



DETERMINATION OF A PROMOTIONAL STRATEGY FOR E-COMMERCE COMPETITION IN INDONESIA USING GAME THEORY

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Abstrak

Penelitian ini bertujuan untuk mengetahui nilai strategi yang diharapkan (expected payoff) dari strategi promosi yang dilakukan oleh dua perusahaan e-commerce Indonesia, Tokopedia dan Shopee. Hal ini dimaksudkan untuk menghasilkan keuntungan maksimal atau kerugian minimal yang disebabkan oleh persaingan antara kedua perusahaan melalui simulasi teori permainan. Desain penelitian menggunakan data kuantitatif dengan desain penelitian terapan. Metode analisis yang digunakan dalam penelitian ini adalah dengan pendekatan Game Theory. Data diolah menggunakan aplikasi POM-QM untuk Windows V5.2. Hasil penelitian menunjukkan bahwa melengkapi matriks kompetitif payoff di kedua perusahaan e-commerce menggunakan strategi murni. Hasil perhitungan dan pengolahan data menunjukkan bahwa nilai maksimum sama dengan nilai minimum yang berarti titik sadel telah tercapai dan merupakan Strategi Optimal untuk nilai permainan -24,11. Karena nilai game dari payoff matrix adalah negatif maka game tersebut dimenangkan oleh pemain kolom yaitu Shopee dengan menggunakan strategi promosi berupa gratis ongkos kirim. Sedangkan untuk meminimalisir kerugian pemain baris, Tokopedia bisa menggunakan strategi promosi berupa cashback.

Kata Kunci: Persaingan, Strategi Promosi, Teori Permainan

Abstract

This research aims to determine the expected value of strategy (expected payoff) from the promotional strategies carried out by two Indonesian e-commerce companies, Tokopedia and Shopee. It is intended to generate maximum profit or minimal loss caused by the competition between the two companies through game theory simulation. The research design uses quantitative data with an applied research design. The analytical method used in this research is the Game Theory approach. The data was processed using the POM-QM application for Windows V5.2. The results show that completing the competitive payoff matrix in both e-commerce companies uses a pure strategy. The calculations and data processing results show that the maximum value is the same as the minimum value, which means that the saddle point has been reached and is the Optimal Strategy for the game value of -24.11. Because the game value from the payoff matrix is negative, the game is won by the column player, namely Shopee, using a promotional strategy in the form of free shipping. Meanwhile, to minimize the loss of row players, Tokopedia can use a promotional strategy in the form of cashback.

Keywords: Competition, Promotion Strategy, Game Theory

INTRODUCTION

Competition among e-commerce businesses in Indonesia has become increasingly fierce lately, especially for the two giant e-commerce companies, Tokopedia and Shopee. The two are often juxtaposed because they dominate the Indonesian market, and meanwhile, no other e-commerce has managed to approach the two giants. In the fourth batch of Ipsos SEA Ahead survey data released in mid-2021 in Southeast Asia, most Indonesians (75%) admitted that they shopped more at e-commerce than before the pandemic. Businesses in the digital industry continue to compete to meet people's needs instantly. Moreover, it gave rise to a new habit, namely shopping online. Several factors support the rapid growth of the e-commerce sector in Indonesia. It is due to an increase in ownership of smartphones and internet networks. Furthermore, it is also due to the large population in Indonesia. In addition, in Indonesia, more and more people understand technology, which means that they are quick to adapt to new things, in this case, new technology (Rakhmawati, Permana, Reyhan, & Rafli, 2021).

Seeing this positive sentiment, Ipsos Indonesia initiated a further survey to find out the e-commerce competition in Indonesia during the year-end festivities that offer many promotions to consumers (www.ipsos.com, 2021). Of various e-commerce sites in Indonesia, Shopee and Tokopedia are online shopping sites often used by Indonesian people. The difference is that Tokopedia is an Indonesian marketplace introduced to the public in 2015 and merged with an online

transportation service, Gojek, in 2021. Meanwhile, Shopee is an e-commerce platform released in 2015 by a Singaporean company. Various surveys also cover the competitive map of the two e-commerce giants in Indonesia, namely Tokopedia Versus Shopee.

