Preference-Based Pricing of the Indonesian JKN-KIS Health Insurance for Urban Middle-Income Self-Funders

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Article Info

Abstract

We determine optimal premiums of the Indonesian JKN-KIS health insurance plans for urban middle-income self-funders based on their preferences. The demand function was derived using the discrete choice experiment assuming a mixed multinomial logit model. The choice data were collected using questionnaires containing choice tasks that are randomly generated such that they are balanced, orthogonal, and have minimal overlap. The population is middle-income people living in the urban area that pay for health insurance with their own money. An online survey with a simple random sampling method taken time from February until March 2020. As many as 228 questionnaires were completed and collected. Individual utilities were estimated from choice data using the Bayesian method and subsequently used for deriving price-response functions. We found that more than 90% of respondents prefer first-class and second-class plans. Accordingly, we set up a pricing optimization formulation for those two plans to maximize total contribution while maintaining the price difference between them and setting the price of the third-class plan as it was. We came up with monthly premiums of Rp290,000 and Rp240,000 for the first-class and second-class plan, respectively, with an estimated monthly total contribution of Rp1.191 trillion, a 150% increase compared to that of the current pricing. It reveals the opportunity for increasing revenue by implementing finer price differentiation without sacrificing the mission of serving the underprivileged with the third-class plan.

Introduction

JKN-KIS is the national health insurance of Indonesia that was launched in 2014 and managed by the Social Security Administering Body of the Government of Indonesia (also called BPJS Kesehatan). By the end of July 2020, 221.8 million people have participated in this program, which constitutes 81.8% of the population. This figure was still below the universal health coverage target of 95% to achieve in 2019. About 35.6 million members were self-funder, while the rest were either government-funded or fully or partially funded by their employers. The JKN-KIS health insurance system offers three classes of service based on the type of ward and the possibility to upgrade. The classes consist of the first-class plan offering 2-4-bed wards and is upgradeable to the VIP class; the second class plan with 3-5-bed wards and upgradeable to the first-class and the VIP-class; and the non-upgradable third class with 4-6-bed wards.

Despite its growing membership coverage, the JKN-KIS has a fundamental problem regarding the continuing deficit. The primary cause of this deficit—which by the end of 2019 was about Rp32 trillion—is a relatively low premium compared to the cost paid to the healthcare providers. As of July 2020, the monthly premiums are Rp42.000, Rp100.000, and Rp150.000 for the first, second, and third classes, respectively. This research objective is to examine these premiums from consumers' perspectives by considering their preferences

and willingness to pay (WTP). The focus is on measuring preferences and WTP of the urban middle-income self-funders for the JKN-KIS health insurance plans then determines the 'right' premium for each class.

The ultimate objective of this research is to determine monthly premiums for the urban middle-income self-funders to maximize the profitability obtained from the first-class and the second-class members. The third-class plan is designed for underprivileged people, and hence the premium should be set so most people could afford it. Since there is no private insurance company that offers similar premiums plans, it practically has no competitors. Meanwhile, the first-class and the second-class plans are offered at higher prices which may compete with health insurance plans available in the market. Since the population studied is not exhaustive, the result is not intended to be implemented marketwide. Yet, it tries to reveal the opportunity for increasing revenue by implementing finer price differentiation than one currently implemented, without sacrificing the mission of serving the underprivileged with the third-class plan.

Most of the previous research on measuring WTP for health insurance plans use the contingent valuation method or CVM (Mitchell, 2013) This method has been used for doing such research in various countries, like Namibia (Gustafsson-Wright, Asfaw, & van der Gaag, 2009), Indonesia (Aryani & Muqorrobin, 2013), Vietnam (Nguyen & Hoang, 2017), Malaysia (Azhar, Rahman, & Arif, 2018), Sierra Leone (Jofre-Bonet & Kamara, 2018)using a purposely-designed survey of a representative sample of this sector. Methods We elicit the WTP using the Double-Bounded Dichotomous Choice with Follow Up method. We also examine the factors that are positively and negatively associated with the likelihood of the respondents to answer affirmatively to joining a HI scheme and to paying three different possible premiums, to join the HI scheme. We additionally analyze the individual and household characteristics associated with the maximum amount the household is willing to pay to join the HI scheme. Results The results indicate that the average WTP for the HI is 20,237.16 SLL (3.6 USD, and Ethiopia (Gidey,

