Competing Suppliers under Price Sensitive Demand with a Common Retailer

Chirawan Opornsawad, Rawinkhan Srinon, Wanpracha Chaovalitwongse

Abstract—**Pricing strategy is extremely important in commoditization. Commoditized products such as drinking water and generic pharmaceutical products are generally considered to be indifferent among manufacturers and can be easily substituted with similar products by competitors. Price is the only factor influencing consumers' decisions. The goal of this study is to investigate and present a price sensitive linear demand model that is more intuitive and interpretable with respect to the effects of competitor price and different bargaining power scenarios. In this model, a duopoly manufacturer and a common retailer are studied under the Manufacturer Stackelberg, Retailer Stackelberg and Vertical Nash scenarios. The results of this study are compared with existing linear demand models in previous studies.**

Index Terms— **Bargaining Power, Channels of distribution, Competition, Game Theory, Oligopoly**

I. Introduction

UNLIKE innovative or emerging products, commoditized products are products that consumers can buy from different small or large competitors because there is no significant difference in quality or consumers' perception. Price is the most sensitive factor and manufacturers generally cannot raise prices because consumers can substitute the products with similar products offered by competitors at lower prices. Examples of commoditized products include drinking water and generic pharmaceutical products. These products fall under proscriptive regulations promulgated by the Food and Drug Administration (FDA) under the Food, Drug, and Cosmetic Act. Thus, there is no significant difference in the quality and specification of the products. For this reason, price strategy is of paramount importance for businesses that produce commoditized products.

To maximize their channel profit under the competition in price of two products from different manufacturers, a retailer selling both of products wishes to know how the retail prices should be set and how much the quantity of each product should be ordered. On the other hand, manufacturers also desire to set the wholesale price to maximize their own profit, which also depends on the intensity of competitor pricing. The competition intensity of pricing degree is the level of consumer's price sensitivity that presents the overall difference of commoditized products in consumer's perspective. In this study, product differentiation is used for describing the difference of commoditized products such as advertising, service, packaging, etc. Pricing interplay will greatly affect the product demand of both products. Furthermore, pricing decision of each manufacturer also depends on its bargaining power. Therefore, understanding the behavior of each type of bargaining power scenarios is necessary for both manufacturers and retailer. Although the competition in supply chain management with a price sensitive demand has been reported extensively in the literature of economics, the linear demand function used in previous studies still have the advantage of directly assessing the effect of product differentiation.

The goal of this study is to develop a linear demand model, in which each channel member can easily understand the behavior trend of an oligopoly competition under different bargaining power scenarios in the real commoditized product industry. This paper focuses mainly on three bargaining power scenarios: Manufacturer Stackelberg (MS), Retailer Stackelberg (RS) and Vertical Nash (VN). MS represents the situation where manufacturers have more bargaining power than a retailer. In other words, manufacturers have a chance to make a move before the retailer and act as the leaders in the non cooperative game. An example of MS scenario is big manufacturers that sell their products to a small or medium retailer. On the other hand, RS represents a situation where the retailer has more bargaining power than manufacturers. An example is the bargaining power of a big chain store on small or medium suppliers. VN represents an equal bargaining power of those manufacturers and the retailer, which can be seen in the situation where manufacturers and the retailer are of the same size. This paper presents a linear price sensitive demand model, and a game-theoretic approach used to derive equilibrium solutions for wholesales prices, retail prices and all of channel member profits. The results are benchmarked with the ones in Choi [1], which are among the most widely studied linear demand functions in the literature [13], [14]. We will also extend our investigation to compare our model with Choi's with respect to product differentiation.

The rest of this paper is organized as follows. Section II briefly reviews previous studies on competing in price sensitive linear demand models. Section III presents a new linear demand model, cost structures, and the optimization problems for the two manufacturers and one common

Manuscript received April 8, 2013.

C. Opornsawad. is now a forth year student, Ph.D. Program in Logistics, School of Engineering, University of the Thai Chamber of Commerce, Bangkok, 10400, Thailand., phone:+66877159505, fax:+6625400877, email: tryja@yahoo.com).

R. Srinon, Ph.D., is now a lecturer in the School of Engineering, University of the Thai Chamber of Commerce, Bangkok, 10400, THAILAND., phone:+6626976730, email: rawinkhan_sri@utcc.ac.th).

W, Chaovalitwongse, Ph.D is now an associate professor in the College of Engineering and School of Medicine, University of Washington, WA, 98195, USA., email: artchao@uw.edu).

retailer. Section IV presents the results and compares the equilibrium solutions with the ones in previous studies. Section V concludes the study and discusses the future work.

