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Using Conjoint Analysis to Predict the Launch Price of a New Smartphone

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This study aims to identify the pricing strategy used by a premium smartphone manufacturer when launching a new type by comparing actual price predictions with price predictions using a rating-based conjoint analysis method. The results of an analysis of 172 respondents from a university in Indonesia showed that the manufacturer use a combination of a skimming strategy, using product variants that are similar to types known to users beforehand, and a penetrating strategy through product variants that have never existed before. Analysis of respondents' evaluation of five smartphone attributes also shows that the feature that has the most part worth and the highest importance is network technology (5G or 4G) followed by internal memory capacity. The manufacturer in the US has set prices that reflect part worths that are in line with RBCA prediction. In contrast, the distributor in Indonesia has set highest importance on the number of cameras. Managerially, these findings can be used by other smartphone manufacturers and distributors to when setting prices for future new products based on customer values. Theoretically, these findings indicate a significant difference between the conjoint analysis results and the producers' decisions that must be explained in the following research.

Introduction

Launching a new product requires essential decisions such as pricing, which is one of a company's most important tactical decisions. New product launches usually involve skimming or penetration strategies [1],[2]. The right high or low product price will be determined by many factors [3], such as demand for the product, competition, market conditions and the economy. For example, a high product launch price (skimming) is the right pricing strategy if the product launched has clear advantages in terms of product, brand name, technology and innovation [4]. However, even though a product has advantages, manufacturers still have to consider the entry of competitors at lower prices with almost the same or even better features. Some manufacturers may combine the two strategies using different product variants, where some products use a skimming strategy, and others use a penetrating strategy.

This study identifies whether the pricing strategy implemented by a smartphone manufacturer from the United States, known for its premium products, uses a skimming strategy or combines it with a penetrating strategy. The combination of the two is a logical choice. In this way, manufacturers can take maximum advantage of the premium variant while maintaining or increasing market share (penetrating) using different variants to face pressure from South Korea's competitors increasingly dominating the smartphone market. Strategy identification is carried out by comparing actual prices at the launch of the five new product variants with price predictions using the conjoint analysis method. This study produces statistical estimates of the value (part worth), and level of importance (importance) of various smartphone attributes in users' eyes through conjoint analysis. This study uses five attributes of smartphones based on features often highlighted by smartphone manufacturers in various marketing communications: network technology, screen size, RAM capacity, screen type, and the number of cameras. By knowing the part worth and importance of the five attributes, manufacturers can adjust their pricing strategy according to customer value.

Literature Review

A. Customer Value-Based Pricing Strategies

There are three general pricing strategies: cost-based pricing, competition-based pricing, and customer value-based pricing [5]. A customer value-based pricing strategy is a strategy in which prices are determined based on the buyer's perception of value and not based on production costs. The user's perception of value is the upper limit of the price of a product because, above that value, no customer wants to buy it. In contrast, the cost of production per unit (including distribution and selling costs as well as a reasonable margin) is the floor price for producers to turn a profit. Therefore, pricing based on customer value will result in higher

profit per unit than a cost-based pricing strategy, often applied by premium product manufacturers [5].

The pricing method for these various variants is called product line pricing. Differences in price levels (steps) between variants can be determined based on differences in production costs, competitor prices, and differences in customer perceptions (evaluations) of various variants in a product line [6]. To carry out product line pricing based on customer value, producers will need information not only on the value of a product in aggregate in the eyes of users but also on the value (part worth) and importance of each attribute contained in different configurations. Various variants are in the eyes of consumers. This information allows producers to set different prices for various variants according to customer perceptions of value.

B. Skimming and Penetrating Strategy in Product Launching

Two pricing strategies are used in launching a new product: skimming or penetrating [1]. Skimming is a strategy of setting a high price at the start of a product launch and lowering the price over time [7],[8]. In contrast, a brilliant strategy is carried out by setting a low price at the time of product launch which is usually applied in a context where there is very tight competition and a price-sensitive market [5],[6]. Ref. [4] shows that a high product launch price (skimming) is the right pricing strategy if the product launched has clear advantages in terms of product, brand name, technology and innovation. It is why the US smartphone manufacturer under study, known as a manufacturer with a firm brand name, leading technology and continuous innovation, has been implementing a skimming strategy (a very high price compared to other products on the market). This manufacturer once launched a smartphone at $ 599, and in two months, it was lowered to $ 399, causing protests from previous customers [9].