Gebretekle, Hogan, & Fenta, 2019)access to at least the basic health services is still a problem in Ethiopia. With the intention of raising funds and ensuring universal health coverage, a mandatory health insurance scheme has been introduced. The Community Based Health Insurance has been implemented in all regions of the country, while implementation of social health insurance was delayed mainly due to resistance from public servants. This study was, therefore, aimed to assess willingness to pay for social health insurance and its determinant factors among public servants in Mekelle city, Northern Ethiopia. Methods: A concurrent mixed approach of cross-sectional study design using double bound dichotomous choice contingent valuation method and qualitative focus group discussions was employed. A total 384 public servants were recruited from randomly selected institutions and six focus group discussions (n = 36. The popularity of this method is due to its simple elicitation method, especially the dichotomous-choice-with-follow-up (DCF), which only needs three yes-no questions, out of which respondents need to answer two (Aizaki, Nakatani, & Sato, 2014).

The research in Namibia (Gustafsson-Wright et al., 2009), Serra Leone (Jofre-Bonet & Kamara, 2018)using a purposely-designed survey of a representative sample of this sector. Methods We elicit the WTP using the Double-Bounded Dichotomous Choice with Follow Up method. We also examine the factors that are positively and negatively associated with the likelihood of the respondents to answer affirmatively to joining a HI scheme and to paying three different possible premiums, to join the HI scheme. We additionally analyze the individual and household characteristics associated with the maximum amount the household is willing to pay to join the HI scheme. Results The results indicate that the average WTP for the HI is 20,237.16 SLL (3.6 USD, and Ethiopia (Gidey et al., 2019)access to at least the basic health services is still a problem in Ethiopia. With the intention of raising funds and ensuring universal health coverage, a mandatory health insurance scheme has been introduced. The Community Based Health Insurance has been implemented in all regions

of the country, while implementation of social health insurance was delayed mainly due to resistance from public servants. This study was, therefore, aimed to assess willingness to pay for social health insurance and its determinant factors among public servants in Mekelle city, Northern Ethiopia. Methods: A concurrent mixed approach of cross-sectional study design using double bound dichotomous choice contingent valuation method and qualitative focus group discussions was employed. A total 384 public servants were recruited from randomly selected institutions and six focus group discussions (n = 36 adopted the DCF elicitation method. The research in Namibia and Sierra Leone assumes a bivariate probit model for the responses to the first and second DCF questions, while one in Ethiopia assumes a logit model for the pooled responses. Research in Malaysia (Azhar *et al.*, 2018), implemented CVM using dichotomous bidding and represented the corresponding response as a function of predictor variables using logistic regression. Meanwhile, the research in Indonesia (Aryani & Muqorrobin, 2013) and Vietnam (Nguyen & Hoang, 2017) use self-stated and payment card elicitation methods, respectively, and represents the WTP as a function of predictor variables using multiple linear regression.

Despite its popularity, CVM has several drawbacks where two of which are highlighted in this research. Namely over-stated WTP value (List & Gallet, 2001) and its inability to cope with competitive choice situations (Woolhandler & Himmelstein, 2017). The over-stated WTP, which is due to hypothetical setting bias, is in the average magnitude of 2.65 but in the worst condition can go up to 5 (List & Gallet, 2001). There are at least five methods to measure WTP (Woolhandler & Himmelstein, 2017). Namely, based on actual purchase data, self-stated WTP, experimental auctions, CVM, and choice-based conjoint (CBC). Among those, CBC is considered the best for measuring WTP in competitive choice situations. In CBC, competing products are presented as alternatives in the choice task, out of which respondents are asked to choose one that fits their preferences.

