International Journal of Innovation in Enterprise System, Volume 2, Issue 01, January 2018, pp. 19-25

Money Back Warranty on Pricing in Dual Channel Supply Chain (Case Study : Garlick Store Surabaya)

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Received: 11 October 2017, Revised: 18 December 2017, Accepted: 19 December 2017, Published: 17 January 2018

Abstract—The development of internet brings great influence in business management, especially in supply chain. Transaction conducted through the internet in supply chain known e-fulfillment, is an integrated process from receiving customer order, managing transaction, warehousing, managing transportation, communicating, with customer using media of information technology. Online sales concept opens up the researchers to conduct research on online sales and offline sales simultaneously, known Dual Channel Supply Chain (DCSC). One category of products that are sold using this structure is fashion product. However, selling fashion product using DCSC structure it still has shortcomings and challenges. Due to customer can not make a selection, viewing and researching product and quality inspaction product dierctly. Based on this, some enterprises provide product warranty sales system offered. Warranty as a guarantee given to customer to provide security and comfort for making purchases. Warranty gives impact on price of product, both online and offline. This leads to the need to do a calculation the optimum price considering money back warranty. Optimum price obtained in the model demand function using quadratic programming adressing the objective function in the form profit maximum in individual channel (P_w, P_s dan P_o) as well as whole profit in DCSC by considering the value of money back warranty

(g). The result obatained is optimum price for two scenarios. There are optimum price in individual channel without money back warranty and optimum price in online channel with accomodate money back warranty.

Keywords—*dual channel supply chain (DCSC); money back warranty; optimization.*

I. Introduction

Internet brings a big impact in the lives of today's society. Many aspects of the community activities that can be reached by using the internet facility. Internet use can reduce the use of some of the resources needed. Development of the internet is expanding rapidly enough, Indonesia has increased by 32% of internet users in 2010, became one of the only country in Southeast Asia that have the greatest increase in the use of the Internet [1]. One role of Internet technology in industrial activity can be seen in the activities supply chain. Because of the success in a variety of activities supply chain cannot be separated from the internet technology. Internet technology applications in supply chain One of which is Electronic Fulfillment (E-Fulfillment). E-Fulfillment is the management process - the process of receiving orders from customers, manage transactions, warehouse management, transportation management, communication with customers and activities reverse logistics with information technology and communication media. As examples of companies that have been applying web-based-ordering is Dell Computer, IBM and Amazon.com [2].

A research conducted by The Nielsen Company give the result that there are five types of products in demand by consumers in business on line. Five types of such products include books with a percentage of 41%, fashion 36%, video game 24%, 23% of electronic devices and computer equipment 16% [3].

With the role of Internet technology in action supply chain it appears a new concept called development dual-channel supply chain (DCSC). This combined structure is a system of manufacturing product fulfillment supply to consumers is done through two channel simultaneously [4]. Two channel among others traditional channel, where a company or manufacturer supplying products to the store. On the other hand, are referred to as direct channel, which the company manufacturing or selling through the Internet network facilities are directly accessible to consumers. In dual-channel supply chain, there are some games that determines your trading decisions on activities dual-channel supply chain. As the pricing decisions of the products and the large quantity of product on each - each channel. Structure dual-channel supply chain can be seen in Fig. 1 below.

A system of sales through dual channel certainly needed a game strategy marketing of the manufacture/ wholesaler. Customer satisfaction and trust is an important factor in this system. One of the strategies to achieve these targets is the after-sales service. After-sales services are often offered by the manufacturer / wholesaler warranty service is provided to consumers after buying the product. Warranty is an important concept for both the manufacturing and consumer sides. It is a guarantee given by the manufacturer/wholesaler to consumers on the product that you have purchased. So that the manufacturing/wholesaler need to determine the optimal sales price to get the maximum benefit. In a related study on the estimated cost of the warranty on multi-module product with a simulation approach, stating that in making estimates concerning warranty costs need to define some aspects of the issue such as product life cycle, failure mode, repair and downtime. By adding information and data on costs of production, it will get output regarding the determination of the warranty period as well as pricing [5].

