Managing Sales Return in Dual Sales Channel: Common Return versus Cross-Channel Return Analysis

Erwin Widodo, Katsuhiko Takahashi, Katsumi Morikawa, I Nyoman Pujawan, and Budi Santosa

***Abstract*—This work examines the financial benefit in performing two kind of sales return (online sales claim because of non conformity) scenarios under dual sales channel structure. The first scenario mimics a strategy of meeting such claim through one designated online facility. The second one represents a re-fulfillment process involving a conventional store as channel counterpart (cross channel return) so that complaining customer preference might be accommodated better. In addition, two kind of pricing decision making processes are evaluated, namely *Bertrand* scheme for simultaneous process and *Stackelberg* leader scheme for leader-follower consideration one. The result shows that central warehouse and its online facility (leader) prefer to apply scenario 2 using *Stackelberg* leader scheme, while conventional store (follower) experiences better profit under first scenario and *Bertrand* scheme. However, the first scenario always performs better than the second one in the view point of total channel profit. Further fruitful management insights are also provided in the analysis section of this paper.**

***Index Terms*—Dual sales channel (DSC), sales return.**

I. INTRODUCTION

Dual sales channel (hereinafter is shortened as DSC) has been increasingly confiscating the interest of researchers in the corresponding area. A number of works have been done to propose managerial insight in dealing with decision making within such channel collaboration between conventional distribution structure and internet-based (online) order fulfillment facility. Some example of works in DSC conceptual idea development are [2], [10], [12]. Later on, some works that based on analytical models to capture specific DSC structure characteristics are proposed for obtaining closer applicability on its channel's coordination and collaboration [1], [6], [8], [9], [11], [14], [17], [20].

To be more particular, sales return is regarded as one prominent phenomenon in managing online sales within DSC environment. However, its existence is still under-represented for further betterment. A limited number of works have been done in dealing with this backward product flow, however they were laid in the layer between central warehouse and its sales outlet. None of them considered the layer between this outlet and its final online customer that offers interplay between conventional store and online facility.

In our previous work [7], to fill in this research gap, we tried to evaluate the financial benefit of performing product substitution in responding the online customer claim for product non conformity. In that paper, we evaluated each player and total channel profits by comparing cash back strategy as the benchmark scenario and product substitution strategy as the online facility sales return scenario. Some beneficial managerial insights have been successfully elicited. As for the main result, it was shown that performing product substitution leads to better total channel profit under *Bertrand* decision making process. However, as our previous work drawback, we did not consider the analysis of customers' channel-preference in claiming their non conformity.

In currently proposed work, we composed one interesting research question, *i.e.* does accommodating customer preference to hand over their non-conformed product directly through conventional store instead of send it back to its online facility lead to better financial performance? In searching for its answer, two scenarios are proposed. The first one is online-facility sales-return scenario, which considers online sales facility as the default option in returning the undesired products. The second one is conventional-store sales-return. This challenging scenario accommodates the customer preference to deliver their below-expectation product directly to conventional store for better substitution. By comparing DSC individual player and total channel profits under *Bertrand* scheme as well as *Stackelberg* leader scheme, this paper is able to show whether accommodating customer preference is beneficial or not.

II. LITERATURE REVIEW

A couple of years after internet boom period in the late of 20th century, DSC concept of parallel selling between previously established conventional channel equipped by newly dedicated online facility was introduced by several authors. [12] is one of them. Then, it was followed by a number of works, like [10] who performed a case study analysis for marketing PC in Europe, or [2] who proposed a conceptual framework that ensures the successfulness of

Manuscript received December 7, 2009.

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embodying conventional channel with internet-based one.

Compared to our idea, all of those papers were focusing on the creation of DSC basic concept. In contrast, our idea focuses on how to normatively implement sales return mechanism in DSC structure. We focus on how to analytically provide some betterment for DSC structure.

After conceptual period, then descriptive and normative analytical period took place. The paper by [5] was one of the pioneers in channel structure analysis of DSC. This paper introduced some substitution inventory-scenarios. The result showed that this kind of integration performed financially better. Quite similar inventory related proposition work was undertaken by [17]. Their originality was on the assumption that the system receives stochastic demands and customer may switch channel when a stock-out occurs. As for the result, mixed strategy of dual-channel outperforms two-single strategies. Furthermore, very interesting idea was presented by [14]. They proposed 2 dynamic assignment policies by taking benefits of: 1) traversal demand e-fulfillment and; 2) still in transit inventory. The numerical showed that total sales increased about 8.2% over the optimal static policy.