CBC is fundamentally different from the traditional conjoint method. It is based on the theory of random utility maximization (RUM). Which so far considered the best theory for modeling and predicting choice. In the theory of discrete choice, CBC is also called discrete choice experiment or DCE (Louviere, Flynn, & Carson, 2010). In its recent development, it can be used to analyze choice at the individual level. It is usually done by assuming a mixed multinomial logit model with multivariate normal distribution which, with current computer processor speed, can be efficiently estimated using the hierarchical Bayes method (Finkelstein *et al.*, 2018). Unlike the traditional conjoint that maximizes maximize some likelihood function, hierarchical Bayes uses the Markov chain Monte Carlo simulation seeking convergence of parameters of interest by conditioning on each other. The capability to model and estimate choices at the individual level makes DCE better in estimating WTP than CVM using an aggregate approach.

In this research, WTP is manifested in the demand function, which is derived by predicting and aggregating individual choices. These choices are estimated from personal utilities using the randomized first choice simulation assuming a mixed multinomial logit choice model (Benjamin *et al.*, 2017). The Bayesian estimation method is suitable to estimate individual utilities from stated-preference choice data (Finkelstein *et al.*, 2018). Compared to the popular contingent valuation method (CVM), DCE is a better approach for analyzing the first and second-class plans because those are in a competitive situation with others available in the market. Moreover, this approach enables us to incorporate the cannibalization effect between classes which is very common in multiple fare-class.

Method

This research uses stated-preference choice data, collected using a DCE questionnaire. The questionnaire consists of a set of choice tasks. Each has several (usually 3-5) product concepts. The researcher adds a 'none' option to accommodate situations where respondents prefer a product not available in the choice task. Each product concept is represented as a combination of attribute levels

that make up the product. We determined product attributes using the critical incidence approach (Benjamin et al., 2017), while each attribute's level incorporates those currently available in the market and considered need to be explored. The choice tasks in a questionnaire are randomly generated and designed such that they are balanced, orthogonal, and have minimum overlap (Woolhandler & Himmelstein, 2017). That complexity requires the use of computer software to design and administer the DCE questionnaire. In this research, we use Lighthouse Studio from Sawtooth Software.

Since the design and generation of the choice tasks in the DCE questionnaire have to be computer-assisted, so does the survey. The population is people identified as being in the middle-income class and living in the urban area that pays for the health insurance out of their pocket. Since the survey is conducted online through chat groups and social media, the sampling frame is those connected to these channels. Using the simple random sampling method, the required sample size, denoted as n, is determined such that (Woolhandler & Himmelstein, 2017).

$$\frac{nta}{c} \geq 1000$$

a)

Where t is the number of choice tasks in the questionnaire, a is the number of alternatives in a choice task, and c is the maximum number of levels in any attribute. In our questionnaire design with t=8, a=4, and c=5, the minimum sample size is 157.

From choice data, individual utilities are estimated using the hierarchical Bayes (HB) method. This method assumes that the individual utility matrix, denoted by β, follows a multivariate normal distribution with mean vector μ and covariance matrix Σ. Estimating the value of β, μ, and Σ can be done iteratively by conditioning on each other. In this research, we employ the Metropolis-Hastings algorithm to estimate the values of $\beta|\mu,\Sigma$, $\mu|\beta,\Sigma$, and $\Sigma|\beta,\mu$ using one data at a time until they converge (Finkelstein et al., 2018). The convergence is implied by the Bernstein-von Mises theorem which simply states that the posterior distribution of a random parameter converges to its maximum likelihood estimator as the sample size increases. These convergent values are used as estimates of β, μ, and Σ.

In pricing research, the demand for a product is represented as a function of its price and denoted as d(p), where p is the price. Based on the WTP approach, the demand for a product at price p is the aggregation of demand from individuals that are willing to pay at least p for the product. Mathematically, this can be expressed as

$$d(p) = D \int_p^\infty w(x)\, dx$$

b)

Where D is the market size and w(x) is the WTP function (Cohodes et al., 2015).

