Cooperative Advertising Strategies in Supply Chain When Retailer Offers Discount

HE Ping, SHI Kuiran, YAO Xinyi
College of Economics and Management, Nanjing University of Technology, Nanjing, P. R. China
peace-sailor@163.com

Abstract: This paper utilizes game theory to analyze cooperative advertising in a manufacturer-retailer supply chain when the retailer offers discount to customers. We firstly investigate Stackelberg leader-follower game when the manufacturer is a leader under price sensitive setting. Then, we consider Nash co-op game. It is shown that all the advertising level, discount, ordering quantity and system profits when the members choose cooperative strategy are larger than those without cooperation. We give the retailer’s discount range in different condition. For any given price discount, the advertising level of the manufacturer or the retailer, ordering quantity are larger than those without discount. Finally, a numerical example is provided to confirm the relevant conclusion.

Keywords: Supply chain, Cooperative advertising, Game theory, Price discount

1 Introduction

The supply chain coordination has grown greatly during the past decade among both academics and practitioners. Without coordination, distribution channel members determine their own decision variables independently in order to maximize one’s own profits, which will lead to “double marginalization”. As a coordination mechanism, cooperative advertising has been a focus in supply chain management. Vertical cooperative advertising is an interactive relationship between a manufacturer and a retailer in which the retailer initiates and implements a local advertisement and the manufacturer offers national advertising expenditures and pays part of the cost of the retailer. The manufacturer’s national advertisement is intended to influence potential consumers to consider its brand and to develop brand knowledge and preference. The retailer’s local advertisement is to stimulate consumer’s buying behavior.

In order to gain more profits or promote the products, the retailer always offers discount to the consumers in festivals and holidays. Promotion leads to higher demand, when demand for the product is price sensitive. The higher demand brings in more profits. The manufacturer and the retailer cooperate together to determine cooperative advertising strategy and promotion strategy. This paper is to identify the optimal range of discount and cooperative advertising strategies for the manufacturer and the retailer in a distribution channel and concerned with their conflict and coordination.

Most of the previous analysis is based on Stackelberg equilibrium where the manufacturer is a leader and the retailer is a follower, which implies the manufacturer dominates the retailer. Huang and Li (2001, 2002) used game theory approach to discuss both Stackelberg leader-follower equilibrium and Nash co-op equilibrium. Furthermore, they distributed the surplus profits by Nash bargaining model. Karray and Zaccour (2003) developed the single-manufacturer–single-retailer channel. They considered a channel consisting of two manufacturers and two retailers. They illustrated the effect between manufacturers and competitive retailers. In contrast to these literatures which studied static models, Jørgensen and Taboubis (2000), Karray and Zaccour (2006) investigated dynamic game theoretic models. Considering the position and influence of consumers, Yue and Austin (2006) extended the co-op advertising model of Huang and Li (2001, 2002) by incorporating price elasticity to study the effect of manufacturer offering price discount to consumers. They obtained the optimal discount and cooperative advertising strategies. Xie and Wei (2009), Xie and Neyret (2009) developed two models where consumer demand was determined by retail price and cooperative advertising efforts by channel members, respectively.
On the basis of previous study, in this paper, we consider cooperative advertising in a two-level
manufacturer-retailer supply chain when demand is price sensitive. We introduce advertising cost
function and promotion of the retailer, which is different from previous literatures. Game theory is used
to analyze both Stackelberg leader-follower and partnership co-op cases. When the retailer provides a
price discount to consumers, the optimal national advertising level, local advertising level and the
manufacturer’s allowance to the retailer are obtained.

The rest of the paper is organized as follows: Firstly, the basic framework of model analysis is presented
in section 2. We give the demand function with national advertising and local advertising effects when
the demand is price sensitive in section 2. In section 3, we utilize Stackelberg equilibrium to analyze
strategies of the manufacturer and retailer when the manufacturer is the leader and the retailer is the
follower. Section 4 discusses Nash co-op equilibrium in which the manufacturer and the retailer
cooperate as partners. We compare two equilibriums and obtain the best choice for the whole supply
chain. We provide a numerical example to confirm relevant conclusion in section 5. Conclusion
remarks are offered in section 6.