II. LITERATURE REVIEW

This study focuses on price competition under a duopoly manufacturer and a retailer where the manufactures compete with each other under different bargaining power scenarios. Choi [1] proposed three non cooperative games of these bargaining power scenarios under a duopoly manufacturer and a common retailer, and concluded that the intensity of bargaining power influence the wholesale prices, retail prices and channel profits. Furthermore, different types of demand model may lead to different trends and dynamics of price competition. Subsequently, McGahan and Ghemawat [2] applied a game-theoretic model for retaining old customers by service and attracting new customers by price. Lee and Staelin [3] studied a non cooperative game under pricing policy with linear and non linear demand models. The study showed that the question of using linear or nonlinear demand functions is not as critical as whether the demand function implies vertical strategic substitute (VSS) or vertical strategic complement (VSC). Choi [4] used subgame-perfect Stackelberg equilibrium to study the effect of bargaining power on four types of channel structures. A limitation of the linear demand model used in [1] was also discussed as it cannot portray product differentiation problem. In addition to [2] and [4], several studies in the literature also suggested that different demand functions result in opposite implications for some important issues such as channel leadership and product line pricing. For example, it was shown that under a multiplicative demand function, the follower benefits more than the leader does [5], whereas a linear demand function is shown to be beneficial only to the leader [6]. Lee and Staelin [7] explained this contradiction by using the concept of vertical strategic interaction, which depended on the type of demand function.

There are several other studies in channel profit with bargaining power. A demand model under one manufacturer and two retailers competing on both price and nonprice factors was studied in [8]. A model under one manufacturer that sells a commoditized product to two independent retailers was studied in [9], where the intensity of competition with respect to each competitive dimension and the degree of cooperation between the retailers were shown to be extremely influential. Kadiyala et al. [10] showed that a higher share of channel profit was associated with a higher channel power. Kim and Staelin [11] studied a demand model under two manufacturers and two retailers, and concluded that the activities in store affect the retailers' and manufacturers' profits. Bernstein and Federgruen [12] introduced an equilibrium stochastic inventory model for a price sensitive oligopoly competition.

III. DEMAND MODEL

In this study, there are two competing manufacturers (*i, j*) in the demand model where each manufacturer produces only one commoditized product sold to a common price sensitive retailer. There is only one retailer in the model in order to eliminate the effect of retailer completion. In our model, the following assumptions have been made: (1) the demand structure is symmetric and decreasing in its own retail price and increasing in the competitor retail price; (2) both products *i* and *j* share market base; (3) decreasing retail price will affect product demands as follows: first, a group of customer switches to another product, and next, a new consumer group comes in because of price attraction. The opposite happens when the retail price increases.

The following notations are used to develop the mathematical model (i = 1, 2; j = 3-i):

q_i the retailer ordering quantity of brand i at price p_i
$\propto$ product market base of the product i and j
b competition intensity of pricing degree for product i
θ competition intensity of pricing degree for product j
w_i wholesale price for product i
c_i manufacturer cost for product i
m_i retail margin for product i

The developed linear duopoly demand model is given by

$$q_i(p_i, p_j) = \propto - bp_i - \theta p_i + \theta p_j \; , \qquad (1)$$

where $\propto > 0$, $b > 0$, $\theta > 0$ as explained in [14],[15]. The competition intensity of pricing degree shows the competition ability on each product price, where the difference b-θ relates to the degree of product differentiation. In equation (1), the product demand depends on its own market base, own retail price, competitor retail price and the competition intensity of pricing degree for product i and j. Unlike Choi [1]'s demand model, one more term of competition intensity of pricing degree of competitor, θ, has been added to demand model in this study. The degree θ is added based on the fact that competitor pricing has immense effect on manufacturer i's demand in price sensitive market. Profit functions of the manufacturers and the retailer can be shown as follows:

Manufacturer i's profit function is

$$\pi_{M_i} = (w_i - c_i) q_i(p_i, p_j). \qquad (2)$$

Retailer's profit function is

$$\pi_R = \sum_{i=1}^{2} m_i q_i(p_i, p_j). \qquad (3)$$

Both manufacturers and the retailer are assumed to seek to maximize their own profits and there is no cooperation between channel members similar to the most common institutional arrangement of the channel structure under consideration.