Our proposed idea is to provide extension research by embodying the DSC structure with sales return function. Our work provides following up action undertaken by DSC players after sales take place. In essence, our research creates new research stream in the area of DSC.

On the other side, product/sales return papers mainly reside on manufacturer-retailer layer. Paper published by [15] can be considered as one of the pioneers in product return work. They considered marketing perspective to examine strategic effect of using incentive for return policies on retail competition. Other paper, such as [4] proposed optimal order quantity in relation to return handling options. They evaluated several models about selling products to secondary market, partial reuse, partial recovery, and its cost. They obtained a closed form analytical expression for optimal order quantity.

Those product/sales return works exist in the environment between supplier/warehouse and retailer. To be compared to our idea, those works experienced big value but relatively small frequency of return. In contrast, within our idea, the sales value is relatively small but the frequency is considerably high. In addition, none of them was devoted to overcome managerial problems in DSC environment that has to deal with online and in-store demand simultaneously. Hence, we are keen to state that our proposed idea is original.

III. SYSTEM DESCRIPTION & ITS MODEL

A. *System under discussion*

Fig.1 comprehensively shows the basic structure of system under discussion. This figure represents a single product flow which is available to be sold both through online and conventional (in-store) ways. Within this DSC structure, there is one central warehouse which gets product supply from a manufacturer. This central warehouse then distributes the products to several conventional stores. Subsequently, this store fulfills in-store demand in its marketing region.

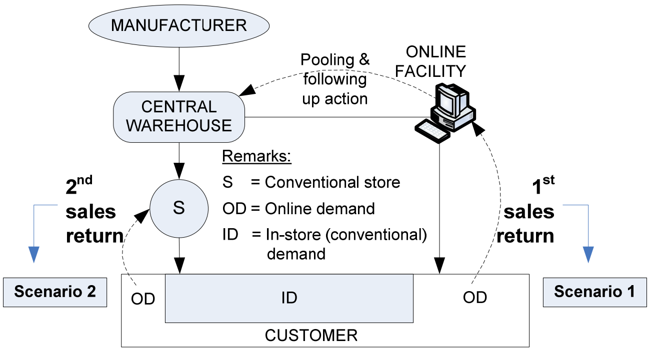


Fig.1 DSC structure with 2 proposed sales return flows.

Aside of this conventional distribution, as a special characteristic of DSC, there is an internet equipped facility which is called online facility to fulfill online customer demand. In short, there are two competing parties in selling the product, the first one is central warehouse with its online facility as newly established channel, and the second one is conventional store as the original sales channel. Both channels work simultaneously.

Online customer may ask for product substitution in two ways. The first way is to re-send the non-conformed product to online facility. It will be elaborated in scenario 1. The other way is to carry the undesired product directly to conventional store. This will be represented by scenario 2.

In addition, there are several system-assumptions, namely:

1. Sales return is allowed only for online sales. There is no return service for in-store (conventional) sales.
2. In return handling, online facility (in scenario 1) or conventional store (in scenario 2) receives the returned product, checks its sales return appropriateness. In case it is appropriate, the customer may get product substitution. Otherwise, the receiving facility or store rejects the claim.
3. The meaning of following up action is a set of categorized actions performed by central warehouse to utilize the value of returned product. In case of there is:
    a. No defect; product is put back into its inventory.
    b. A slight defect; product is sold in discounted price.
    c. A serious defect; product is liquidated to salvager.
4. Profit components to be considered are total channel profit, central warehouse and its online facility profit, as well as conventional store profit, under deterministic demand setting for both conventional and online customers.

B. *Mathematical model components*

Prior to detail description of our proposed mathematical model, let us consider three decision variables, namely p_{CW} for wholesale price decided by central warehouse, p_S for retailer price decided by conventional store, and p_{OL} for retailer price decided by online facility. Alongside these decision variables, a set of indirect variables and parameters are employed in this work (See appendix).