Although US manufacturer has long set skimming prices, the incessant penetration of smartphone products from South Korea into the global market has forced US manufacturers to consider a more competitive strategy [10], for example, using a penetrating price strategy. By implementing both a penetrating strategy and a skimming strategy at the same time, producers are basically conducting price discrimination. The practice of price discrimination will provide benefits where producers can enjoy greater profits than producers who have only one price because producers will capture more consumer surplus. Customers with a high perceived value will be willing to pay a higher price than those with a lower perceived value, for a product variant with a production cost that is not much different from a simpler product variant.

Producers must launch a product line with various variants with significant or important value differences in customers' eyes to discriminate prices effectively. For this reason, producers need information on the level of importance of various existing product attributes.

Furthermore, producers also need to know the user's perception of the value of each attribute so that they can determine the difference in the price of the various variants. As long as the price set for each variant does not exceed the buyer's perception of the value for that attribute configuration (customer value as the price ceiling), there will be demand for each variant by different customer segments.

C. Conjoint Analysis

Conjoint analysis is a multivariate technique used to understand how a respondent's preferences are formed [11]. Through conjoint analysis, researchers can study the combined effects of various product features/attributes/characteristics on customer perceptions of the value of a product (customer value). In the conjoint analysis method, research subjects are asked to assess various product configurations with various features simultaneously, not for each feature in isolation. Thus, the conjoint analysis method considers the interaction effects between features likely to shape a customer's perception of the value of a product. The two main outputs of the conjoint analysis are the importance of each attribute and the perceived value of each attribute of a product.

Conjoint analysis has three main phases [12]. The first is to determine each attribute's relevant attributes and level. Second is the collection of preference data from each respondent, which will be used to estimate the respondent's utility function. The most frequently used model is the linear additive model. This model assumes that the overall utility attributes are the sum of the part-worth of each attribute. So that the prediction of conjoint utility for respondent I (i=1,..., L) with utility for the product profile (j=1,..., J) can be specified as follows [13].

$$U_{ij} = \sum_{k=1}^{K} \sum_{l=1}^{L_k} \beta_{ikl} x_{jkl} + \varepsilon_{ij} \quad (1)$$

x_{jkl} is variable (0, 1) where the value is 1 if the profile j has the k attribute at level l, and the value is 0 if it does not have that attribute.

β_{ikl} is the utility of respondent i to level l (Lk – is the number of levels in attribute k) of attribute k (K = number of attributes).

ε_{ij} is the stochastic error term

The parameter (also called part-worth utilities) is estimated using regression analysis. The value of the beta coefficient can be used to: determine the impact of an attribute on the overall utility of a profile, segment buyers based on preferences, and calculate the relative importance of each attribute. The importance level of an attribute is calculated from the utility range of each attribute. The greater the range, the higher the level of importance.

Two types of conjoint analysis are most commonly performed in market research, namely: rating-based conjoint analysis (RBCA) and choice-based conjoint analysis (CBCA) [14]. In the

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RBCA method, respondents are asked to provide a number which is an assessment score or the maximum price that is still considered reasonable for several product variants. Theoretically, if a product has five features, each of which consists of two types (two levels), then there are 25 variants or 32 types of configurations that respondents must assess. It is undoubtedly complicated for respondents because of the limited ability to compare so many different combinations of features. With the help of SPSS software, the conjoint analysis algorithm will produce a much smaller number of configurations than 32 types so that respondents can still give a fair assessment.

In the CBCA method, respondents are also asked to do almost the same thing. However, in this case, respondents were asked to determine their preferences or choices from several product configuration options with different features and prices. With this method, the situation faced by respondents is more similar to the real world because when buying a product, buyers generally do not set a maximum price for each product but choose from several available options. The CBCA method will also produce the relative importance and part worth of each attribute in the eyes of the customer. Literature studies show no practical reason to choose RBCA over CBCA or vice versa regarding experimental techniques, data analysis, output, user-friendliness, estimation power and other practical issues [15]. This article, this research will use the RBCA method.

Methods

A. Participant

Respondents are lecturers and students from a university smartphone users, both those using the brand being researched and other brands. Data were collected using a web-based survey method in which participants were shown eight smartphone product variants, each of which had a different attribute configuration. All data is collected several months before the launch of a new premium smartphone product model for a particular brand from the United States, which is usually held once a year.

B. Research protocol

This research is the second part of 3 stages. The first stage is the initial research (preliminary stage) to determine patterns of smartphone use in tertiary institutions. Of the 900 invitations distributed, 591 responded in the first stage (65.7% response rate). A total of 152 (22%) users were users of the premium brands studied, and 439 (78%) users of other brands.