To understand the pricing decision behavior of each type of bargaining power scenarios, a game-theoretical approach is used as follows:

Manufacturer Stackelberg (MS): the manufacturers have the first-mover advantage. This scenario will be solved by the backwards induction method, where the retailer's reaction function is solved first, and then each manufacturer takes the retailer's reaction function as part of their decisions but chooses its wholesale price based on observed competitor's price. Subsequently, the retailer uses the wholesale prices to determine the retail price of each product to maximize the total profit from both brands.

Specifically, to solve the MS scenario, the manufacturers must take the retailer's reaction function for their decisions. Therefore, retailer's reaction function is solved first. The retailer chooses the retail prices from

$$p_i^* \in \arg\max_{p_i} \prod_R (p_i, p_j^* | w_i, w_j), \quad (4)$$

where p_i^* *and* p_j^* are the retailer prices that maximize the retailer's profit. Given the wholesale prices of both products, the retailer's reaction function can be derived from the first-order conditions of (3),

$$0 = \frac{\partial \prod_R}{\partial \prod_{p_i}} = \alpha - 2bp_i - 2\theta p_i + \theta p_j + bw_i + \theta w_i. \quad (5)$$

The negative definite Hessian is checked: $\partial \prod_R^2 / \partial p_i^2$=-2b-2$\theta$, $\partial \prod_R^2 / \partial p_i p_j$ =2θ, $\partial \prod_R^2 / \partial p_j p_i$ =2θ and $\partial \prod_R^2 / \partial p_j^2$= -2b-2$\theta$, where $b > 0, \theta > 0$. The equation satisfies the second-order condition for a maximum.

From equation (5), the retailer's reaction function is

$$p_i = \frac{w_i}{2} + \frac{\alpha}{2b}. \quad (6)$$

From (6), the manufacturers choose their wholesale prices from

$$w_i^* \in \arg\max_{w_i} \prod_{M_i} (w_i, w_j^* | p_i, p_j). \quad (7)$$

The manufacturers' wholesale prices can be derived from the first-order conditions of the respective manufacturers' profit maximization problems:

$$0 = \frac{\partial \prod_{M_i}}{\partial \prod_{w_i}} = \frac{1}{2b}(\alpha b - 2w_i b(b+\theta) + bw_j\theta + c_i b(b+\theta)). \quad (8)$$

From (8), the MS wholesale prices and retail prices are

$$w_i = \frac{\propto}{2b+\theta} + \frac{2c_i(b+\theta)^2 + c_j\theta(b+\theta)}{(2b+3\theta)(2b+\theta)}, \ i, j = 1,2, j = 3\text{-}i,$$

$$p_i = \frac{\alpha}{2b} + \frac{\alpha(2b+3\theta) + 2c_i(b+\theta)^2 + c_j\theta(b+\theta)}{2(2b+3\theta)(2b+\theta)}. \quad (9)$$

To compare the results with the ones in [1], manufacturing cost condition is set as $c_i = c_j = c$. Therefore, under this symmetry condition, the MS wholesales and retail prices are

$$w_i = w_j = \frac{\alpha + c(b+\theta)}{2b+\theta},$$

$$p_i = p_j = \frac{\alpha(3b+\theta) + bc(b+\theta)}{2b(2b+\theta)}, \quad (10)$$

where the prices always have positive values since the competition intensities of pricing degree for product are set as $b > 0, \theta > 0$.

To get the positive results of manufacturers' profits and retailer's profit, the contribution margin for manufacturer *i* can be derived as

$$w_i - c_i = \frac{\alpha - bc}{2b+\theta}. \quad (11)$$

For manufacturers to be profitable, the contribution margin has to be nonnegative. Therefore, following condition is set as an upper bound of production cost:

$$c_i \le \frac{\alpha}{3b+\theta}. \quad (12)$$

<u>Retailer Stackelberg (RS)</u>: the retailer has the first mover advantage. Similarly, the backwards induction method will be used to solve this problem. The manufacturers' reaction functions is solved first, and then the retailer uses the manufacturers' reaction functions to choose the retail prices of each product based on the retailer's margin on each product and observed retail prices of the competing brand.

Specifically, to solve the RS scenario, the retailer takes manufacturers' reaction functions as part of its decision. Therefore, manufacturers' reaction functions have to be solved first. The manufacturers choose their wholesale prices from

$$w_i^* \in \arg\max_{w_i} \prod_{M_i} (w_i, w_j^* | p_i, p_j), \quad (13)$$

where w_i^* *and* w_j^* are the manufacturers' wholesale prices that maximize each manufacture's profit.