The first component to be prepared is conventional store demand. Basically, we employ commonly used demand function is $d_S = D_S - \beta p_S$ [13], [18], [19], where D_S is the largest amount of in-store demand, and β is the demand elasticity ratio on price. Without losing its generality we assume $\beta = 1$. To represent in-store and online demands simultaneously, this $d_S = D_S - p_S$ function has to be modified by inputting p_{OL} into the equation. In addition, customer acceptance ratio of online product parameter ρ, is introduced. It expresses the product value decrease because the online product is only virtually inspected prior to purchase by customer. Hence, the term: $\frac{p_S - p_{OL}}{1-\rho}$ is introduced to replace p_S. The numerator represents the deviation between the in-store price and online price (customer saving) and the denumerator shows customer sacrifice in accepting the decreasing value of online product [16]. Accordingly, the new in-store demand function demand is

$$d_S = D_S - \frac{p_S - p_{OL}}{1-\rho} \tag{1}$$

Secondly, the online demand function is prepared. This function is defined as the total amount of product ordered by customer who prefers to shop through internet-enabled system facility. Mathematically, this component is obtained from subtracting (1) from $d_S = D_S - p_S$ modified with adjoining ρ to d_{OL} as

$$d_{OL} = \frac{\rho p_S - p_{OL}}{\rho(1-\rho)} \tag{2}$$

The next component is handling cost HC. Handling cost incurred in online facility is simply calculated by multiplying handling cost/product H with online sales return rd_{OL}. By this way, we get

$$Hr\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} \tag{3}$$

A group of return value components which deal with handling the sales return by customer are also prepared.

1. Let k_I to be the proportion of sales return being put back in to inventory, then, the amount of sales return in this treatment is $R_I = k_I r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)}$. Consequently, central warehouse gets $$V_{RI} = k_I r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)}(c_U - c_U) = 0 \tag{4}$$
2. Suppose k_D to be the proportion of sales return being sold in discounted price and αp_{OL}^D is the amount of unsold product in second sales, then, the amount of sales return in this treatment is $$R_D = k_D r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} - \alpha p_{OL}^D \tag{5}$$
3. It is assumed that equation (5) is a typical decreasing demand function of secondary market for sales return sold in p_{OL}^D. Hence, the value of selling the products is $$V_{RD} = (k_D r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} - \alpha p_{OL}^D)(p_{OL}^D - c_U) \tag{6}$$
4. Let α represents the elasticity ratio of second market demand on discounted price p_{OL}^D. It is also assumed that:
    a. $p_{OL}^S < p_{OL}^D$, therefore $l_S < l_D$, where l_S is the salvage ratio for sales return being sold in discounted price and l_D is the salvage ratio for sales return being liquidated.
    b. Until the end of period, unsold R_D will be added to R_S.
5. Suppose k_S is the proportion of sales return being liquidated through salvager, then, the amount of sales return in this treatment is $$R_S = k_S r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} + \alpha p_{OL}^D \tag{7}$$
6. Using similar logic, the value of selling liquidated products is $$V_{RS} = (k_S r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} + \alpha p_{OL}^D)(p_{OL}^S - c_U) \tag{8}$$

C. Sales return scenario

1) Scenario 1: Sales return to online facility

This scenario is developed based on idea of performing product substitution for online customer return undertaken by online facility. Based on previously prepared model components, the objective function for scenario 1 is:

$$\begin{aligned}
&\max_{p_{CW}, p_{OL}, p_S} \prod_{Tot} = \max_{p_{CW}, p_{OL}, p_S} (\prod_S + \prod_{C-O}) \\
&= \max_{p_{CW}, p_{OL}, p_S} (\prod_S + (\prod_{CW} + \prod_{OL} + \prod_{OL}^{Sub} - HC - IC_{OL} + V_{RD} + V_{RS})) \\
&= \max_{p_{CW}, p_{OL}, p_S} \left\{ \frac{((1-\rho)D_S - (p_S - p_{OL}))(p_S - p_{CW})}{1-\rho} \right. \\
&+ \frac{((1-\rho)D_S - (p_S - p_{OL}))(p_{CW} - c_U)}{1-\rho} \\
&+ \left(\frac{(1-r)(\rho p_S - p_{OL})(p_{OL} - p_{CW})}{\rho(1-\rho)} + \frac{r(\rho p_S - p_{OL})(p_{OL} - p_{CW})}{\rho(1-\rho)} \right) \\
&- Hr\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} - Ir\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)} \\
&+ k_D r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)}(l_D p_{OL} - c_U) - \alpha l_D^2 p_{OL}^2 \\
&\left. + k_S r\frac{(\rho p_S - p_{OL})}{\rho(1-\rho)}(l_S p_{OL} - c_U) + \alpha l_D l_S p_{OL}^2 \right\}
\end{aligned} \tag{9}$$