Instead of estimating w(x) and subsequently calculating d(p), we estimate (b) — which represents the share of preference—from individual utility data using the randomized first choice (RFC) method (Benjamin et al., 2017). If product i is offered at price level p, we can estimate d(p) by aggregating choices across all individuals and then multiply the result by D. In this research, to obtain a continuous demand function, we simulate for 5-6 different values of p and interpolate the resulted [p,d(p)] data points using cubic splines (Wolberg & Alfy, 2002).

In this research, the price of the third-class plan is set to the minimum between one follows the government's policy and one where at least 95% of the urban middle-income self-funders are willing to pay. Once we have the demand function, determining the price of the third-class plan is straightforward. Meanwhile, prices of the first-class and second-class plans are set to maximize profitability. If we denote p_1, p_2, $d_1(p_1)$, and $d_2(p_2)$ as prices and demand functions of the first-class and the second-class plans, respectively, the objective function of the pricing problem for those plans can be expressed as

$$\max_{p_1,p_2} d_1(p_1)(p_1 - c_1) + d_2(p_2)(p_2 - c_2)$$

c)

Where   and   are the corresponding increwhere c_1 and c_2 are the corresponding

incremental costs. Incremental costs are additional costs incurred when a company makes one additional customer commitment (Cohodes et al., 2015). In this regard, customer commitment is the generalization of sales.

This simple objective function becomes much more complicated when we incorporate the cannibalization effect between the first-class and the second-class plans and between two and the third-class. Cannibalization takes place when customers with higher WTP buy lower-priced products (Cohodes et al., 2015). It is necessary to set the right premiums for the first-class and second-class plans to minimize the cannibalization effect and maximized revenue.

Let $p_3{}^\star$ be the minimum of the current price of the third-class plan and one that ensures at least 95% affordability. The demand function for the first-class plan, $d_1 (p_1)$, is derived using RFC simulation by setting a competitive scenario where the price of the second-class plan is p_2 and that of the third-class plan is $p_3{}^\star$. This can be expressed as

$$d_1(p_1) = f(p_1|p_2, p_3^*)$$ d)

where f(·) represents a function that converts individual utilities into demand function, which, as described above, combines RFC simulation and cubic spline interpolation. Using the same approach to derive $d_1 (p_1)$, we have

$$d_2(p_2) = f(p_2|p_1, p_3^*)$$ e)

Equation (d) and (e) serve as a constraint to the objective function previously defined, together with the price-difference and nonnegativity constraints. We discretize the decision variables, p_1 and p_2, to make the solution feasible to be obtained using enumeration.

Result and Discussion

From preliminary interviews and observation, we came up with attributes and levels of health insurance plans for our DCE

questionnaire as in Table 1. There are some conditional relationships between attributes. Namely, service class and type of ward, and service class and upgradability. The levels determination based on the current JKN-KIS health insurance plan and those we want to explore. Since we are to explore the possibility to increase revenue by price differentiation, we set the price levels up to twice as it is now and try to find out respondents' preferences to those levels.

TABLE 1. Attributes and Levels of Health Insurance Plans

Attributes	Levels
Service class	First; Second; Third
Type of ward	1 bed; 2-3 bed; 3-4 bed; 4-6 bed
Upgradability	Upgradeable; Not upgradeable
Monthly premium	Rp42,000; Rp110,000; Rp160,000; Rp250,000; Rp300,000

Source: Primary Data (2020)

Our critical incidence interview suggests not including insurance providers as an attribute in the DCE questionnaire. Moreover, incorporating this attribute in the questionnaire would be problematic. There are too many levels that respondents may consider. Some attributes representing service quality came up during the interview, such as waiting time and reliability. We do not include these attributes in the questionnaire design because we assume they have been represented by the JKN-KIS name acting as a composite attribute. Besides, previous research on the service quality of the JKN-KIS health insurance found that, in general, policyholders consider the service quality has been improved (Indarwati & Phuoc, 2018). It implies that the level of service quality of the JKN-KIS health insurance is comparable to that of other plans available in the market. The hypothetical setting in our choice tasks is a situation where respondents are offered the JKN-KIS health insurance plan. Then they should choose one that suits them best, or the 'none' option, otherwise. It makes the questionnaire still realistic since the possibility of respondents prefers choosing other insurance plans is accommodated.