The manufacturers' reaction functions can be derived from the following first-order conditions:

$$0 = \frac{\partial \prod_{M_i}}{\partial \prod_{w_i}} = q_i + (w_i - c_i)\frac{\partial \prod_{q_i}}{\partial \prod_{p_i}} \frac{\partial \prod_{p_i}}{\partial \prod_{w_i}}. \quad (14)$$

The negative definite Hessian is checked: $\partial \prod_{M_i}^2 / \partial w_i^2$=-b-$\theta$, $\partial \prod_{w_i}^2 / \partial w_i \partial w_j$ =0, $\partial \prod_{w_i}^2 / \partial w_j \partial w_i$ =0 and $\partial \prod_{w_i}^2 / \partial w_j^2$= -b-$\theta$, where $b > 0$ and $\theta > 0$. The equation satisfies second-order condition for a maximum. Thus, this implies that a solution of equation (14) is a Nash equilibrium between the two manufacturers.

From the manufacturers' reaction functions in equation (14), wholesale prices can be derived from the following first-order conditions of the respective manufacturers' profit maximization problem:

$$w_i = \frac{1}{(b+\theta)}(\alpha - (b+\theta)p_i + c_i(b+\theta) + \theta p_j). \quad (15)$$

From the manufacturers' reaction functions (15), the retailer chooses retail prices from

$$p_i^* \in \arg\max_{p_i} \prod_R (p_i, p_j^*). \quad (16)$$

The retail prices can be derived from the first-order conditions of the respective retailer's profit maximization problem:

$$0 = \frac{\partial \prod_R}{\partial \prod_{p_i}} = \left(1 - \frac{\partial w_i(p_i, p_j)}{\partial p_i}\right) q_i(p_i, p_j) + \big(p_i - w_i(p_i, p_j)\big)\frac{\partial q_i}{\partial p_i}(p_i, p_j) + \left(-\frac{\partial w_j(p_i, p_j)}{\partial p_i}\right) q_j(p_i, p_j) + \big(p_j - w_j(p_i, p_j)\big)\frac{\partial q_j}{\partial p_i}(p_i, p_j) \quad (17)$$

From equation (17), the RS retail prices and wholesale prices are

$$p_i = \frac{A_i}{B-C}, \tag{18}$$

$$w_i = \frac{\alpha+c_i(b+\theta)}{b+\theta} - \left[\frac{A_i(b+\theta)-A_j\theta}{(b+\theta)(B-C)}\right], \tag{19}$$

where
$A_i = \alpha(3b+\theta) + c_i b(b+2\theta) + c_i\theta^2 - c_j\theta(b+\theta)$
$B = (2b+2\theta)^2 + 2\theta^2$
$C = 6\theta(b+\theta)$

The retail margins can be derived from

$$m_i = p_i - w_i, \tag{20}$$

$$m_i = \frac{2A_i(b+\theta)-A_J\theta}{(b+\theta)(B-C)} - \frac{\alpha+c_i(b+\theta)}{(b+\theta)}. \tag{21}$$

To get the positive results of the retailer's margin. Therefore, the following condition is set as an upper bound of manufacturer cost:

$$c_i \le \frac{\propto(3b^2+5b\theta+\theta^2-1)}{b(2b+\theta)(b+\theta)}. \tag{22}$$

When manufacturing cost is assumed to be equal, $c_i = c_j = c$, the RS wholesale and retail prices are

$$w_i = w_j = \frac{\alpha+c(b+\theta)}{b+\theta} - \frac{bA}{(B-C)(b+\theta)},$$

$$p_i = p_j = \frac{A}{B-C},$$

Therefore, the retail margin is

$$m_i = m_j = \frac{\alpha}{2b} - \frac{c(2b^2+3b\theta-\theta^2)}{2(2b+\theta)(b+\theta)}. \tag{23}$$

<u>*Vertical Nash (VN)*</u>: the manufacturers and the retailer have equal power. Each manufacturer chooses its wholesale price subject to the retailer's margins on individual products and observed retail prices of the competing brand. The retailer determines the margin of each brand subject to the respective wholesale prices.