The first term shows the profit gained by the conventional store $\prod_S$ considering its in-store demand (1) and store profit margin, (p_S - p_{CW}). The second term is central warehouse profit for fulfilling in-store demand $\prod_{CW}$ based on the its profit margin (p_{CW} - c_U). Next, the third term is online facility profit by considering of net online ratio, online demand, and the online facility profit margin (p_{OL} - p_{CW}). Fourth is the profit gained by product substitution. The negative contribution is given by total handling cost for sales return considering handling cost per unit for sales return H by return ratio r, and online demand. Another negative effect is inventory cost for anticipating product substitution involving unit inventory cost I. The last two items are the obtained values of performing following up actions by selling in discounted price and through salvager as elaborated in equation (6) and (8) respectively.

Besides this objective function, the corresponding constraints are also necessary to be composed. They are:

1. $p_{CW}, p_{OL}, p_S > c_U$, prices are higher than its unit cost c_U.
2. $p_S \geq \frac{p_{OL}}{\rho}$, to ensure demand interplay (*threshold value*).
3. $p_{OL} \geq p_{CW}$, to let online facility taking profit.
4. $p_S \geq p_{CW}$, to let conventional store taking profit
5. $p_S \leq p_{OL} + (1-\rho)D_S$, the highest value of p_S.
6. $\frac{p_{OL}}{\rho} < p_{OL} + (1-\rho)D_S$, p_S threshold value is reasonable.

7. $E_L d_S \le d_{OL}$, lower limit of online demand, which is defined as at least there is a portion (expressed by existence lower limit E_L) of in-store demand d_S as a minimum amount of online demand d_{OL} .
8. $d_{OL} \le E_U d_S$, upper limit of online demand, which has a meaning of at most there is a portion (expressed by existence upper limit E_U) of in-store demand d_S as a maximum amount of online demand d_{OL} .

2) *Scenario 2: Sales return to conventional store*

This opposite scenario is based on the idea of giving more freedom to online customer. When a claim occurs, the customer is asked to bring the product to the conventional store instead of initial online facility server (cross-channel return). The benefit are:1)customer has opportunity to directly inspect the substitution product so that it guarantees the next claim will not happen, and 2)by knowing this policy, customer has higher acceptance ratio on online product offered. Then, the differences to scenario 1 are:

1. Increase in customer acceptance ratio on online product, from ρ in scenario 1 to ρ^{Sub} in scenario 2 ($\rho < \rho^{Sub}$).
2. Inventory cost shift from the responsibility of online facility (so that IC_{OL} is introduced) to responsibility of conventional store (hence IC_S is introduced).
3. K is proposed. This notation means the proportion of compensation fee provided by central warehouse to conventional store for performing product substitution.

The objective function for this scenario 2 is:

$$\begin{aligned}
&\max_{p_{CW},p_{OL},p_S} \prod_{Tot} = \max_{p_{CW},p_{OL},p_S} \left(\prod_{SS} + \prod_{C-O}\right) \\
&= \max_{p_{CW},p_{OL},p_S} \left(\left(\prod_S + \prod_S^{Sub} - IC_S\right) + \left(\prod_{CW} + \prod_{CW}^{Sub} + \prod_{OL} - HC + V_{RD} + V_{RS}\right)\right) \\
&= \max_{p_{CW},p_{OL},p_S} \Bigg\{\Bigg(\frac{((1-\rho^{Sub})D_S - (p_S - p_{OL}))(p_S - p_{CW})}{1-\rho^{Sub}} \\
&+ K\frac{r(\rho^{Sub} p_S - p_{OL})(p_{OL} - p_{CW})}{\rho^{Sub}(1-\rho^{Sub})} - Ir\frac{(\rho^{Sub} p_S - p_{OL})}{\rho^{Sub}(1-\rho^{Sub})}\Bigg) \\
&+ \Bigg(\frac{\left((1-\rho^{Sub})D_S - (p_S - p_{OL})\right)(p_{CW} - c_U)}{1-\rho^{Sub}} \\
&+ (1-K)\frac{r(\rho^{Sub} p_S - p_{OL})(p_{OL} - p_{CW})}{\rho^{Sub}(1-\rho^{Sub})} \\
&+ \frac{(1-r)(\rho^{Sub} p_S - p_{OL})(p_{OL} - p_{CW})}{\rho^{Sub}(1-\rho^{Sub})} - Hr\frac{(\rho^{Sub} p_S - p_{OL})}{\rho^{Sub}(1-\rho^{Sub})} \\
&+ k_D r\frac{(\rho^{Sub} p_S - p_{OL})}{\rho^{Sub}(1-\rho^{Sub})}(l_D p_{OL} - c_U) - \alpha l_D^2 p_{OL}^2 \\
&+ k_S r\frac{(\rho^{Sub} p_S - p_{OL})}{\rho^{Sub}(1-\rho^{Sub})}(l_S p_{OL} - c_U) + \alpha l_D l_S p_{OL}^2 \Bigg)\Bigg\} \qquad (10)
\end{aligned}$$