Since this research is about pricing, determining the suitable levels for price attributes is very important. Firstly, they should cover the current pricing scheme, which is Rp42,000 – Rp150,000. Secondly, they should cover prices beyond the current range but still reasonable for the product of interest. In this research, it does not make sense to explore prices below the current price range. It would only make the deficit problem worse. Moreover, the fact that more than 90% of the respondents prefer higher service classes indicates that the population being studied is willing to pay more than the current premiums. We set the upper price limit of Rp300,000, which is twice the current maximum price level.

Each questionnaire consists of seven random choice tasks and one fixed choice task, each of which has four product concepts and a 'none' option. Fixed choice tasks are non-randomized choice tasks presented to all respondents and will be used for internal validation. Several prohibitions were imposed in the design to prevent the unrealistic product concepts occurrence, such as the first-class plan with a low monthly premium. Data were collected through an online survey during February-March 2020 from respondents identifying themselves as urban middle-income self-funders. After a one-month survey, 228 completed questionnaires were collected.

Estimation of individual utilities using the hierarchical Bayes method resulted in an average percent certainty of 0.686 means that the model is 68.6% fit with the data. Meanwhile, the average root likelihood is 0.603 means that the model predicts respondents' choices 0.603/0.20 = 3.015 times better than one without a model (i.e. random guess). The denominator of 0.20 comes from the probability of random guesses in a choice task consists of five alternatives (four product concepts and a 'none' option) as in our questionnaire (Woolhandler & Himmelstein, 2017). Next, internal validation was done by comparing respondents' actual choices toward the fixed choice task from the questionnaires with those predicted by the model using RFC simulation. Comparison across all alternatives in the fixed choice task resulted in a mean absolute error of 3.49%. Compared to the standard, this is a good result despite the relatively small sample size (Vilikus, 2012). Table 2 shows the average utility values of all respondents and an example of utility values from one of the respondents.

The utility value in Table 2 is represented in zero-centered ordinal data where greater values indicate more desirable levels. We

TABLE 2. The Average Utility of Each Attribute Level

Attributes	Levels	Average Utilities of All Respondents	Utilities of Respondent #79
Service class	First	1.126	-0.173
	Second	1.385	1.268
	Third	-2.511	-1.094
Type of ward	1 bed	1.749	1.551
	2-3 bed	1.782	1.219
	3-4 bed	-0.128	0.563
	4-6 bed	-3.403	-3.333
Upgradability	Upgradable	0.591	1.318
	Not upgradable	-0.591	-1.318
Monthly premium	Rp42,000	1.028	0.957
	Rp110,000	0.649	0.358
	Rp160,000	-0.108	0.814
	Rp250,000	-1.014	-1.343
	Rp300,000	-1.554	-1.786

Source: Data Processing

estimated the importance of each attribute by individual utilities from the Bayesian estimation. The result is in Table 3.

TABLE 3. Attribute importance

Attributes	Relative importance
Service class	42.81%
Type of ward	33.17%
Upgradability	8.28%
Monthly premium	15.74%

Source: Data Processing

The mean absolute error of 3.49% from internal validation indicates a good model considering the purpose of our research. We do not test external validity since we do not have data about the JKN-KIS policyholders from the population studied. From the average utility values in Table 2, respondents prefer the second-class and the first-class over the third class. It is also shown in Table 3 that respondents are not sensitive to price. It is consistent with the result of the simulation under the current condition. The majority of respondents choose the first-class (62.17%) and the second-class (34.03%). With a mean absolute error of 3.49%, it can be inferred from this simulation result that the differences in preference between service classes are significant. The corresponding order of preference is robust.