2 Assumptions and Basic Model

In this section, we consider a supply chain consisting of a single manufacturer and a single retailer. The
manufacturer produces a product with unit cost \(c\), provides the product to the retailer with a unit
wholesale price \(w\), and the retailer sells the product to the end consumers by a retail price \(p\). We
assume that \(c\), \(w\) and \(p\) are exogenously variables, and \(p > w > c\). The variables \(n\) and \(a\) denote the manufacturer’s national advertising level and the retailer’s local advertising level
respectively. The fraction of total local advertising expenditures which the manufacturer agrees to share
with the retailer is \(t (0 \leq t \leq 1)\).

We will determine the demand function with national advertising, local advertising and retail price
discount efforts. We assume that the demand is price sensitive, which is different from previous
literatures. Similar to Yue and Austin (2006), the one period expected demand (sale volume) \(D\) is
determined by

\[
D(a,n,\sigma) = (\alpha - \beta a^{-\gamma} n^{\delta}) \sigma^{-\varsigma} + \varepsilon
\]

(1)

Where \(\alpha\), \(\beta\), \(\gamma\), \(\delta\) and \(\varsigma\) are positive constants, \(\varepsilon\) is the enviromental uncertainty with mean
zero. Furthermore, \(\gamma\) and \(\delta\) are called the national advertising elasticity and the local advertising
elasticity respectively, and \(\varsigma\) is the price elasticity. The higher the value of \(\gamma\) and \(\delta\), the larger the
influences of the national advertising and local advertising level on the demand. It is also true that the
higher the value of \(\varsigma\), the larger the effect of the discount. The demand function is a non-decreasing
function with respect \(n\) and \(a\). When either or both national advertising and local advertising level
tend to infinity, the demand tends to the constant \(\alpha\). Let \(\sigma = (\frac{P}{P_0})\), \(\sigma (0 \leq \sigma \leq 1)\) is the price discount,
where \(P_0\) is the full price for customers, and \(P\) is the discounted price. If the price is full price
\((\sigma = 1)\), the retailer will not give discount to customers. If the price is reduced \((\sigma \neq 1)\), the retailer will
give some deduction to customers.

Furthermore, we assume that the manufacturer’s and the retailer’s advertising cost function are linear.
They are \(C(n) = hn\), and \(C(a) = ea\), respectively, where \(h\) and \(e\) are unit advertising cost of the
manufacturer and the retailer respectively. The manufacturer’s, retailer’s and system’s expected profits
function, the expected order quantity of the retailer are as follows

\[
\pi_M(\sigma) = (w - c)(\alpha - \beta a^{-\gamma} n^{\delta}) \sigma^{-\varsigma} - tea - hn
\]

(2)

\[
\pi_R(\sigma) = (\sigma p_0 - w)(\alpha - \beta a^{-\gamma} n^{\delta}) \sigma^{-\varsigma} - (1 - t)ea
\]

(3)
\[ \pi_T = (\sigma p_0 - c)(\alpha - \beta a^{-\gamma} n^{-\delta} )\sigma^{-\gamma} - kn - ea \]  
\[ q = (\alpha - \beta a^{-\gamma} n^{-\delta} )\sigma^{-\gamma} \]  

3 Stackelberg Equilibrium

In this section, we model the decision process as a sequential, non-cooperative Stackelberg game, considering the manufacturer as the leader and the retailer as the follower. At first, the manufacturer declares the national advertising level \( n \) and local advertising participation rate \( t \). Then, the retailer, basing on the information from the manufacturer, decides the local advertising level \( a \), ordering quantity \( q \) and discount \( \sigma \). In order to determine the Stackelberg equilibrium by backward induction, we first solve the problem of the second stage. For a given manufacturer’s national advertising level and local advertising participation rate, the retailer’s local advertising level will be determined by

\[ \text{Max}_{a,\sigma} \pi_R = (\sigma p_0 - w)(\alpha - \beta a^{-\gamma} n^{-\delta} )\sigma^{-\gamma} \]  
\[ -(1-t)ea \]  

By solving the first-order equation \( \frac{\partial \pi_R}{\partial a} = 0 \), we have

\[ a(\sigma) = (\beta \gamma (\sigma p_0 - w))^{-\frac{1}{\gamma}} \]  

We observe that \( \partial a/\partial t < 0 \) and \( \partial a/\partial t > 0 \). It means that the local advertising level increases when the participation rate increases, or the national advertising level decreases. When \( \zeta > 1 \), by taking \( \partial \pi_R/\partial \sigma = 0 \), we get

\[ \sigma = \frac{\zeta w}{p_0(\zeta - 1)} \]  