Specifically, to solve the VN scenario, the first-order conditions for this equilibrium that come from retailer and manufacturer profit maximization conditions from the MS and RS scenarios are used:

$$0 = \frac{\partial\Pi_R}{\partial\Pi_{p_i}} = \alpha - 2bp_i - 2\theta p_i + \theta p_j + bw_i + \theta w_i,$$

$$0 = \frac{\partial\Pi_{M_i}}{\partial\Pi_{w_i}} = q_i + (w_i - c_i)\frac{\partial\Pi_{q_i}}{\partial\Pi_{p_i}}\frac{\partial\Pi_{p_i}}{\partial\Pi_{w_i}}.$$

Therefore, the VN retail prices and wholesale prices are

$$p_i = \frac{D_i+E}{F}, \tag{24}$$

$$w_i = \frac{\alpha+c_i(b+\theta)}{b+\theta} - \frac{D_i+E}{F} + \theta\frac{D_j+E}{F(b+\theta)}, \tag{25}$$

where
$D_i = (b+\theta)[3(\alpha+bc_i)(b+\theta) + \theta(\alpha+bc_j)]$,
$E = \alpha b(3b+4\theta)$, $F = b(3b+4\theta)(3b+2\theta)$.

Note that, the condition in equation (12) must be satisfied for demand and contribution margin to be non-negative.

When manufacturing cost is assumed to be equal, $c_i = c_j = c$, the VN wholesale prices and retail prices are

$$w_i = w_j = \frac{\alpha+(b+\theta)c}{b+\theta} - \left[\frac{(\alpha+bc)(b+\theta)+\alpha b}{b(3b+2\theta)}\right]\left[\frac{b}{b+\theta}\right],$$

$$p_i = p_j = \frac{(\alpha+bc)(b+\theta)+\alpha b}{b(3b+2\theta)}. \tag{26}$$

The comparison of wholesale prices and retail prices from this study with the ones in [1] for all bargaining power are shown in Table I.

TABLE I
COMPARISON OF WHOLESALE PRICES AND RETAIL PRICES IN DIFFERENT BARGAINING POWER

	Choi (1991)	This paper
	Manufacturer Stackelberg	
w_i	$\frac{\alpha+bc}{2b-\theta}$	$\frac{\alpha+c(b+\theta)}{(2b+\theta)}$
p_i	$\frac{\alpha(3b-2\theta)+bc(b-\theta)}{2(2b-\theta)(b-\theta)}$	$\frac{\alpha(3b+\theta)+bc(b+\theta)}{2b(2b+\theta)}$
	Retailer Stackelberg	
w_i	$\frac{\alpha+(3b-\theta)c}{2(2b-\theta)}$	$\frac{(\alpha+c(b+\theta))(B-C)-bA}{(b+\theta)(B-C)}$
p_i	$\frac{\alpha(3b-2\theta)+bc(b-\theta)}{2(2b-\theta)(b-\theta)}$	$\frac{A}{B-C}$
	Vertical Nash	
w_i	$\frac{\alpha+2bc}{3b-\theta}$	$\frac{\alpha+(b+\theta)c}{b+\theta} - \left[\frac{(\alpha+bc)(b+\theta)+\alpha b}{b(3b+2\theta)}\right]\left[\frac{b}{b+\theta}\right]$
p_i	$\frac{\alpha(2b-\theta)+bc(b-\theta)}{(3b-\theta)(b-\theta)}$	$\frac{(\alpha+bc)(b+\theta)+\alpha b}{b(3b+2\theta)}$

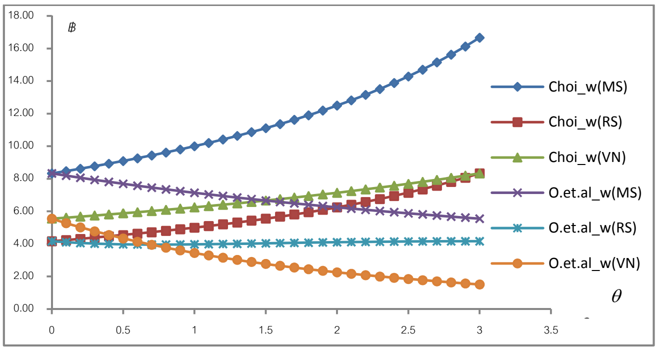
IV. ANALYTICAL RESULTS

This section discusses analytical results from the proposed price sensitive demand function model with those in [1] based on three bargaining power scenarios. In order to compare the trend of product differentiation to those in [1], parameters in our linear demand model are set as follows: $\alpha = 50$, $b = 3$ and $0 < \theta < 3$. The difference of b-θ shows the degree of product differentiation; therefore, the smaller value of θ, the more product differentiation.