The constraints remain the same as used in scenario 1.

D. *Decision making scheme*

In prototyping the DSC decision makers' behavior of, game theory can be used as noted by [3]. Let us consider two kinds of decision making process for p_{CW} , p_S , and p_{OL} :

1. *Bertrand* scheme: a simultaneous process of determining the value of decision variables. It means that all managers of central warehouse, conventional store, and online facility decide their own unit's product price at the same time. The implication is the search of optimality for total channel profit can be done only in one phase optimization.
2. *Stackelberg* leader scheme: a sequential process in establishing the value of decision variables. This process requires three rounds of decision process. The first round is done by the leader, central warehouse, by releasing p_{CW} arbitrarily. In responding to this value, the follower, conventional store tries to maximize its own profit by considering its objective function. This second round provides an optimum p_S . After knowing this value, the central warehouse together with its online facility can optimize their profits and yields optimum p_{CW} and p_{OL} .

IV. NUMERICAL ANALYSIS

To evaluate the performance of two sets of DSC with return consideration scenario, first, let us have the following parameter values: D_S = 100; c_U = 10; ρ = 0.7; ρ^{Sub} = 0.75; r = 0.1; H = 1; k_I = 0.7; k_D = 0.2; k_S = 0.1; l_D = 0.8; l_S = 0.7; α = 0.03; I = 3; and K =0.5. The complete notation list for setting is provided in Appendix. Then, the objective functions (9) and (10) for scenario 1 and 2 respectively can be solved under *Sequential Quadratic Programming* (SQP) by using *Quasi-Newton* algorithm providing the optimum decision variables p_{CW} , p_{OL} , and p_S and corresponding profit $\prod_S$, $\prod_{C-O}$, and $\prod_{Tot}$ as shown in table 1.

A. *Scenario and decision making analysis*

Table 1 shows that from the leader (central warehouse and its online facility) point of view, scenario 2 of conventional store sales return scenario (CS-SR) is preferable since this scenario gives better $\prod_{C-O}$ profits (from 281.09 to 648.18and from 1239.36 to 1298.47 under *Bertrand* and *Stackelberg* leader schemes respectively). The reason is the increase of customer acceptance ratio on online product ρ = 0.7 to ρ^{Sub} =0.75. This difference increases online demand significantly, from 9.40 to 25.39 under *Bertrand* scheme and from 6.39 to 25.82 under *Stackelberg* leader scheme. Because of this online sales increase, the leader experiences better profit by employing scenario 2.

In contrast, in the follower (conventional store) point of view, scenario 1 of online facility sales return scenario (OLF-SR) is preferable since this scenario provides better $\prod_S$ profits (from 1167.43 to 1685.22 and from 259.09 to 645.28 under *Bertrand* and *Stackelberg* leader schemes respectively). The reason is ρ in scenario 1 is set to be lower than the one in scenario 2. It leads to more conventional store demand in scenario 1, i.e. 37.58 compared to 25.99 under *Bertrand* scheme and 25.53 compared to 10.64 under *Stackelberg* leader scheme. This results in better profit of $\prod_S$ for conventional store as the follower.