In Stackelberg equilibrium, the retailer’s reaction is well known by the manufacturer. Given this knowledge, the manufacturer will maximize its profits by deciding the optimal national advertising level and participation rate to the retailer. We have the manufacturer’s expected profits objective function

\[ \text{Max}_{n,t} \pi_M = (w-c)(\alpha \sigma^{-\gamma} - \beta \sigma^{-\gamma} n^{-\delta} - k n) \]  

By taking \( \partial \pi_M / \partial \sigma = 0 \), we have

\[ I^*_1(\sigma) = \begin{cases} 
\frac{(w-c) - (1+\gamma)(\sigma p_0 - w)}{(w-c) - \gamma(\sigma p_0 - w)} & \text{when } (w-c)/(\sigma p_0 - w) > 1+\gamma, \\
0 & \text{otherwise}
\end{cases} \]  

If \( (w-c)/(\sigma p_0 - w) > 1+\gamma \), the manufacturer will provide local advertising allowance, otherwise, the manufacturer will not share the advertising cost with the retailer. When \( (w-c)/(\sigma p_0 - w) > 1+\gamma \), we have
\[
\frac{\partial^2 q}{\partial \varsigma^2} = -\frac{p[1 + \gamma(\sigma p_0 - w)]}{(w-c) - \gamma(\sigma p_0 - w)^2} < 0
\]
From the retailer’s point of view, if he gives more deduction to consumers, the manufacturer will share more local advertising investment. On the other hand, the manufacturer should offer more advertising allowance to the retailer, if he attempts to get higher demand of consumers.

After solving the manufacturer’s decision problem, we obtain the Stackelberg equilibrium results which are expressed as

\[
n_1^* (\sigma) = \frac{\beta \gamma}{h} \left( \frac{1}{\gamma} \right)^{\frac{1}{1+\gamma+\delta}} \frac{1}{\sigma^{-\frac{1}{1+\gamma+\delta}}}
\]

(11)

\[
a_1^* (\sigma) = \frac{\beta \gamma}{e} \left( \frac{1}{\gamma} \right)^{\frac{1}{1+\gamma+\delta}} \frac{1}{\sigma^{-\frac{1}{1+\gamma+\delta}}}
\]

(12)

\[
q_1^* (\sigma) = a \sigma^{-\gamma} - \left( \frac{\beta \gamma}{h} \right)^{\frac{1}{\delta}} \left( \sigma p_0 - c \right)^{1+\gamma+\delta}
\]

(13)

4 Nash Co-op Equilibrium

In this section, we focus on a cooperative game structure in which the manufacturer and the retailer have the equal position. The shift of power from manufacturers to retailers is one of the most significant phenomena in manufacturing and retailing. According to the phenomena, many researchers begin to study the new structure in which the supply chain members take cooperative strategy. In Nash equilibrium, as partners, the manufacturer and retailer agree to maximize the total profits together. The total profits are described by

\[
\text{Max}_{a,\sigma, \pi} \pi = (\sigma p_0 - c)(\alpha - \beta a - \gamma a) - h n - e a
\]

(14)

By taking \( \partial \pi_r / \partial n = 0 \), \( \partial \pi_r / \partial a = 0 \), we have the final results expressed as

\[
n_2^* (\sigma) = \frac{\beta \gamma}{h} \left( \frac{1}{\gamma} \right)^{\frac{1}{1+\gamma+\delta}} \frac{1}{\sigma^{-\frac{1}{1+\gamma+\delta}}}
\]

(15)

\[
a_2^* (\sigma) = \frac{\beta \gamma}{e} \left( \frac{1}{\gamma} \right)^{\frac{1}{1+\gamma+\delta}} \frac{1}{\sigma^{-\frac{1}{1+\gamma+\delta}}}
\]

(16)

\[
q_2^* (\sigma) = a \sigma^{-\gamma} - \left( \frac{\beta \gamma}{h} \right)^{\frac{1}{\delta}} \left( \sigma p_0 - c \right)^{1+\gamma+\delta}
\]

(17)