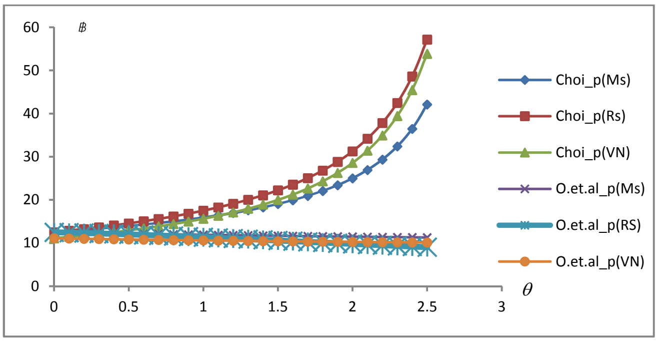
Figure 1 presents the characteristics of wholesale and retail prices in different bargaining power scenarios. Figure 1 (a) shows the opposite trends between results from [1] and this study. Using traditional linear price sensitive demand models, the wholesale prices in different bargaining power scenarios tend to increase when the competition intensity of competitor pricing degree, θ, increases. In contrast, resulting wholesale prices in this study tend to decrease when θ increases. The decreasing trend suggests that a wholesale price of a manufacturer product will decrease when the ability of competitors to compete with the former manufacturer in this industry increases. In other words, decreased degree of product differentiation leads to a

ISBN: 978-988-19251-0-7
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

decrease in wholesale prices in the supply chain. Figure 1 (b) compares the retail price trend from this model with Choi's when θ increases. These trends yield similar results to the wholesale price trends shown in Figure 1 (a).

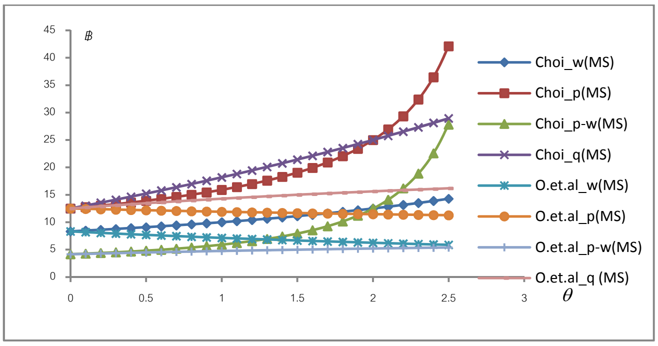


(1 a) Wholesale prices

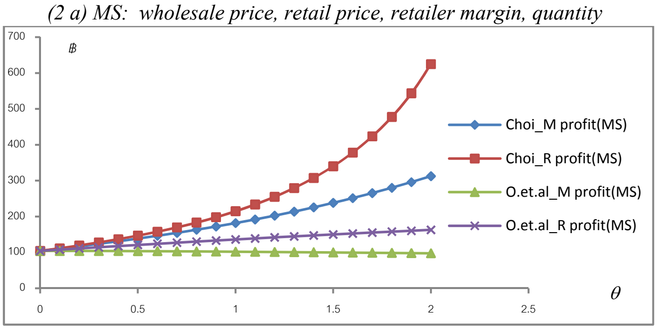


(1 b)Retail Prices

Fig. 1. Comparison of wholesale price and retail price with Choi(1991) for three types of bargaining power.



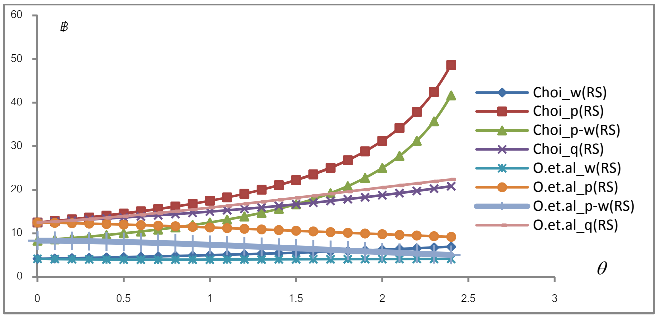
(2 a) MS: wholesale price, retail price, retailer margin, quantity



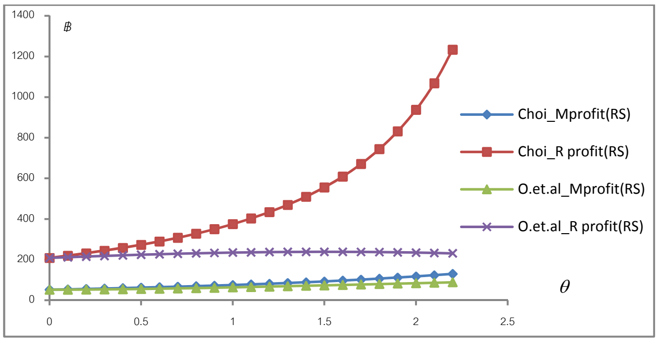
(2 b) MS: manufacturer profit and retailer profit.