In The Map of E-commerce in Indonesia report published by iPrice, in Q2 2021, Tokopedia had monthly web visits, which was 16% higher than Shopee. Tokopedia recorded 147,790,000 monthly web visits, and Shopee with 126,996,700 monthly web visits. Meanwhile, from the same iPrice report, it can be seen that according to application rankings, both on the Apple App Store and the Google Play Store, Shopee is still the champion of the marketplace in Indonesia. In the Apple App Store, Shopee is still first, ahead of Tokopedia, which is in second place. It is the same with app rankings on the Google Play Store. Shopee is still the defending champion in the first place, while Tokopedia is far behind in fourth place.

It is in line with data from App Annie, wherefrom the beginning to the middle of 2021, Shopee was listed as the number one online shopping platform in Indonesia for the total number of downloads (total downloads) both on the Google Play Store and the Apple App Store, and also became the number one online shopping platform in the number of monthly active users. In other words, in 2021, Shopee is still the champion of the marketplace in Indonesia, with the highest number of downloads and users.

Based on SimilarWeb data on e-commerce applications in Indonesia, the number of daily active users (DAU) or Shopee's daily active visitors far exceeds

the Tokopedia application, even reaching more than three times. In August 2021, the number of daily active visitors to the Shopee application reached 28.35 million, while the Tokopedia application was only 8.43 million. Of course, this is not surprising because according to GlobalWebIndex (GWI) data in Q3 2020, 78.2% of internet users aged 16-64 years use online shopping applications via their mobile phones or tablets (www.gwi.com, 2020). This data shows that most e-commerce users access it through applications, and only a tiny proportion shop via the web. Because most Indonesians shop online through applications where Shopee is still the defending champion with first place in both the Apple App Store and Google Play Store, even though Tokopedia recorded a slightly higher monthly web visit, Shopee seems to be still the champion of the marketplace in Indonesia throughout the year 2021.

It is in line with the number of Shopee's social media followers, which is far more than Tokopedia. For example, on Facebook, one of the social media platforms widely used by Indonesians, Shopee has nearly 23 million followers, four times that of Tokopedia, which only has 6.5 million followers (Luthfan & Pasha, 2019). Meanwhile, on Instagram, the social media platform most widely used by the younger generation, Shopee has almost 8 million followers, two times that of Tokopedia, which only has 4.3 million followers (Pamungkas, Rohajawati, Fitriana, Nurhaida, & Wachyu, 2018).

Meeting the needs of e-commerce businesses to customers with many users is

essential for companies to pay attention to the quality of their services. Service quality is assessed from customer responses regarding the products or services provided. The habit of customers submitting their complaints on social media is a means of direct contact with the company. Customer feedback regarding perceived service can be a separate assessment for companies, especially e-commerce such as Shopee and Tokopedia; customer responses can provide a negative or positive response. It creates competition between Shopee and Tokopedia e-commerce because Tokopedia and Shopee appear simultaneously (Praditya & Prasetyo, 2021).

The competition between these two e-commerce giants has always been fierce. So, it is no wonder that Tokopedia and Shopee are competing to create promising innovations and promotions that pamper their loyal users. Therefore, these e-commerce companies must try to achieve optimal conditions in choosing the right promotion strategy. So in this study, the goal to be achieved is to determine the selection of the right promotional strategy with the expected value of the strategy use (expected pay off) from the selection of promotional strategies by e-commerce companies, namely Tokopedia and Shopee, in order to generate maximum profit or minimal loss from competition that occurs through simulation using game theory.

LITERATURE REVIEW

Promotion Strategy

Promotion is essentially a marketing communication, meaning marketing activities that seek to disseminate information, influence/persuade, and or

remind the company's target market and its products to be willing to accept, buy, and be loyal to the products offered by the company concerned (Tjiptono, 2018). The meaning of promotion is an effort or company activity in influencing "actual consumers" and "potential consumers" so that they want to make purchases of the products offered, currently or in the future. Actual consumers are consumers who immediately buy the products offered at the time or shortly after the company launches the promotion of the product. Moreover, potential consumers are interested in purchasing the products offered by the company in the future.

It is not just communication to attract interest or introductions. The promotion aims to capture the market, increase sales volume, increase awareness, create interest, generate sales, or create brand loyalty (Kotler, 2016).