In the second stage, a Rating Based Conjoint Analysis study was carried out on 224 people. A total of 172 provided valid answers and whose results are reported in this article. In the third stage, as many as 76 respondents gave answers to Choice Based CA whose results were reported in another article.

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C. Analysis Technique

The data collected was processed using SPSS software version 16. Five smartphone attributes were studied at each level, as described in Table 1.

Table 1. List of Features and Levels of Premium Smartphone Products

No	Attribute Name	Levels
1	Network Technology	4G or 5G
2	Internal Memory	128GB, 256GB, 512GB
3	Screen Type	Retina LCD, OLED (XDR)
4	Number of Cameras	Dual, Triple
5	Screen Size	Regular 5.8”-6.1” or Large >=6.5”

Theoretically, 2x3x2x2x2 product configurations equal to 48 variants that each respondent must assess. However, the RBCA algorithm in SPSS software produces eight configurations (called card plans) as Table 2.

Table 2. SPSS Card Plan

No	Network Technology	Memory Internals	Screen Type	Number of Cameras	Screen Size
1	4G	512GB	Retina LCDs	Triple Camera (Wide, Ultra, Tele)	Large 6.5"-6.7"
2	5G	256GB	Retina LCDs	Dual Camera (Wide, Ultrawide)	Large 6.5"-6.7"
3	5G	512GB	OLED (XDR) Retina	Dual Camera (Wide, Ultrawide)	Regular 5.8"-6.1"
4	5G	128GB	OLED (XDR) Retina	Triple Camera (Wide, Ultra, Tele)	Large 6.5"-6.7"
5	4G	128GB	OLED (XDR) Retina	Dual Camera (Wide, Ultrawide)	Large 6.5"-6.7"
6	5G	128GB	Retina LCDs	Triple Camera (Wide, Ultra, Tele)	Regular 5.8"-6.1"
7	4G	128GB	Retina LCDs	Dual Camera (Wide, Ultrawide)	Regular 5.8"-6.1"
8	4G	256GB	OLED (XDR) Retina	Triple Camera (Wide, Ultra, Tele)	Regular 5.8"-6.1"

Result

A. Part Worth and Importance

Responses from all respondents to the question "What is your maximum reasonable price for the eight configurations above produce estimates of part worth and importance as shown in Table 3.

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Table 3. Part Worth Utilities and Importance

Attribute	Levels	Utility Estimates	std. Error	importance
Technology	4G	(1,794,197)	212,465	
	5G	1,794,197	212,465	3,588,394
Screen Type	Retina LCDs	(522,963)	212,465	
	OLED (XDR) Retina	522,963	212,465	1,045,926
Camera	Dual Camera (Wide, Ultrawide)	(296,973)	212,465	
	Triple Camera (Wide, Ultra, Tele)	296,973	212,465	593,946
Size	Regular 5.8”-6.1"	(78,440)	212,465	
	Large 6.5"-6.7"	78,440	212,465	156,879
Memory	128GB	832,019	173,477	
	256GB	1,664,038	346,954	2,496,057
	512GB	3,328,076	693,907	
(Constant)		10,518,674	406,839	

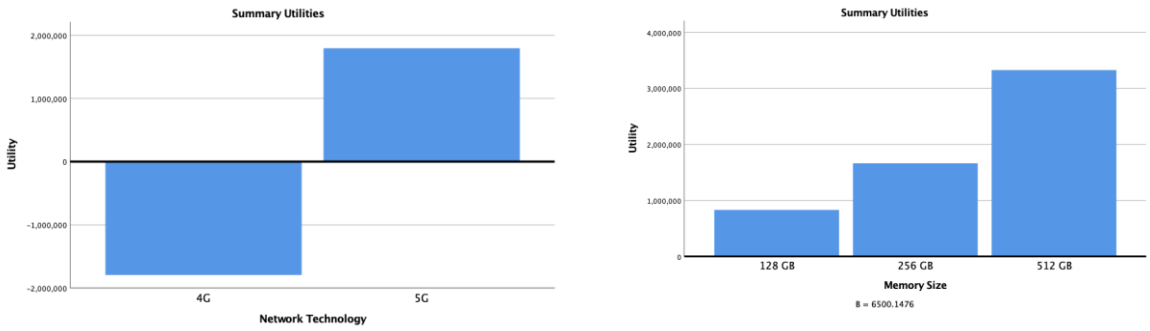
B. Importance level

In RBCA, an attribute's importance level is calculated from that feature's utility range. The results of the importance level analysis are shown in Table 4 below.