In determining optimal prices, we set the third class price as known today, which is Rp42,000 per month. The government determines the third-class price so that the majority of people could afford it. The population that we studied is limited to the middle-class in the urban area which can not be considered as a representation of the total population for which the JKN-KIS insurance plans were designed. Hence, we will not evaluate the price of the third class but focus on the first and the second class instead. While the third class price is set to ensure affordability, we should settle the higher class price to maximize profitability. With a low monthly premium, BPJS Kesehatan would likely suffer a deficit from running the third-class plan only. Although they are a not-for-profit organization, if they could make sufficient profit from the first-class and the

second-class plans, they can allocate the profit to cover the deficit resulted from serving the third-class members. Nevertheless, they cannot set too high premiums because there is a risk that members of the higher-class plan defect to the third-class plan (cannibalization effect). In our pricing optimization, we do not restrict the price difference between the third-class and both higher-class plans. Instead, by our demand model, we let the mechanism of individual preferences determines optimal prices for each plan.

We start the search for optimal prices by simulating the current condition where the first-class (2-3 bed ward; upgradable), the second-class (3-4 bed ward; upgradable), and the third-class (4-6 bed ward; not upgradable) plans are offered at the prices of Rp150,000, Rp110,000, and Rp42,000, respectively. The simulation predicts that 62.17% of the respondents will choose the first-class plan, 34.03% the second-class, 2.68% the third-class, while the remaining 1.12% will not choose any of those. By simulating various possible price combinations of the first-class and the second-class plans, we found that the combined share of these two classes is always greater than 90%.

Since more than 90% of respondents prefer the first-class and second-class plans, we determine optimal prices for the first-class and second-class plans by setting the third-class plan at the current price of Rp42,000. We start by deriving the demand function for each plan using the method described in the previous section. The market size () for the demand functions is assumed to be 5,350,052. From the assumption that there is a 153.7 million urban population in Indonesia, out of which 21.7% has middle-level income, and based on the data from the Social Security Administering Body, 16% of the current members are self-funder. The incremental cost was estimated using data from the 2018 BPJS Kesehatan Financial Report. There was total spending of Rp94.3 trillion with 201.6 million active members.

By the method we use to derive the demand functions, the formulation of our pricing optimization problem incorporates the effect of cannibalization (Pratikto, 2019). This makes the pricing optimization model more realistic, but at the same time, much

more complicated. In a standard optimization problem, objective function coefficients are constant. In this research, we have an optimization problem where the coefficients of the objective function (i.e. and) change with the value of the decision variables (i.e. and). In addition to that, the use of cubic demand functions implies a quartic polynomial objective function which is extremely difficult to solve analytically (Ahmadi, Olshevsky, Parrilo, & Tsitsiklis, 2013). By discretizing the solution space to the multiple of Rp10,000, the number of solutions that need to be evaluated is 231, which can be completed in about 2 hours of computation. The optimal price for each plan was obtained by enumerating for all possible combination values of and in the multiple of Rp10,000 between Rp50,000 and Rp300,000 while maintaining the price difference constraint of . In each enumeration cycle, a combination of and values are picked, and demand functions are derived and subsequently used to estimate the quantity demanded of each plan. Accordingly, the total contribution was then calculated. This procedure was repeated for all possible combinations of and , and one with the greatest total contribution is selected. We came up with optimal prices of Rp290,000 and Rp240,000 for the first-class and the second-class, respectively, with an estimated monthly total contribution of Rp1.911 trillions.

The optimal prices of Rp290,000 and Rp240,000 have the corresponding share of 66.49% and 28.51% preferences. It suggests that respondents are willing to pay much higher than the current premiums of Rp150,000 and

Rp100,000. The monthly total contribution from this pricing is estimated to be Rp1.191 trillion, an almost 150% increase compared to that of the current pricing. The demand functions at these optimal prices are specified in Table 4 and Table 5.

This result highlights the importance of managing price differentiation not only as a tool to provide customers with varied product choices but also as a tactic to increase profitability. BPJS Kesehatan also assumes social missions, increased profitability from optimal price differentiation on the first-class and the second-class plans would help to cross-subsidize the third-class. The result of this research indicates that finer price differentiation (with additional fare-classes to the existing three) is potential for increasing revenue from higher fare-classes (currently, these are the first-class and the second-class). Designing a comprehensive pricing policy marketwide requires information about preferences and WTP from all market segments, for which the method that we adopt in this research can be used. The corresponding pricing optimization problem would be more complicated, but our approach is still feasible to be used. Implementing this finer price differentiation should be accompanied by service differentiation which may be delivered through leaner processes, shorter processing time, easy access, etc.