- a) Increase Sales: The primary purpose of promotion is to increase sales. Some strategies stimulate primary demand, while some focus on stabilizing sales.
- b) Stabilize Sales: the purpose of promotion is to stabilize sales; companies usually promote sales content during declining sales and motivate salespeople by offering gifts such as vacations, television, and scholarships to those who reach specific targets.
- c) Highlight Product Value: The purpose of promotion is to highlight the product's value by explaining the product's proprietary benefits that the buyer is less familiar with.
- d) Remind: the purpose of promotion is to remind potential consumers that the product in question is needed shortly.

Promotion as a reminder, reminding potential consumers of places that sell company products. Promotions also help consumers remember the product, and promotion keeps the buyer's first memory of the company's product.

- e) Differentiating a product: the purpose of promotion is to differentiate the company's product or service objectives from competitors' products or services. With the promotion, the company will train consumers to be able to differentiate a product. Marketers are trying to gain a place in the minds of consumers, and it is done by communicating significant differences regarding the attributes, price, quality, or benefits of the consumer's product or service.
- f) Inform: the purpose of promotion is to inform the market about the existence of a new product. The purpose of this promotion also includes information on new ways to use a product, price changes, services provided, correcting wrong impressions, and reducing consumer fears or concerns. This goal can also build the image of a product or company.
- g) Persuade: the purpose of promotion is to persuade. Promotion helps shape brand choice, shifts the choice to a particular brand, changes perceptions, and encourages potential consumers to buy the product.

Meanwhile, according to (Kotler & Keller, 2012), the promotion strategy is a marketing logic in which the business unit hopes to create value and profit from its relationship with consumers. This understanding is in line with marketing strategy, a marketing mindset that will be

used to achieve marketing goals, in which there is a detailed strategy regarding the target market, positioning, marketing mix, and budget for marketing. A promotion strategy is a company activity to encourage sales by directing effective communications to buyers (Lupiyoadi, 2018). Another opinion expressed by (Swasta & Irawan, 2011), a promotion strategy is a plan for optimal use of promotional elements: advertising, public relations, personal selling and sales promotion.

The most effective form of promotion today is the promotion mix. A promotional mix is a promotion carried out by blending four essential tools in promotion: advertising, personal selling, sales promotion, and publicity (Kotler, 2016).

- a) Advertising is a form of presentation and promotion of ideas for goods and services. The primary purpose of advertising is to increase the demand for the products offered.
- b) Personal selling is an attempt to introduce a product through direct communication (face to face) so that consumers are interested in buying the products offered.
- c) Sales Promotion is a marketing activity other than personal selling, advertising and publicity that encourages the effectiveness of consumer purchases by using tools such as demonstrations, exhibitions, demonstrations, and discounted prices such as product purchase discounts.
- d) Public Relations is an activity to build good relations with the relevant public to gain support, build a good "company image", and deal with or eliminate

gossip, stories and events that can be detrimental.

- e) Direct marketing uses various media to interact directly with consumers, usually calling consumers to get an immediate response.

So promotion is a company activity carried out in order to introduce products to consumers so that with these activities, consumers are interested in making purchases with various promotional strategies (Kotler & Keller, 2012), namely:

- a) Defensive strategy or survival strategy is a promotional strategy that is just so that consumers do not forget the brand of a product or turn to other brands.
- b) Attack or expansion strategy is carried out to gain or seize a larger market share.
- c) Development Strategy has generally used by-products with a relatively high market share but a prolonged growth rate.

Game Theory

Game theory uses a mathematical approach in formulating situations of competition and conflict between various interests (Fang, Liu, Basak, Zhu, Kiekintveld, & Kamhoua, 2021). This theory was developed to analyze the decision-making process, namely the optimum strategy for different competitive situations involving two or more interests. In general, game theory can be defined as an approach to the possible strategies used, arranged mathematically to be accepted logically and rationally. Moreover, used to find the best strategy in an activity, where each player equally achieves the highest utility. The advantage for one is a loss for the other; therefore, the assumption is used

that each player can make decisions freely and rationally. The purpose of using game theory is to win the competition.