Table 4. Attribute Weight and Rank

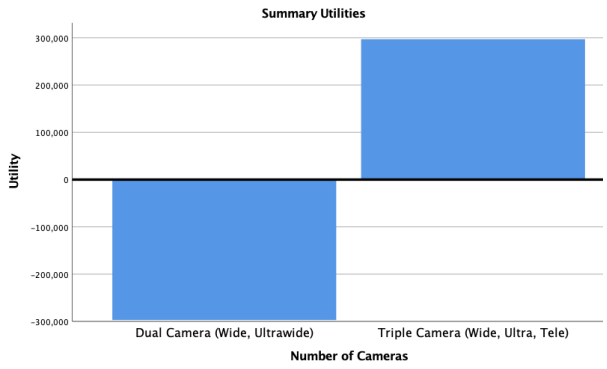
Attributes	Weight	Rank
Technology	36.97	1
Screen Type	14.16	3
Camera	11.18	4
Size	9.93	5
Memory	27.76	2
Total	100.00	

The part worth of these utilities is presented in Fig. 1.

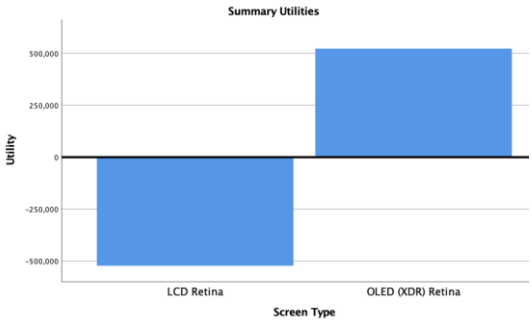


(a) (b)

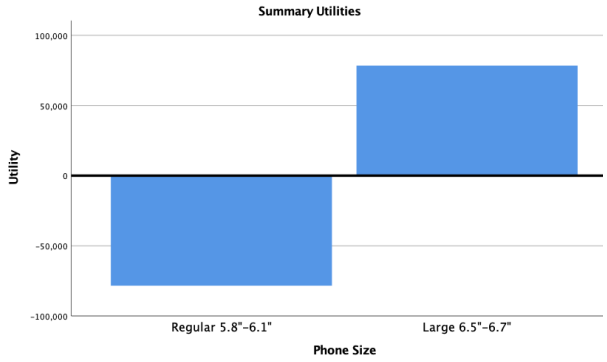
Fig. 1a and b. Part Worth Utilities Diagram (Network Technology and Memory Size)



(c)



(d)



(e)

Fig. 1c, d, and e. Part Worth Utilities Diagram (No. of Camera, Screen Type, and Phone Size)

C. Comparison of Expected vs Actual Price

Several months after the RBCA data was processed, the anticipated premium smartphone product was launched, so that researchers had a reference to the manufacturer's actual price and could compare it with the predicted price using the sum of the part worth for each particular configuration. The actual price in Indonesia is obtained from the official price of the product's official distributor (iBOX). While prices in the United States were obtained from the manufacturer's official website using the exchange rate of IDR14,200 per USD, as prevailing in the market at the time the research was conducted. Comparisons were made for 5 (five) product variants marketed by this premium smartphone manufacturer from the United States. The analysis results using constants and part worth for each attribute for the five products are shown in Table 5.

Based on Table 5, all predicted prices for Variant 1 are close to prices in the United States but significantly lower than in Indonesia. In other words, producers charge a higher price than the amount of part worth according to the customer, so the manufacturer applies the skimming method. For Variant 2, there is no part worth the mini screen size because this product has

never been launched. By comparing the actual prices with regular screens (regular size), all predicted prices are higher than actual prices in Indonesia and the United States.