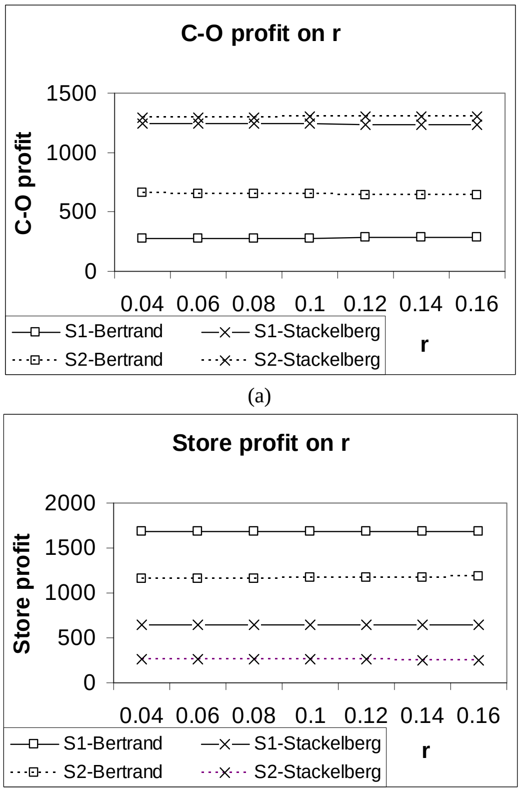
Table 1. Optimization result for p_{CW} , p_{OL} , and p_S and their corresponding profit $\prod_S$, $\prod_{C-O}$, and $\prod_{Tot}$

Scenario	**Scheme**	r	I	ρ	K	p_{CW}	p_{OL}	p_S	d_{OL}	d_S	$\prod_S$	$\prod_{C-O}$	$\prod_{Tot}$
S1:OLF-SR	Bertrand	0.1	3	0.7	n/a	11.0000	37.1172	55.8431	9.3951	37.5803	1685.2186	281.0915	1966.3101
	Stackelberg	0.1	3	0.7	n/a	44.7267	47.6596	70.0000	6.3829	25.5320	645.2779	1239.3595	1884.6374
S2:CS-SR	Bertrand	0.1	3	0.75	0.5	11.0000	36.4667	54.9695	25.3889	25.9888	1167.4265	648.1800	1815.6064
	Stackelberg	0.1	3	0.75	0.5	45.2141	47.6596	70.0000	25.8155	10.6384	259.0943	1298.4661	1557.5604

Considering the total profit of the whole channel, it is shown that scenario 1 outperforms scenario 2 in both *Bertrand* and *Stackelberg* schemes (1966.31 against 1815.60 and 1884.64 against 1557.56 respectively). This indicates that the increase in $\prod_S$ as the strong contributor of scenario 1 is greater than the decrease in $\prod_{C-O}$ as the weak one, hence, the scenario 1 experiences positive total profit margin. The reason for high increase in $\prod_S$ is the opposite fact (ρ decrease) of the reason for decreasing $\prod_{C-O}$ as explained before.

A. *Sensitivity analysis*

The first sensitivity analysis is to examine the behavior of leader and follower profit on the change of sales return ratio, r . This parameter is chosen because r is the representation of sales return consideration in this paper. However, the result in Fig.2 shows insignificant shifts on the observed profits.



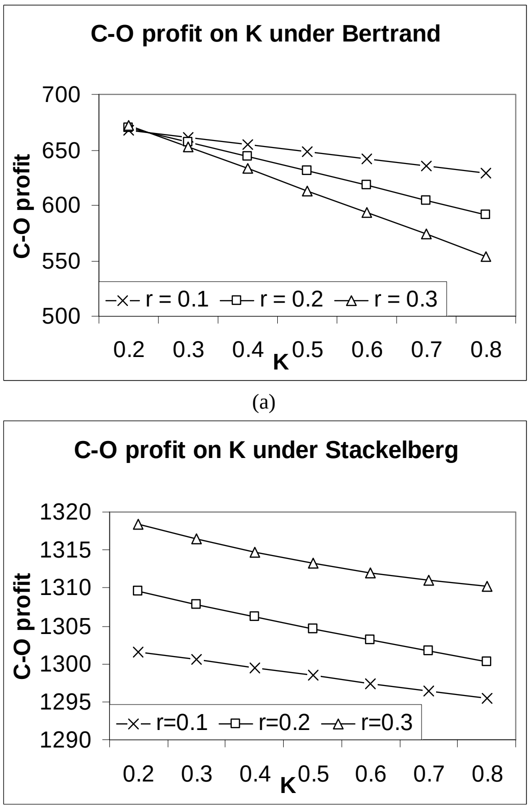
(a)

(b)

Fig.2 $\prod_{C-O}$ and $\prod_S$ sensitivity to r

Moreover, when we combine several values of r with a set of K value shifts, a number of interesting sensitivity results are gained. K is a percentage which reflects a part of online-sales profit per unit provided by online facility to conventional store as a compensation for performing product substitution through conventional store. Nonetheless, since K is not involved in scenario 1, this K - r combinatory sensitivity analysis is done exclusively in scenario 2.