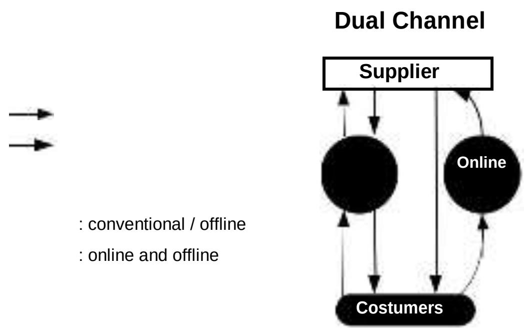

Fig. 1 Dual Channel Supply Chain Structure

Pricing has a significant role in behavior supply chain, especially on dual channel or multiple chain [6]. In the dual channel, there are two important issues in determining the price, namely the determination that the decision-makers (retailer or manufacturer) and the competition between the two channel.

Product fashion is one of the categories of products which have a rapid movement of the market share and see the product sales system fashion very crowded in online channel. Generally, people are more interested in buying the product fashion on offline channel. Purchasing decisions made by the peoples have a right decision because by purchasing traditional (store / offline channels) customers can make selections and see live product that will feel satisfied with the product purchased. So to further attract customers, the company opened the warranty on the product - the product being sold on line. This guarantee is given on the grounds online store can not provide the same facilities as offline store. With the provision of the warranty will give the benefit of both parties. The first party, namely the manufacturer, use warranty as a means of promotion because consumers will feel more comfortable to the products purchased by the warranty. In addition, to limit the claims of consumers who are not rational. The second party, the consumer, giving the warranty will protect from purchasing a defective product [7]. If you look at the structure of any divergence DCSC will certainly guarantee the delivery mechanism in each channel. Some enterprises structured in DCSC and providing guarantee facilities are Garlick Store, Rumah Warna, Klastik Shoes, and Sepatu Trendy.com.

To time this no studies combining elements of the warranty on the system dual-channel supply chain. So in this study will be proposed research on modeling the optimal pricing on sales on line and offline taking into account the warranty so that will be generated the maximum profit.

II. Model Development

The development of model on this research can be described as follows:

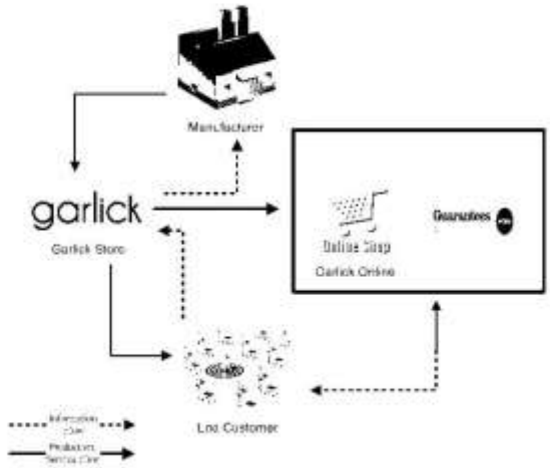

Fig. 2 Conceptual Model

Fig. 2 above can be explained that DCSC structure built in Store Garlick Surabaya system begins manufacturer (wholesaler) who do supply product to the store. Then Garlick Store has two channel for bid for the product, in store and online shop. In the system online shop provides warranty services to consumers in the event claim.

Furthermore, mathematical models are built Chen and Simchi-Levi, 2004; Yan, 2008; Zhan and Wang, 2002. [4] formulate function demand on traditional retail channel as follows:

$$D_s = d_s^{max} - \beta P_s \quad (1)$$

Where:

D_s = Demand on traditional channel/store
d_s^{max} = Maximum demand on store
β = Elaticity ratio demand on selling price
P_s = Product price in store

In the traditional retail channel did not interplay between P_s and P_o to influence demand.