Fig. 2. Comparison of Manufacturer Stackelberg solutions with Choi(1991): wholesale price, retail price, retailer margin, quantity, manufacturer profit and retailer profit.

The comparison of MS results is shown in Figure 2. Figure 2(a) shows that wholesale price, retail prices, retailer margin. The figure suggests that product demand of Choi's model increases when the competition intensity of competitor pricing degree increases. On the contrary, the wholesale price, retail price and retailer margin of this study decrease slightly, and the product demand increases as the competition intensity of competitor pricing degree increases. It shows that when two products have smaller degrees of differentiation, the retail prices decrease. Therefore the product demands increase, complying with Assumption 3. Importantly, these results capture the actual behavior in real business situations. Figure 2(b) shows that the manufacturer's and retailer's profits of our model as well as both profits in Choi [1] increase as the competition intensity of competitor's pricing degree increases. However, the retailer profit in our model increases slightly, whereas the manufacture profit decreases slightly. It shows similar results to those in MS, the retailer still gains more benefit than manufacturers, even when manufacturers have more bargaining power.



(3 a) RS: wholesale price, retail price, retailer margin, quantity



(3 b) RS: manufacturer profit and retailer profit

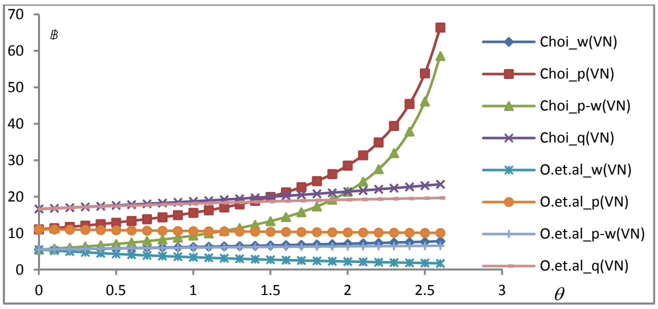
Fig. 3. Comparison of Retailer Stackelberg solutions with Choi(1991): wholesale price, retail price, retailer margin, quantity, manufacturer profit and retailer profit.

Figure 3 compares the RS results. They show different characteristics than those in Choi [1] as shown in the MS scenario. Especially, in Figure 3(a), the retailer also gains more benefit than manufacturers in the RS scenario. Furthermore, the difference of wholesale prices and retail prices increases when products are more differentiated. The figure also shows a higher retailer profit in the RS scenario than that in the MS scenario. Moreover, Figures 2 and 3 suggest that when manufacturers compete with each other, selling their products to a common retailer, the bargaining power lies on the retailer side, and the degree of differentiation becomes less influential on the manufacturer and retailer profits

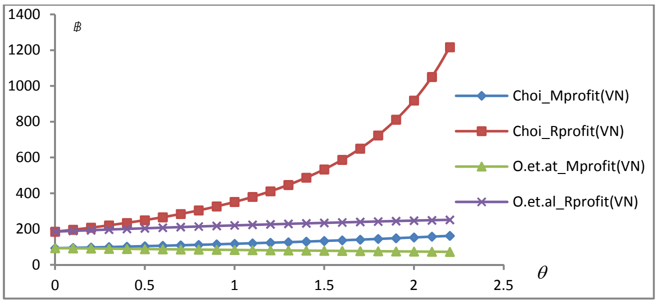
The results of the Vertical Nash scenario in Figure 4 show similar characteristics of retailer profit to those in the MS and RS scenarios. The retailer gains more profit than manufacturers because the product demand increases significantly more than the change of retailer's contribution

ISBN: 978-988-19251-0-7
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

margin. Although the degree of differentiation decreases, the product demand still increases. Therefore, the retailer has more profit than the manufacturers.



(4 a) VN: wholesale price, retail price, retailer margin, quantity



(4 b) VN: manufacturer profit and retailer profit

Fig. 4. Comparison of vertical Nash solutions with Choi(1991): wholesale price, retail price, retailer margin, quantity, manufacturer profit and retailer profit.

Table II compares the results of our model with those in [1]. The table shows that the retailer has more advantages in the VN scenario than Choi's model.