The basic idea of game theory is the strategic behaviour of players or decision-makers. Each player is assumed to have a series of plans or behaviour models from which the player can choose if choosing a set of strategies. The game is defined as a special move that must be selected from existing strategies. The assumption is that every player can make decisions freely and rationally.

Game theory has basic concepts for completing a competition, including the number of players, game values, and game strategies (Ho, Rajagopalan, Skvortsov, Arulampalam, & Piraveenan, 2022). This theory provides a language for formulating, structuring, analyzing and understanding strategic scenarios and is used for strategy selection. The first step in using game theory is to define the players explicitly and the strategies that exist and determine each player's preferences and reactions.

The general provisions of game theory (Fang, Liu, Basak, Zhu, Kiekintveld, & Kamhoua, 2021) are:

- a) Each player plays rationally, assuming they have the same intelligence and goal, namely maximizing payoff, with maximin and minima criteria.
- b) It consists of at least two players; an advantage for one player is a loss for the other player.
- c) The compiled table shows the row player gains and column player losses.
- d) The game is said to be fair; if the final result is zero (0), no one wins or loses.
- e) The purpose of this game theory is to identify the most optimal strategy.

Game theory models can be classified in several ways, such as the number of players, the number of advantages and disadvantages and the number of strategies used in the game. If the sum of the gains and losses is zero, it is called a zero-sum game or constant sum. Conversely, if it is not equal to zero, it is called a non-zero-sum game.

In-game theory, each player will gain or lose from each strategy he uses. The profit or loss obtained can be seen from the payoff of each player's strategy. The payoff in a game states how well a player performs a game. Payoff - the payoff is presented in a matrix known as the payoff matrix. In this study, the concept of 2-person games is used. So that the general form of the pay off matrix used is like matrix (1) below (Ho, Rajagopalan, Skvortsov, Arulampalam, & Piraveenan, 2022):

$$\begin{matrix}
 B_i \\
 \vdots \\
 B_j
 \end{matrix}
 \begin{bmatrix}
 (a_{11}, b_{11}) & \cdots & (a_{1k}, b_{1k}) \\
 \vdots & \ddots & \vdots \\
 (a_{ij}, b_{1j}) & \cdots & (a_{jk}, b_{jk})
 \end{bmatrix}
 \quad (1)$$

The matrix above interprets the payoff for player A when he uses strategy, player B uses strategy, and player C uses strategy, for $i = 1, \dots, r; j = 1, \dots, s; k = 1, \dots, t$.

To determine the payoff value in a game with two players, you can use the following formula:

$$a_{ij} = A_i - \text{maks}(B_j) \quad (1.1)$$

$$b_{ij} = B_j - \text{maks}(A_i) \quad (1.2)$$

The concept of Nash Equilibrium can determine in-game theory, the best (optimal) strategy. Nash equilibrium, abbreviated as equilibrium, is a combination of player strategies so that the strategy is the best strategy for each player.

In other words, Nash equilibrium is a condition in which one party makes a decision based on the decisions taken by the other party so that all players play an equilibrium strategy (Yadewani, Akbar, & Arief, 2020).

The marketing concept also includes a marketing strategy. One of the marketing strategies is promotion which is an effort to select and analyze the target market and create an appropriate marketing mix. This strategy describes the company's actions in a market to develop profitable marketing strategies and find attractive opportunities.

The combination of matrix, promotion strategy and game theory is mutually sustainable. Promotion strategy is indirectly related to the matrix, while game theory is directly related to the matrix. The promotion strategy describes each player's attributes in a market condition. The description of these attributes is needed in game theory for strategic decision-making determination. In comparison, the description of this strategy is presented in the form of a matrix.

METHOD

This research design uses quantitative data with an applied research design (Akbar & Mar'aini, 2022). This research was conducted quantitatively by distributing questionnaires to respondents, namely people who have made online purchase transactions through Tokopedia and Shopee e-commerce. The sample size was taken, referring to the opinion (Hair, Black, Babin, & Anderson, 2014) that to meet the criteria, the appropriate sample was determined to be between 100 and 200. So the maximum number of samples

used was 200 respondents. Of the 200 questionnaires distributed via the internet, as many as 59 questionnaires did not meet the requirements because the answers given were incomplete and there were outliers, so the research sample used was 141 respondents. The analytical method used in this research is the Game Theory approach. The data was processed using the POM-QM application for Windows V5.2. The steps to complete the game (Fang, Liu, Basak, Zhu, Kiekintveld, & Kamhoua, 2021) are as follows:

- 1) Identifying game variables or attributes
- 2) Create a payoff matrix
- 3) Checks for the existence of a Nash equilibrium.