Fig.3 shows the sensitivity of central warehouse and online facility profit $\prod_{C-O}$ to the change of K value under 3 values of r . When K increases, $\prod_{C-O}$ will decrease under both decision making process schemes. In *Bertrand* scheme (Fig. 3(a)), the reason of this decrease is there is "1-sum" effect for K as indicated in the objective function (11) for 2nd and 5th items. This effect results in the stable value of 3 decision variables. When the total profit is distributed to leader and follower, K increase gives benefit to $\prod_S$, then, the leader experiences $\prod_{C-O}$ decrease. In *Stackelberg* leader scheme (Fig. 3(b)), the reason is that when K increases, optimization results will give higher p_{CW} . This situation leads to less decrease to $\prod_{C-O}$ (from around 1320 to 1295) than the one in *Bertrand* scheme (from around 670 to 560).



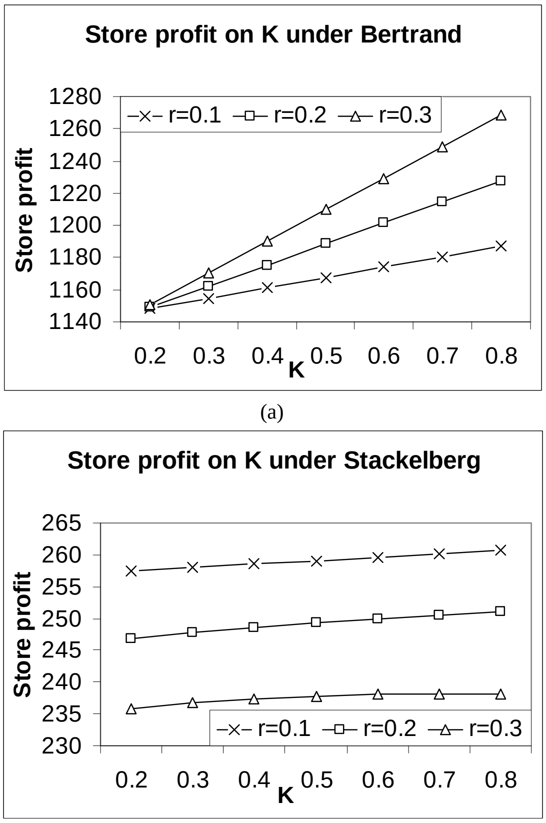
(a)

(b)

Fig.3 $\prod_{C-O}$ sensitivity to $K-r$

ISBN: 978-988-18210-5-8
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

Fig. 4 is about the opposite result of profit shift compare to the ones in figure 3. This figure illustrates the increase of follower profit $\prod_S$ when K increases under several value of r. This is the opposite effect burdened by conventional store. Consequently, the inverse reason, compare to $\prod_{C-O}$ sensitivity analysis is applied.

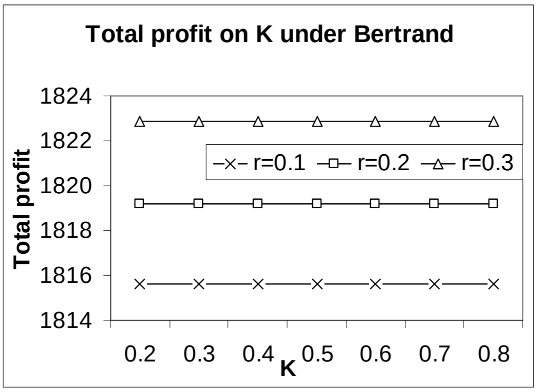


(a)

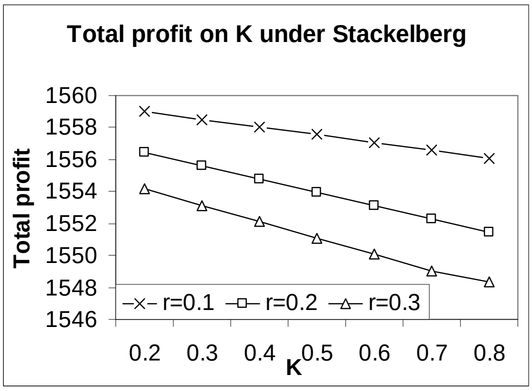
(b)

Fig.4 $\prod_S$ sensitivity to $K-r$

Fig. 5 represents the sensitivity of channel total profit $\prod_{Tot}$ to the shift of K value under 3 values of r. In *Bertrand* scheme, stable total profits are shown. The reason is “1-sum” effect. This fact leads to the stable optimization result of decision variable which is eventually gives the same $\prod_{Tot}$ value even when K and r values shift up or down. In *Stackelberg* leader shceme, increase in K yields higher p_{CW} value optimization results. This kind of increase yields the lower value of channel total profit.