The models in Store Demand Function which is formulated by Chiang, et al., (2003) can be seen in equation 2 below [4]:

$$D_s = d_s^{max} - \beta \left(\frac{P_s - P_o}{1 - \rho} \right) \quad (2)$$

The purpose of the model demand above is a calculation to represent the sacrifice of consumers in the acceptance of the product on line compared with conventional products that can be formulated by the denominator in on. Model mentioned β assume equal

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to 1. Then in the numerator represents that the difference in price between the selling price traditional retail and direct channels.

Furthermore, in the function demand online a model obtained from a decrease in equation (1) and equation (2). Decreased function was performed by subtracting the equation (1) with equation (2) to obtain a model online demand function below:

$$\rho D_o = D_s^{lt} - D_s^{ut}$$

$$\rho D_o = (d_s^{max} - \beta P_s) - \left[d_s^{max} - \beta\left(\frac{P_s - P_o}{1-\rho}\right)\right]$$

$$\rho D_o = -\beta P_s + \beta\left(\frac{P_s - P_o}{1-\rho}\right)$$

$$\rho D_o = -\beta P_s + \frac{(\beta P_s - \beta P_o)}{(1-\rho)}$$

$$\rho D_o = \frac{-\beta P_s(1-\rho) + \beta P_s - \beta P_o}{(1-\rho)}$$

$$\rho D_o = \frac{P_s(\beta - \beta(1-\rho)) - \beta P_o}{(1-\rho)}$$

$$\rho D_o = \frac{P_s(\beta - \beta + \beta\rho) - \beta P_o}{(1-\rho)}$$

$$\rho D_o = \frac{\beta(P_s\rho - P_o)}{(1-\rho)}$$

$$D_o = \frac{\beta(P_s\rho - P_o)}{\rho(1-\rho)}$$

(3)

As for the model function demand on online channel with money back warranty as follows.

$$D_o' = \frac{\beta(P_s\rho - (P_o' - g))}{\rho(1-\rho)(1-c)}$$

(4)

Then calculate the profit maximization, with the formula as follows:

$$G_s = \left[\left(d_s^{max} - \beta\left(\frac{P_s - (P_o)}{1-\rho}\right)\right)(P_s - P_w)\right]$$

$$G_o = \left[\left(\frac{\beta(P_s\rho - P_o)}{\rho(1-\rho)}\right)(P_o - P_w)\right]$$

$$\mathrm{Max}_{P_o, P_s, g}\, G_{dcsc} = \mathrm{Max}_{P_o, P_s, g}\,(G_s + G_o)$$

Considering money back warranty:

$$G_s' = \left[\left(d_s^{max} - \beta\left(\frac{P_s - (P_o' - g)}{1-\rho}\right)\right)(P_s - P_w)\right]$$

$$G_o' = \left[\left(\frac{\beta(P_s\rho - (P_o' - g))}{\rho(1-\rho)(1-c)}\right)(P_o' - g) - P_w)\right]$$

$$\mathrm{Max}_{P_o', P_s, g}\, G_{dcsc}' = \mathrm{Max}_{P_o', P_s, g}\,(G_s' + G_o')$$

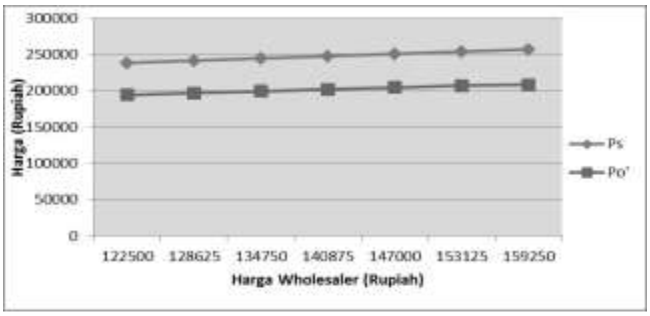
(5)

III. NUMERICAL EXPERIMENT

Numerical experiment is a step to test whether the models that have been developed can be used properly and can represent real conditions. In this case will do verification and validation on the model, then analyze the effect of the provision of warranty on *online channel* and performed a sensitivity analysis on some of the model parameters.

