization of the research. Methodology development. Writing of the research manuscript. Hossein Hakimpour: Qualitative analysis and investigation. Writing of the research manuscript. Mahdi Mahmoodzadeh Vashan: Data collection. Data curation. Writing of the research manuscript. Behrooz Basirat: Quantitative Analysis.

All authors have contributed significantly to the research process and the development of the manuscript.

Ethics principles

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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