If there is a pure Nash equilibrium, then the optimal strategy for each player is determined.

If there is no pure Nash equilibrium:

- a. Reduce the pay off matrix if possible, using the concept of dominance.
- b. Forming the expected pay of the equation.
- c. Determine the expected payoff value for each candidate using the Nash equilibrium concept.
- d. Determine the optimal strategy for each candidate based on the expected payoff value that has been obtained.

RESULTS AND DISCUSSION

Based on data collected from observations and surveys to respondents who have made buying and selling transactions through the online applications/platforms of Tokopedia and Shopee, the results are tabulated data.

Before being analyzed through the Game Theory approach, the data were first tested for validity and reliability.

Validity and Reliability Test

A validity test of how much the instrument items represent the concept being measured (Akbar, 2020). It means whether the item of the instrument (item of statement/question made in the questionnaire) can be understood by the respondent. This test uses two sides (df = n-2) at probability 0.05 by comparing the calculated r-value with the r table value (see table r). Test the validity of the data in this study using SPSS 24. If the r-count (correct item-total correlation) is greater than the r-table, the question or indicator is valid. To test the validity of the questionnaire data with n = 141 and a = 5% (one way) then the r-table = 0.134.

Table 1. Validity Test

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Discount	17.3972	6.427	.563	.870
COD	17.5248	5.980	.750	.837
Ongkir	17.5106	6.037	.781	.833
Cashback	17.1773	6.004	.610	.865
Poin	17.6312	6.692	.647	.857
Paylater	17.4397	6.048	.732	.841

Source: SPSS output (2022)

A reliability test is used to test the reliability of the questionnaire (Akbar, 2020). It means that if a questionnaire with the same question is given to the same respondent in a not too distant period, it is likely that the respondent will give the same response to the survey question (consistent). The reliability criterion has a Cronbach alpha coefficient of at least 0.6 (Koning & Franses, 2006). If Cronbach's alpha coefficient values range is below 0.5, then the reliability is considered low. If the

range value is between 0.5 to 0.7, the reliability is moderate. Meanwhile, if the Cronbach alpha value is above 0.7, the reliability is sufficient (Cronbach, 1951).

From the results of the reliability test of the questionnaire instrument, it was found that the Cronbach alpha value was 0.872. Each item or instrument in a promotional strategy, namely Discount, COD (Cash on Delivery), Free Shipping, Cashback, Points, Installments (Pay later), is declared reliable because the Cronbach alpha value is more significant than 0.6.

Table 2. Reliability Test

Case Processing Summary

		N	%
Cases	Valid	141	100.0
	Excluded ^a	0	.0
	Total	141	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.872	6

Source: SPSS output (2022)

Based on the test, it shows that the data is valid and reliable so that the data has met the requirements to be processed and analyzed at a later stage.

Variable Identification

The initial research is done by observing the application of these two e-commerce companies. Moreover, making an inventory of the various promos in the application. In addition, questionnaires were distributed to respondents about what promos were influential for consumers on product selection decisions transacting through the marketplace. The researchers

finally determined six variables from the observations and data collection results through the questionnaire. Researchers carried out this step to determine the variables of the promotion strategy of e-commerce companies, Tokopedia and Shopee. From the observation and the distribution of the questionnaire, the variables used in the game's attributes were grouped.

Table 3. Variable (Game Attribute)

Attribute On Game	Variable Used	
	Tokopedia	Shopee
Discount	X1	Y1
Cash on Delivery	X2	Y2
Free Shipping	X3	Y3
Cashback	X4	Y4
Point	X5	Y5
Paylater	X6	Y6

Source: SPSS output (2022)

Based on the table, the coding of each variable is carried out.