(a)



(b)

Fig.5 $\prod_{Tot}$ sensitivity to $K-r$

V. CONCLUSION

A number of previous works have contributed some important insights in the area of DSC. Nonetheless, for the time being, online sales return management is still under-represented. Our current work gives one significant contribution on bridging this lack. Our research proposes two different scenarios in portraying customer preferences in dealing with returning non-conformed online purchase. In addition, besides paying attention to customer side, our proposed model also portrays decision making process for pricing which is performed by DSC managers. We evaluate formal-form *Bertrand* and strategic-form *Stackelberg* leader schemes’ performance in finding the equilibrium solutions.

Based on our analysis, the important findings are:

1. Central warehouse and its online facility prefer to apply conventional store (cross channel) sales return scenario.
2. In contrast, conventional store experiences better financial performance under online facility sales return scenario.
3. However, in the whole channel point of view, online facility sales return scenario outperforms conventional store one.

In responding to the research question, we are keen to state that allowing conventional store to perform product substitution is not financially beneficial when total channel profit is considered. Nonetheless, when the coordination and collaboration is still far away from reality, the leader and follower under the represented system structure could take benefit by referring to our quantitative measures.

There are some possibilities regarding the future works for our research continuations. In prototyping real situation, it will be more interesting to develop a model which accommodate stochastic or uncertain demand situation. In addition, in treating the returned product by online customer, some new idea on reselling strategies will be helpful for increasing entire channel profitability.

APPENDIX

Decision variable	
p_{CW}	wholesale price (decision variable)
p_S	conventional store price (decision variable)
p_{OL}	online price (decision variable)
Function of decision variable	
d_S	in-store demand (f(p_S , p_{OL}))
d_{OL}	customer online demand (f(p_S , p_{OL}))
d_{ROL}	online customer demand after return (f(p_S , p_{OL} , r))
HC	handling cost incurred in central warehouse, online facility or store for undertaking sales return
IC_{OL}	product substitution inventory cost in online facility
IC_S	product substitution inventory cost in convt. store
p_{OL}^{D}	reselling price in discounted price (f(p_{OL} , l_D))
p_{OL}^{S}	Liquidation price (f(p_{OL} , l_S))
R_I	number of sales return being put back into inventory
V_{RI}	value of sales return being put back into inventory
R_D	number of sales return sold in discounted price
V_{RD}	value of sales return being sold in discounted price
R_S	number of sales return liquidated through salvager
V_{RS}	value of sales return liquidated through salvager
Π_{CW}	profit for central warehouse
Π_S	conventional store profit for undertaking conventional sales only
Π_{SS}	conventional store profit for undertaking conventional sales and sales return
Π_{OL}	online facility profit
Π_{OL}^{Sub}	online facility profit gained by performing sales return substitution
Π_{CW}^{Sub}	central warehouse profit gained by performing sales return substitution through conventional store
Π_{S}^{Sub}	conventional store profit gained by performing sales return substitution through conventional store
Π_{C-O}	profit of central warehouse and online facility
Π_{Tot}	profit for the whole supply chain
System parameters	
D_S	maximum value of d_S when p_S is set to be in lower limit value
ρ	customer acceptance ratio of an online product compare to the conventional one
r	proportion of sales return from d_{OL}
k_I	sales return ration of being put back into inventory
k_D	sales return ratio of being sold in discounted price
k_S	sales return ratio of liquidation through salvager
α	unsoldness ratio of 2nd market sales to discounted price p_{OL}^{D}
l_D	salvage ratio for sales return being sold in discounted price
l_S	salvage ratio for sales return being liquidated through salvager
E_L	existence lower limit level for online demand
E_U	existence upper limit level for online demand
K	proportion of compensation fee provided to conventional store for performing substitution
Cost parameters	
c_U	unit cost in supplying a single product
H	handling cost per unit for sales return
I	inventory cost per unit for sales return substitution

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