A. Verification and Validation Model

The purpose of verification of the model is to see whether the models has been built to run and does not occur *error*. Verification of this model is also done in conjunction with the determination parameter β value that matches the real condition. At the time of verification of the model will be found *initial solution* which will be used as a parameter in numerical experiments. By developing the model and incorporate the objective function parameter value on the M-Files will be *running* by using *software* MATLAB R2010a. It also saw the results of *running* MATLAB R2010a on the model – the model by entering the barrier function and assign commands to the optimization function *non-liner programming* by using *syntax Find Minimum of Constrained Nonlinear Multivariable Function* (FMINCON) to see the validation of the model. As for validation of the model can be seen in the figure below.



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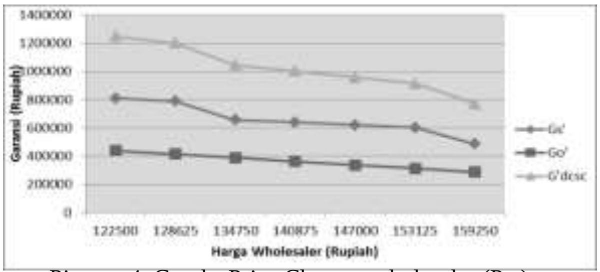

Picture, 4. Graphs Price Changes wholesaler (Pw) to advantage in DSCS

From both a combination of the above, the patterns formed from numerical experiments with raising prices *wholesaler* (Pw) has described the real condition of the system. Thus the model that as been prepared as valid.

a. Trial *Initial* Solution

Here are sales data Garlick store Surabaya month period July 2013 – February 2014.

Table 1.
Garlick S Sales Data t ore Surabaya

No	**Period**		**Sale**	
	Month	**Year**	***Offline***	***Online***
1	July	2013	32	3
2	August		21	3
3	September		15	3
4	October		13	1
5	November		14	1
6	December		5	0
7	January	2014	2	2
8	February		2	2
Total			**104**	**15**

In doing optimization function aim maksimsi profit, it takes a parameter that becomes *input* for numerical experiments. Data parameters used are as follows:

Table 2.
Model Parameter Data Collection

No	**Parameter**	**Notation**	**Value**	**Information**
1	The highes number of requests for a certain period	dsmax	35	The sum of each dsmax *offline* and *on line* obtained from Garlick store sales data 2013-2014
2	The ratio of consumer acceptance of the product *online channel*	P	0.816	The ratio of customer acceptance for the products of shoes, (Safitri, Zenia, 2014)
3	Price *wholesaler*	Pw	122.500	The result of the reduction of Ps and Po with the percentage of the profit margin obtaines by Garlick Store
4	Elasticity of demand on prices	β	0.0000989	Results *trial* determination of value β with MATLAB

On the pricing optimization study carried out in stages, based on Scheme *Stackeberg Leadership*. The first optimization of product prices in *traditional retail channel* with MATLAB generated as shown in Table 3 below.

Table 3.
Output MATLAB Function *Demand Traditional Retail Channel*

Exitflag	**Fval**	**iteration**	**ps**
1	-3,77E + 05	2	238200

Table 4.
Calculations Manual *Demand Traditional Retail Channel*

ps	**ds Max**	**β**	**p**	**ds**	**Gs**
238 200	35	0.0000989	0,816	12	1388400

Optimization of the two is the optimization of pricing in *online channel* without giving warranty. This follows the results of *running* MATLAB and manual calculations.