Variable X:

X1 = Discount

X2 = COD (Cash on Delivery)

X3 = Free Shipping

X4 = Cashback

X5 = Points

X6 = Installment (Paylater)

Variable Y:

Y1 = Discount

Y2 = COD (Cash on Delivery)

Y3 = Free Shipping

Y4 = Cashback

Y5 = Points

Y6 = Installment (Paylater)

Based on the coding, the promotion strategies used by Tokopedia and Shopee are six items each.

Determination of Pay Off Matrix

A game payoff matrix was formed from the data collection results, with Tokopedia as the row player (P1) and Shopee as the column player (P2). $X_i = (X_1, X_2, X_3, X_4, X_5, X_6)$ is a strategy used by row players (P1) and $Y_i = (Y_1, Y_2, Y_3, Y_4, Y_5, Y_6)$ is a strategy used by column players (P2). The value included in the game payoff matrix is the value of the importance level of the attribute multiplied by the value of the respondent's perception level of Tokopedia and Shopee. Then the attribute value P1 is reduced by the attribute value P2.

Table 4. Pay Off Matrix

Tokopedia VS Shopee						
	Y1	Y2	Y3	Y4	Y5	Y6
X1	-34.04	-8.51	-44.68	-43.26	-2.13	-1.42
X2	-9.93	9.22	-27.66	-19.86	29.79	28.37
X3	-21.99	5.67	-42.55	-30.5	9.22	9.93
X4	-9.93	12.77	-24.11	-16.31	20.57	25.53
X5	-20.57	7.09	-31.21	-28.37	9.93	14.18
X6	-23.4	1.42	-42.55	-34.75	12.77	13.48

Source: POM-QM for Windows output (2022)

To fill in the matrix above, it is obtained in the following way:

$$(P1 - P2) / \text{Number of respondents} \times 100\% = (13-61) / 141 \times 100\% = -34.04, \text{ e.g } X_1, Y_1 \text{ (shown in table 4).}$$

Row's Expected Values

The expected value of the line is the value from the point of view of player 1 (P1). In this case, player 1 is Tokopedia. The value in the matrix is the real value obtained by Tokopedia when using this strategy. For the row players will use the maximin rule. The line expectation value

in the Tokopedia e-commerce company's marketing strategy can be seen in the following table.

Table 5. Row's Expected Values

Tokopedia VS Shopee Solution						
	Col mix 1 * cell payoff	Col mix 2 * cell payoff	Col mix 3 * cell payoff	Col mix 4 * cell payoff	Col mix 5 * cell payoff	Col mix 6 * cell payoff
Column's Optimal Mix	0	0	1	0	0	0
X1	0	0	-44.68	0	0	0
X2	0	0	-27.66	0	0	0
X3	0	0	-42.55	0	0	0
X4	0	0	-24.11	0	0	0
X5	0	0	-31.21	0	0	0
X6	0	0	-42.55	0	0	0
Value of game (to row)						

Source: POM-QM for Windows output (2022)

Based on the table, it is found that when the Tokopedia company chooses Strategy X1, the Shopee company will choose Strategy Y3, so the loss suffered by the Tokopedia company is 44.68. When the Tokopedia company chooses Strategy X2, the Shopee company will choose Strategy Y3 so that the loss suffered by the Tokopedia company is 27.66. When the Tokopedia company chooses Strategy X3, the Shopee company will choose Strategy Y3 so that the loss suffered by the Tokopedia company is 42.55. When the Tokopedia company chooses Strategy X4, the Shopee company will choose Strategy Y3 so that the loss suffered by the Tokopedia company is 24.11. When the Tokopedia company chooses Strategy X5, the Shopee company will choose Strategy Y3 so that the loss suffered by the Tokopedia company is 31.21. When the Tokopedia company chooses Strategy X6, the Shopee company will choose Strategy Y3 so that the loss suffered by the Tokopedia company is 42.55. The Tokopedia company is most optimal if it chooses the X4 Single Strategy because it will minimize losses, among other strategies.

Column's Expected Values

The expected value of the column is the value from the point of view of player 2 (P2). In this case, player 2 is Shopee. The value in the matrix is the opposite of the actual value obtained if Shopee uses this strategy. For the column players will use the minimax rule. The expected value of the column in the Shopee e-commerce company's marketing strategy can be seen in the following table.