Table 5. Price Prediction vs Actual Price for Variant 1 (in IDR)

Variants	RBCA predictions	Actual (IDR)	Actual (USD)
Variant 1 iPhone 11 (4G, Dual camera, Screen 6.1", Liquid Retina)			
64GB	8,242,111	11,499,000	8,505,800 (599USD)
128GB	8,658,120	11,999,000	9,215,800 (649USD)
256GB	9,490,139	14,499,000	10,635,800 (749USD)
Variant 2 iPhone 12 mini (5G, Dual camera, Screen size 5.4" (mini), XDR)			
64GB	12,876,430	10,999,000	9,925,800 (699USD)
128GB	13,292,440	12,499,000	10,635,800 (749USD)
256GB	14,124,459	13,999,000	12,055,800 (849USD)
Variant 3 iPhone 12 (5G, Dual camera, Screen 6.1", XDR)			
64GB	12,876,430	12,999,000	11,345,800 (799USD)
128GB	13,292,440	14,499,000	12,055,800 (849USD)
256GB	14,124,459	15,999,000	13,475,800 (949USD)
Variant 4 iPhone 12 Pro (5G, Triple camera, Screen 6.1", XDR)			
128GB	13,886,386	17,999,000	14,185,800 (999USD)
256GB	14,718,405	19,999,000	15,605,800 1099USD)
512GB	16,382,443	23,999,000	18,445,800 (1,299USD)
Variant 5 iPhone 12 Pro Max (5G, Triple camera, Screen 6.7", XDR)			
128GB	14,043,265	19,499,000	15,605,800 (1099USD)
256GB	14,875,284	21,999,000	17,025,800 (1.199 USD)
512GB	16,539,322	25,999,000	19,865,800 (1,399USD)

It can be assumed that the manufacturer launched this variant with a penetrating pricing strategy to face tough competition in the non-premium segment. Furthermore, for variant 3, variant four and variant 5, all predicted prices are lower than actual prices in Indonesia and the United States. So that overall, variants (1, 3, 4, 5) were launched by the manufacturer to take advantage of their premium position in the market by using a price skimming strategy.

D. Comparison of Product Line Pricing vs Importance

By comparing the actual prices of several variants, we can calculate the difference in prices for these attributes. Furthermore, by comparing these prices with importance (range of part worth), we can assess whether producers in the United States and distributors in Indonesia apply pricing strategies under customer perceptions. The comparison is presented in Table 6.

Table 6. Comparison of Attribute Price Differences vs Estimated Part Worth Range

Comparison Variant	Attribute Difference Main	Price difference (IDR)	Price difference (USD)	Estimation importance
1 and 3	Technology 4G and 5G	2,000,000	2,840,000 (200USD)	3,588,394
3 and 4	Dual vs Triple Cameras	5,000,000 – 8,000,000	2,840,000 (200USD)	593,946
4 and 5	Screen size	2,000,000	1,420,000 (100USD)	156,879
3 (128 vs 256gb)	128GB memory	1,500,000	1,420,000 (100USD)	832.018 (for 128GB)

E. Memory Unit Price Comparison

One aspect prospective buyers must determine is memory capacity, bearing in mind that buyers can only add little memory in the future for the smartphone product under study. It opens up opportunities for producers and distributors to implement a skimming price strategy. The analysis results show that the coefficient for memory (predicted unit price) is IDR6,500 per GB. In other words, the fair value for 128 GB of memory is IDR832,019 or IDR1,664,038 for 256GB, in the eyes of respondents. While the actual price set by distributors in Indonesia is IDR2,500,000 (an additional 128 GB to 256 GB unit price IDR19,531 per GB or 300% above the predicted unit price for memory), or IDR4,000,000 to upgrade from 256GB to 512GB (unit price IDR15,625 or 240% above the unit price for memory). In the United States, the manufacturer set the unit price for memory at 100 USD for 128 GB (unit price IDR11,094 / GB) or around 1.7x the predicted unit price. See Table 7.

Table 7. Memory Unit Price Comparison

	RBCA Predicted Price	IDR	USD
Unit price (IDR/ GB)	6,500	15.625 - 19.531	11,094
Premium over the predicted price	1x	2.4x – 3.0x	1.7x

Calculation of import duties, distributors have provided unit prices ranging from 2.4x (240%) to 3x (300 per cent) of the predicted RBCA value. It is likely that distributors have understood the importance of the memory attribute in users' eyes compared to other smartphone features, so they set a skimming price strategy for these features.

Discussion

The results of the study show that the premium smartphone manufacturer above have implemented a combination of skimming and penetrating strategies. The practice of applying several prices at once for a product is a very popular tactic among producers [1]. A study by Rao and Kartono [16] found that about 50% of companies apply one to five pricing strategies for one type of product, while only 10% of companies apply a single price.