Table 5.
Output MATLAB Function *Online Demand Channel* without guarantee

Exitflag	**Fval**	**iteration**	**Pro**
1	-3,77E + 05	2	185 260

Table 6.
Calculations Manual *Online Demand Channel* without warranty

Po	**ps**	**pw**	**β**	**p**	**do**	**Go**
185 260	238 200	122 500	$9{,}89 \times 10^{-5}$	0.816	7	439 320

Table 7.
Output MATLAB Function *Online Demand Channel* with gurantee

Exitflag	**Fval**	**iteration**	**Po'**	**g**
1	-3,77E + 05	2	194 370	9110

Table 8.
Calculations Manual *Online Demand Cahnnel* Warranty

Po'	**g**	**ps**	**pw**	**Ds max**	**β**	**Gs'**	**Go'**
238200	122500	194370	911035	0.0000989	0.816	809900	439320

The table above can be explained that *Online Channel* (P=') US $ 194,370.00, the amount of guarantee (g) USD 9110.00 on price *traditional retail channels* (Ps) Rp 238,200.00 and prices *wholesaler* (Pw) Rp 122,500.00, party *offline channel can be demand* for seven products and *online channels* six products. Advantages of each-each *channel* namely

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on *traditional retail channel.* (G s) Rp 809,900.00 and profits *online channel* (G o) Rp 439,320.00

b. Effect on *online channel*

From the results of the optimization pricing of the products above, then do a comparasion system *dual-channel supply chain* with warranty and without any warranty *online facility*. The influence of the warranty provision are visible on the optimal pricing obtained. As seen from the chart below that in *plots* the results of parameter changes p the function *online demand channel w*ithout warranty and warranty.

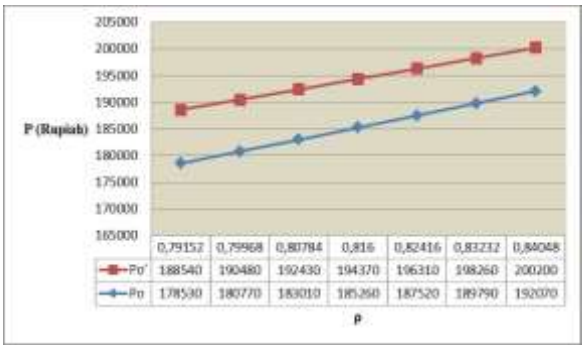

Figure 5. graph difference in the price *online channel* before and after warranty

Based on Figure 6 above, it can be seen that the provision of guarantee to raise prices in *online channel*. This happens because when the guarantee is given on the product *online channel* burden to be sacrificed by Garlick Store higher. So to maintain the gains achieved in *online channel,* prices on *online channel* should be increased in accordance with the provision of guarantees and desired profit.

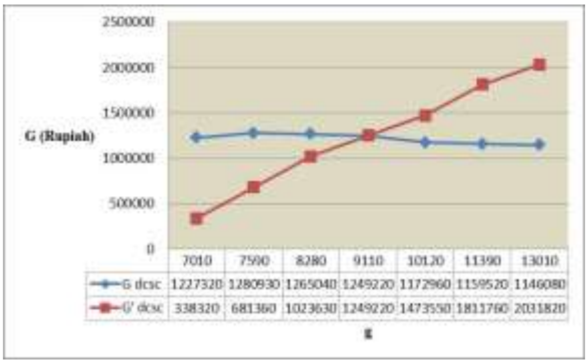

Figure 6. effect advantage warranty on DSCS

In figure 7 above it can be seen that the provision of the warranty will also affect the overall system gain (DCSC). In the graph obtained by changing the value of ρ that will generate value changes in the amount of warranty. Thus will affect the optimal price of the product on *online channel* (P o).