Table 6. Column's Expected Values

Tokopedia VS Shopee Solution							
	Optimal Row Mix	Y1	Y2	Y3	Y4	Y5	Y6
Row 1 mix * cell payoff	0	0	0	0	0	0	0
Row 2 mix * cell payoff	0	0	0	0	0	0	0
Row 3 mix * cell payoff	0	0	0	0	0	0	0
Row 4 mix * cell payoff	1	-9.93	12.77	-24.11	-16.31	20.57	25.53
Row 5 mix * cell payoff	0	0	0	0	0	0	0
Row 6 mix * cell payoff	0	0	0	0	0	0	0
Expected Value (Col sum)		-9.93	12.77	-24.11	-16.31	20.57	25.53
Value of game (to row)	-24.11						

Source: POM-QM for Windows output (2022)

Based on the table, it is obtained that when the Shopee company chooses Strategy Y1, the Tokopedia company will choose Strategy X4, so that Shopee's pay-off is 9.93. When the Shopee company chooses Strategy Y2, the Tokopedia company will choose Strategy X4 so that the loss suffered by the Shopee company is 12.77. When the Shopee company chooses Strategy Y3, the Tokopedia company will choose Strategy X4 so that Shopee's pay-off is 24.11. When the Shopee company chooses Strategy Y4, the Tokopedia company will also choose Strategy X4 so that Shopee's pay-off is 16.31. When the Shopee company chooses Strategy Y5, the Tokopedia company will choose Strategy X4 so that the loss suffered by the Shopee company is 20.57. When the Shopee

company chooses Strategy Y6, the Tokopedia company will choose Strategy X4 so that the loss suffered by the Shopee company is 25.53. Shopee companies are most optimal if they choose the Y3 Single Strategy because they will get a higher pay-off than other strategies.

Maximin-Minimax Strategy

In a pure strategy game, row players identify their optimal strategy through maximin criteria, while column players use minimax criteria to identify their optimal strategy. The value achieved must be the maximum of the row minima and the minimum of the column maximin. In this case, an equilibrium point has been reached, and this point is called the saddle point. If the maximin value is not equal to the minimum value, the saddle point cannot be reached, so the game cannot be solved using pure strategy but mixed strategy. The results of the maximin-minimax strategy calculation can be seen in the following table:

Table 7. Maximin-Minimax Strategy

Tokopedia VS Shopee Solution							
	Y1	Y2	Y3	Y4	Y5	Y6	Row Minimum
X1	-34.04	-8.51	-44.68	-43.26	-2.13	-1.42	-44.68
X2	-9.93	9.22	-27.66	-19.86	29.79	28.37	-27.66
X3	-21.99	5.67	-42.55	-30.5	9.22	9.93	-42.55
X4	-9.93	12.77	-24.11	-16.31	20.57	25.53	-24.11
X5	-20.57	7.09	-31.21	-28.37	9.93	14.18	-31.21
X6	-23.4	1.42	-42.55	-34.75	12.77	13.48	-42.55
Column Maximum	-9.93	12.77	-24.11	-16.31	29.79	28.37	
Minimax			-24.11				
Value=-24.11							

Source: POM-QM for Windows output (2022)

The data processing results show that the completion of the pay off matrix from

the promotional strategy competition between Tokopedia and Shopee uses a pure strategy. Row players will use the maximin rule, and column players will use the minimax rule.

For column players, select the most considerable value for each row (first row the most considerable value -44.68, the second row the most considerable value -27.66, the third row the most considerable value -42.55, the fourth row the most considerable value -24.11, the fifth row the most considerable value -31.21, the sixth row the most considerable value is -42.55. Then select the best or most significant value from the row, namely the value -24.11 (the most considerable profit). For row players, choose the smallest value for each column (the first column the smallest value is -9.93, the second column the smallest value is 12.77, the third column has the smallest value -24.11, the fourth column the smallest value is -16.31, the fifth column the smallest value is 20.57, the sixth column the smallest value is 25.53. Then select the best or smallest value from the column, namely the value -24.11 (the most significant loss). From the results of the calculation of the maximin minimax analysis using game theory, it can be concluded that the choices for the Tokopedia row players and Shopee column players are the same because the maximum value is the same as the minimum value, the game value is -24.11.