TABLE II
COMPARISON RESULTS FROM THE THREE SCENARIOS

	Choi (1991)	THIS PAPER
Wholesale price	$w^{MS} > w^{VN} > w^{RS}$	$w^{MS} > w^{VS} > w^{RS}$
Retail price	$p^{RS} > p^{VN} > p^{MS}$	$p^{MS} > p^{RS} > p^{VN}$
Retailer margin	$m^{RS} > m^{VN} > m^{MS}$	$m^{RS} > m^{VN} > m^{MS}$
Demand quantity	$q^{MS} > q^{VN} > q^{RS}$	$q^{VN} > q^{RS} > q^{MS}$
Manufacturer profit	$\prod_M^{MS} > \prod_M^{VN} > \prod_M^{RS}$	$\prod_M^{MS} > \prod_M^{VN} > \prod_M^{RS}$
Retailer Profit	$\prod_R^{RS} > \prod_R^{VN} > \prod_R^{MS}$	$\prod_R^{RS} > \prod_R^{VN} > \prod_R^{MS}$

When *$1<\theta<1.5$, $b=3$*

V. Conclusion

To understand the behavior of an oligopoly competition under different bargaining power scenarios, a simple price sensitive linear demand model was introduced. The demand model provided better real life business interpretation with respect to the effect of rival prices and different bargaining power scenarios than that from previous studies. In addition, this study also demonstrated the differences in retailer's benefit in the VN scenario, which contrasted the findings in [1]. Understanding the characteristics of commoditized products in different bargaining power scenarios can be extremely useful in real life business application. Nevertheless, the model proposed in this paper only focused on the wholesale price contract. The future research should be developed using other types of contracts under different bargaining power scenarios.

References

[1] S. C. Choi, "Price competition in a channel structure with common retailer," *Marketing Science*, vol. 10, no. 4, pp. 271–296, autumn 1991

[2] A.M. McGahan, P. Ghemawat, "Competition to retain customers," *Marketing Science,* vol. 13, no. 2,pp. 165–176, spring 1994**.**

[3] E. Lee, R. Staelin,1997. Vertical strategic interaction: implications for channel pricing strategy. Marketing Science, vol. 16, no. 3, pp. 185–207, 1997

[4] S. C. Choi, "Price competition in a duopoly common retailer channel," *Journal of Retailing*, vol. 72, no. 2, pp. 117-137, 1996.

[5] S.M. Shugan, "implicit understandings in channel of distribution," *Marketing Sciences*, vol.1, no. 4, pp. 435-460, April 1985.

[6] K. S. Moorthy, "Cournot competition in a differentiated oligopoly," Journal of economic theory, vol. 36, pp.86-109, 1985.

[7] E.Lee, R. Staelin, "Vertical strategic interaction: implications for channel pricing strategy," *Marketing Science*, vol. 16, no. 3, pp. 187-207, 1997.

[8] G. Iyer, "Coordinating channels under price and nonprice competition," *Marketing Science*., vol. 17, no. 4, pp. 338–355, Dec. 1998.

[9] A.A.Tsay, N. Agrawal, "Channel dynamics under price and service competition," .Manufacturing & Service Operations Management, vol. 2, no. 4, pp. 372–391,2000

[10] V. Kadiyala, P. Chintagunta, N. Vilcassim, "Manufacturer-retailer channel interactions and implications for channel power: an empirical investigation of pricing in a local market," *Marketing Science*, vol.19, no.2, pp.127-148, 1983.

[11] S.Y.Kim, R. Staelin, "Manufacturer allowances and retailer passthrough rates in a competitive environment," *Marketing Science*, vol.18, no.1, pp.59-76, 1999.

[12] F. Bernstein, A. Federgruen, "Dynamic inventory and pricing models for competing retailers," *Naval Research Logistics*, vol. 51, no. 2, pp. 258–274, 2004**.**

[13] T. W. McGuire, R. Staelin, "An industry equilibrium analysis of downstream vertical integration," *Marketing Science*, vol. 2, pp.161-192, 1983.

[14] A. Jeuland, S. Shugan, "Reply to: Managing channel profits: comment," *Marketing Science.,* vol. 7, no.1 pp.103-106, winter 1988.

[15] J.C. Lu, T.Y.Tsao, C. Charoensiriwath, "Competition under manufacturer service and retail price," Economic Modelling, vol. 28, pp.1256-1264, 2011.

.

ISBN: 978-988-19251-0-7
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)