Based on the comparison of actual prices and RBCA above, it appears that in general actual prices in Indonesia and in the United States are higher than the predicted prices for RBCA. The manufacturer appears to have implemented a skimming strategy for most of their product variants (variant 1, variant 3, variant 4, and variant 5) to maintain the brand image as a premium smartphone in the market [17] and maintain profitability at an optimal level [18] Through skimming strategy, the smartphone manufacturer has implemented a customer value based pricing which has proven to have a positive effect on company performance, unlike cost based and competitive based strategies [19]. The results of this study confirm that in order to

increase revenue, many firms would rather combine features that are relevant for different customer segements into integrated product offers (bundles), than just simply increase their prices [20]

However, the manufacturer is also trying to launch a new variant (variant 2) with a mini screen size that has never been introduced before, using a penetrating pricing strategy. By offering a new feature, potential buyers do not have a reference for the attribute's market price. Psychologically, the manufacturer can exceed customer expectations by offering a very affordable launch price compared to other smartphone variants (official distributor prices start at IDR 10,999,000 compared to the highest variant, IDR 25,999,000.

The penetration pricing strategy adopted by the producer for its simplest new variant seems appropriate because the target segment for this product is more liekely to be price sensitive and the competition in this market segment is tighter in the premium segment [1] [21]. In addition, the use of a new variant using a completely new attribute (small screen size) can also be experimental. If proven successful, smartphone the manufacturer will have presence in broader segments, both in the premium and in the more affordable segments. The manufacturer will also have the option to increase the price of the new variant gradually as the popularity of the product increases, as is commonly applied by technology companies, where there is a strong network effect [22]. On the other hand, if the penetration strategy does not produce the intended results, the manufacturer can choose to discontinue the new variant and maintain a skimming strategy for their premium products, thus preserving the image as a premium producer.

Furthermore, an analysis of feature prices and the range of part worth (importance), as presented in Table 7, shows that the largest to the smallest price differences applied by the official distributor in Indonesia are respectively for the following features: the number of cameras, network technology and screen size, and memory. In the country of origin (the United States), the order is as follow: the network technology and number of cameras, screen size and memory. On the other hand, according to RBCA respondents, the essential attributes are network technology, memory, the number of cameras, and screen size.

The results show that there is a gap between customer perception of part worth and the prices set by the distributor in Indonesia. The information provided by RBCA can help both producers and distributors to understand price ranges that are acceptable by the customers and which elements of their product offer that will affect price sensitivity [23]. In other words, RBCA can produce information about how customers provide value to product features (part worth), so that both smartphone manufacturers and their distributors in Indonesia will be able to better implement pricing strategies that are acceptable to the target segment so as to maximize profits [24]. This is of course in accordance with the principle that to achieve

profitability goals, companies must be able to understand how customers will evaluate and react to the prices of the products they offer [25].

Limitations

This research has several limitations. First, because 5G technology has been introduced relatively recently and in limited areas only, users still need time to be able to give proper value to the feature. The same limitation also holds for the mini screen size, which has never existed before. The second limitation of the study is related to the samples. Not all of the respondents who participated in the study have used the premium gadgets produced by the manufacturer being studied. Users of non-premium products are very likely to provide an assessment based on the prices and the user experience of other products in the market, which can reduce their price estimates. Another factor that may limit the generalization of the findings of this study is the respondents' purchasing power. Some respondents, especially students with little or no income, could predict prices that tend to be lower than reasonable levels, because of their limited purchasing power. Future research can involve the comparison of the results of this study with those generated with more diverse respondents. Finally, further research can be carried out using the Choice Based Conjoint Analysis, to see whether or not it can identify consistent or similar attribute levels of importance.

Conclusion

This study shows that, theoretically, RBCA can be used to predict the price of new products to be launched. The prices set by the premium smartphone manufacturer in the United States and their distributors in Indonesia were generally higher than the respondents' expectations (RBCA predictions). Except for one new variant that was launched, the manufacturer were generally implementing a skimming pricing strategy, which can help the firm to maintain level of revenue, profitability, and market positioning. The success of this combination strategy requires an analysis of the sales volume of each variant.

The prices that were set by the manufacturer in the United States placed the highest level of importance on the same feature as the most important attribute according to RBCA respondents, i.e. network technology. Contrary to this, the distributor in Indonesia placed the number of cameras as the most valuable feature, although its importance is actually the third according to RBCA respondents. Finally, the manufacturer in the United States and the distributor in Indonesia set a unit price 1.7x-3x above the predicted unit price for memory, which is a reasonable skimming strategy because the design of the smartphone does not allow post-sales memory upgrade. These differences demonstrated the gaps that may exist between what the firms and the customers think as valuable features in a product, that can be systematically identified through RBCA.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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