Conclusion

We estimate the preferences and WTP of the urban middle-income self-funders for the JKN-KIS health insurance plans and derive the

TABLE 4. Demand function of the first-class plan assuming p_2 = Rp240,000 and p_3 = Rp42,000

Price, p_1	Demand functions, $d_1(p_1)$
$42.000 \leq p_1 < 110.000$	$d_1(p_1) = 4,740,030 - 0.91\,p_1 + 3.53 \times 10^{-5}\,p_1^2 - 2.80 \times 10^{-10}\,p_1^3$
$110.000 \leq p_1 < 160.000$	$d_1(p_1) = 3,697,983 + 27.51\,p_1 - 2.23 \times 10^{-4}\,p_1^2 + 5.03 \times 10^{-10}\,p_1^3$
$160.000 \leq p_1 < 250.000$	$d_1(p_1) = 6,614,268 - 27.17\,p_1 + 1.19 \times 10^{-4}\,p_1^2 - 2.09 \times 10^{-10}\,p_1^3$
$250.000 \leq p_1 < 300.000$	$d_1(p_1) = -631,998 + 59.78\,p_1 - 2.29 \times 10^{-4}\,p_1^2 + 2.55 \times 10^{-10}\,p_1^3$

TABLE 5. Demand function of the second-class plan assuming p_1 = Rp290,000 and p_3 = Rp42,000

Price, p_2	Demand functions, $d_2(p_2)$
$42.000 \leq p_2 < 110.000$	$d_2(p_2) = 3,337,559 - 4.37\,p_2 + 8.08 \times 10^{-5}\,p_2^2 - 6.41 \times 10^{-10}\,p_2^3$
$110.000 \leq p_2 < 160.000$	$d_2(p_2) = 682,930 + 68.02\,p_2 - 5.77 \times 10^{-4}\,p_2^2 + 1.35 \times 10^{-9}\,p_2^3$
$160.000 \leq p_2 < 250.000$	$d_2(p_2) = 7,566,710 - 61.05\,p_2 + 2,29 \times 10^{-4}\,p_2^2 - 3.27 \times 10^{-10}\,p_2^3$
$250.000 \leq p_2 < 300.000$	$d_2(p_2) = 782,433 + 20.37\,p_2 - 9,64 \times 10^{-5}\,p_2^2 + 1,07 \times 10^{-10}\,p_2^3$

corresponding demand functions. Accordingly, we set up a pricing optimization problem for the first and second-class plans to maximize total contribution when maintaining between-class price difference and the current price of the third-class plan. The preference-based demand functions were obtained from DCE data using the combination of the Bayesian estimation method, randomized first choice simulation, and cubic spline interpolation. By applying enumeration to the resulted quartic polynomial optimization problem, we came up with optimal prices of Rp290,000 for the first-class plan and Rp240,000 for the second-class plan with an estimated monthly total contribution of Rp1.911 trillion. This is a 150% increase compared to that of the current pricing. This result reveals the opportunity for increasing revenue by implementing finer price differentiation than one currently implemented, without sacrificing the mission of serving the underprivileged with the third-class plan.

The use of stated-preference data may result in bias caused by the hypothetical setting. Although the bias is usually less than that of the CVM, it cannot be determined unless we conducted some experimental study to measure it accordingly. The use of the "none" option instead of direct competitors in the choice task may also cause bias. All these biases are the consequences of choices that we made. To obtain a more efficient survey instrument and consequently more valid data. The remaining bias is unavoidable and would be greater if the choices were made otherwise.

We can direct future research toward overcoming these biases. Bias caused by the use of the "none" option can be eliminated by including health insurance providers as an attribute in the questionnaire. We can use a mechanism like one in the adaptive choice-based conjoint to handle a situation where there are many attribute levels. Hypothetical bias may be reduced by combining stated-preference DCE data with revealed-preference data. Nowadays, in the e-commerce era, revealed preference data can be easily obtained from click, inquiry, and sales data.

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