Similarly, the system *dual-channel supply chain* without the provision of guarantees, also made changes in the value of ρgiving guarantee (g) will significantly influence the overall profit DSCS system. The graph above clearly shows the increase in the amount of guarantee (g) will increase profits in DSCS. While the system DSCS without warranty provision would have the advantage of a relatively constant. However, gains in both scenarios DSCS, there *thereshold* which indicates the point of intersection between gains DSCS with a warranty and no guarantee thet the amount of guarantee amounting to Rp 9110.00. meant that the point mentioned second each scenario profitable.

c. Sensitivity analysis

A sensitivity analysis was conducted to see how much influence the changes in the parameters of the function aim. Following this charts illustrates the sensitivity of the change ρ on price, warranty and DSCS advantage.

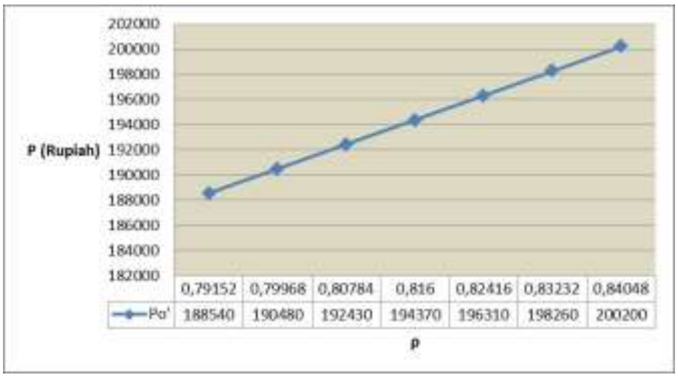

Figure 7. Graph changes ρ against price *online channel* by Giving Match

Figure 7 above can be explained that the cange in consumer acceptance ratio parameter value to *online channel* will change the price in *online channel*. The higher consumer acceptance of the *online channel* then the manager *online facility* will put a greater price. Meanwhile, if the consumer acceptance falls, price in pairs by *online channel* also declined. For example, the value of ρ at 0.79152, the decline in the value of ρ at 3% of the value of ρ = 0.816, the posted price is Rp 188,540.00, whereas when the value of ρ will produce a price on *online channel* Rp 194,270.00. this happens because the manager *online facility* would dare put a high price when the level of consumer acceptance of the product *online channel* too high and become on opportunity management to maximize profit.

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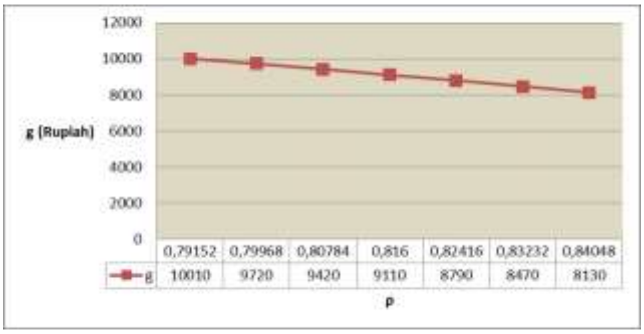

Figure 8. Graph changes ρ Magnitude of the Match

Parameter value changes to the size of the warranty will cause fluctuations in the amount of warranty. When the value of the initial ρ is lowered by 3% will cause the warranty provision of USD 10010.00. then the amount of acceptance of *online channel* (ρ). This happens because of the provision of the warranty depends on what proportion of the price of the product in *online channel* the thresgolds in the model DSCS with warranty administration.