The results of game theory calculations for the two e-commerce companies, namely Tokopedia and Shopee, can be seen in the following table:

Tabel 8. Games Theory Results

Tokopedia VS Shopee Solution							
	Y1	Y2	Y3	Y4	Y5	Y6	Row Mix
X1	-34.04	-8.51	-44.68	-43.26	-2.13	-1.42	
X2	-9.93	9.22	-27.66	-19.86	29.79	28.37	
X3	-21.99	5.67	-42.55	-30.5	9.22	9.93	
X4	-9.93	12.77	-24.11	-16.31	20.57	25.53	
X5	-20.57	7.09	-31.21	-28.37	9.93	14.18	
X6	-23.4	1.42	-42.55	-34.75	12.77	13.48	
Column Mix-->	0	0	1	0	0	0	
Value of game (to row)	-24.11						

Source: POM-QM for Windows output (2022)

Based on the results of the calculation and analysis of maximin minimax using game theory, it can be concluded that the choices for the Tokopedia row players and the Shopee column players are the same because the maximin value is the same as the minimum value, so the game value is -24.11. Thus, this game can be optimal because the same game value (saddle point) has been found, so there is no need to do a mixed strategy.

Discussion

Game theory analysis has provided an optimal solution for companies in determining promotional strategies that maximize company profits or minimize losses suffered by the company. These results can be seen in the following table.

Table 9. Results in list form

Tokopedia VS Shopee Solution	
ROW	
X1	
X2	
X3	
X4	
X5	
X6	
COLUMN	
Y1	
Y2	
Y3	
Y4	
Y5	
Y6	

Source: POM-QM for Windows output (2022)

Based on the analysis results, it can be concluded that the settlement of the payoff matrix from the promotional strategy competition between Tokopedia and Shopee uses a pure strategy. Row players will use the maximin rule, and column players will use the minimax rule. Based on the results of the calculation and analysis of maximin minimax using game theory, it can be concluded that the choices of the Tokopedia row players and the Shopee column players are the same because the maximin value is the same as the minimum value, the game value is -24.11; thus this game can be said to be optimal. Because the same game value (saddle point) has been found, there is no need to do a mixed strategy.

Therefore, the optimal strategy has been obtained from Tokopedia players and Shopee players with a pure strategy. The optimal strategy is (X4, Y3), which means that Tokopedia uses a promotional strategy by giving cashback. Meanwhile, Shopee uses a promotional strategy by providing free shipping to its buyers. The final value of the game is -2.75; this means that the game value of the payoff matrix is negative, and then the game is won by the column player, namely Shopee.

It is in line with previous research on Praditya (2021) with the results of game data between Shopee and Tokopedia obtaining optimal game values using a single strategy. Shopee Company wins the game using the Convenience and Service Strategy in Optimum Shopping to generate maximum profits. Meanwhile, the Tokopedia company uses the Convenience and Service Strategy in Optimum

Shopping to generate minimal losses. Therefore, to win the competition in the e-commerce market, Shopee uses a promotional strategy in the form of free shipping. Meanwhile, to minimize the loss of line players, namely Tokopedia, using a promotional strategy in cashback.

CONCLUSION

From the analysis and discussion results, it can be concluded that the completion of the pay off matrix from the promotional strategy competition between Tokopedia and Shopee uses a pure strategy. Based on the results of the calculation and analysis of maximin minimax using game theory, it can be concluded that the choices for the Tokopedia row players and the Shopee column players are the same because the maximin value is the same as the minimum value. Thus, this game can be optimal because the same game value (saddle point) has been found, so there is no need to do a mixed strategy. Therefore, the optimal strategy has been obtained from Tokopedia players and Shopee players with a pure strategy. The expected payoff value in the optimal strategy of this game is (X4, Y3) with a game value of -2.75. The game value of the payoff matrix is negative; then, the game is won by the column player, namely Shopee. So Shopee can use a promotional strategy in the form of free shipping. Meanwhile, to minimize the loss of row players, namely Tokopedia, they can use promotional strategies in the form of cashback.

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