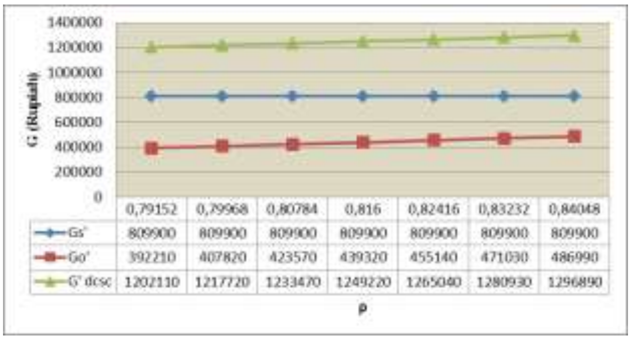

Figure 9. Graph Changes ρ to advantage

Changes in the value parameter ratio of consumer acceptance of *online channel* will also affect the profits to be eamed *online channel* aswell as the overall profitability DSCS and do not affect profit in *offline channel*. Gains in *traditional retail channel* (G s') On impairment ρ of the 3%, 2%, and 1% to 3% increase in point, the benefits are relatively constant, amounting to USD 809,900.00. this occurs due to the change in the value of ρ is not done on a price optimization *traditional retail channels* (P s).

In contrast, gains in *online channel* will change in conjunction with changes in the value of ρ. The increase in the value of the parameter ρ will increase profits in *online channel*. As seen in Figure 9, the graph G o 'Further, for example at a rate of 0.79152 obtained value ρ G o 'Amounting to USD 392,210.00 and the rate of increase of ρ at 0,82416 obtained the value of G o 'Rp 455,140.00. the increase in profit in *online channel* (G o') is directly due to the price increases in *online channel* (P o'). so that profits increasingly go upsignificantly.

The increase profit *online channel* (Go') will be an influence also on the rise in the overall DSCS system (G DSCS'). Thus the ratio parameter value increase consumer acceptance of *online channel* (ρ) will increase profits in *dual-channel supply chain* (DSCS) with a warra

IV. CONCLUSION

The following will describe some of the conclusions that can be drawn from the research that has been done:

1. In one of the optimal pricing of footwear products With the trademark name Wondershoe offered by Garlick Store Surabaya, which is modeled mathematically in the structure *dual-channel supply chain* the warranty provision is done by using schemes *Pricing Stackelberg Leadership*. Warranty (g) is only granted in *online facility*, so that the optimal pricing model the amount of guarantee (g) will reduce the price in *online channel* (P o')
2. The decision variables obtained price optimalpProduct on each-each *channel* and the amount of guarantee to be provided. Here is the optimization results were obtained:
   - The first optimal pricing that is pricing in *traditional retail channel* with function *traditional retail demand channel* obtained optimal price (P s) Rp 238,200.00
   - The second optimization, is optimization fo optimal price for *online channel* (P o) without warranty obtained the value of P o Rp 185,260.00
   - The third optimization, is optimization for optimal prices on *online channel* (P o) and the amount of guarantee (g) with the function *online demand channel* with the provision of warranty. The price obtained in *online channel* (P o') is Rp 194,370.00 and the amount of guarantee (g) £ 9110.00.
3. The results of the optimization obtained between models *online demand channel* without warranty with models *online demand channel* warranty produced their optimal price difference in *online channel*. The optimal *online channel* without warranty (P o) is Rp 185,260.00 and optimum prices in *online channel* with warranty (P o') is Rp 194,370.00 with the provision of guarantees amounting to rp 9110.00. however, the optimal price does not increase profit *online channel* and DSCS overall profit. So at price points and warranty provision mentioned above, when calculating the profit did not differ significantly between the maximization of profit for *online demand channel* without warranty and warranty administration. But a certain point when the value of the parameter ρ lowered 1% and 2% *online demand channel* the warranty will be higher than. *Online demand channel* without warranty. The decline in the value of ρ 1% - 3% guarantee value

obtained is Rp 8130.00, 8470.00 and USD 8790.00 USD and generate demand as much as seven products in *online channel* with warranty and six products in *online channel* without warranty. The indication is when the consumer acceptance in *online channel* down should be increased the amount of guarantee given by lowering prices *online channel*.

ACKNOWLEDGEMENT

Thank you on this occasion, the authors thank so much to the various parties. Starting from parents, siblings, Mr. Erwin Widodo, Dr. Eng as lecturers. And a number of parties other top realization helped me to selve this scientific research.

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