Proposition 1. In Stackelberg game, the optimal discount of the retailer is \( \sigma_1^* = \min \left[ \frac{c_w}{p_0 (\gamma - 1)}, 1 \right] \), when \( \varsigma > 1 \). In Nash cooperative game, the optimal discount of the retailer is \( \sigma_2^* = \min \left[ \frac{c c_e}{(\varsigma - 1)p_0}, 1 \right] \), when \( \varsigma > 1 \).
Proof of Proposition 1. When $\zeta > 1$, let $\frac{\partial \pi_T}{\partial \sigma} = 0$, we have $\sigma_1 = \frac{\zeta w}{p_0 (\zeta - 1)}$. Since $0 \leq \sigma \leq 1$, we obtain the optimal discount in Stackelberg game

$$\sigma_1^* = \min[\frac{\zeta w}{p_0 (\zeta - 1)}, 1].$$

By solving $\frac{\partial \pi_T}{\partial \sigma} = 0$, we have $\sigma_2 = \frac{\zeta c}{p_0 (\zeta - 1)}$. Taking the second derivatives of $\pi_T$, we have

$$\frac{\partial^2 \pi_T}{\partial \sigma^2} = (\alpha - \beta a^{-\gamma} n^{-\delta})\sigma^{-\zeta - 1}(-2\zeta p_0 + (\zeta + 1)$$

Since $0 \leq \sigma \leq 1$, we obtain the optimal discount in Nash co-op game

$$\sigma_2^* = \min[\frac{\zeta c}{(\zeta - 1)p_0}, 1].$$

Proposition 1 means that the retailer should offer no discount to consumers if the calculated result is larger than 1. Proposition 1 implies that the discount increases when the manufacturer’s wholesale price increases or the original retail price decreases in Stackelberg equilibrium, and the discount increases when the manufacturer’s cost increases or the original retail price decreases in Nash co-op equilibrium.

**Proposition 2.** In Stackelberg game and Nash cooperative game, the ratio of the optimal national advertising level and local advertising level always equals a constant, which is $\frac{e \delta}{h \gamma}$.

Proof of Proposition 2. By solving $\frac{n_1^*}{a_1}$ and $\frac{n_2^*}{a_2}$, we have $\frac{n_1^*}{a_1} = \frac{n_2^*}{a_2} = \frac{e \delta}{h \gamma}$.

In Stackelberg game, the manufacturer will share the cost of the local advertisement, if $\frac{(w - c)}{(\sigma p_0 - w)} > 1 + \gamma$. It means that only if the marginal profit ratio of the manufacturer and retailer is high enough, the manufacturer would provide advertising allowance to make sure that the ratio of the optimal national and local advertising level is $\frac{e \delta}{h \gamma}$. In Nash cooperative game, the ratio of the optimal national and local advertising level is kept at $\frac{e \delta}{h \gamma}$ as long as the manufacturer and retailer cooperate as partners.

**Proposition 3.** When the retailer offers a discount to consumers, comparing with the condition that the retailer does not take promotion strategy, the national advertising level, the local advertising level and ordering quantity will increase.

Proof of Proposition 3. Compare national and local advertising level, ordering quantity between two situation whether the retailer offers discount or not, which is equal to prove

$$[(w - c) - \gamma (\sigma p_0 - w)\sigma^{-\zeta} > (w - c) - \gamma (p_0 - w),$$

$$(p_0 - c)\sigma^{-\zeta} > (p_0 - c).$$

Since $\sigma^{-\zeta} > 1$, we obtain Proposition 3.

Proposition 3 indicates that offering some deduction to consumers will stimulate purchasing power. The larger the demand of consumers, the larger the ordering quantity of the retailer.

**Proposition 4.** In Nash cooperative equilibrium, $\pi_T^*$ is the maximum profits of the whole supply chain.

Proof of Proposition 4. Let
We have $A < 0$, so point $(n^*_1, a^*_1)$ is the maximum point. The corresponding total profits of the whole supply chain $(\pi^*_1)$ is the maximum profits of the whole supply chain.

The supply chain members get more profits as partners, comparing with non-cooperative game. As long as the retailer’s profits are no less than the case when the manufacturer is a leader, the retailer is willing to adopt cooperative strategy. Since the total profits of the supply chain in Nash co-op equilibrium is maximized, we should stipulate the supply chain members agree to cooperate. Whether the manufacturer and the retailer collaborate or not depends on how to share the surplus profits between them. Similar to Huang (2001), we distribute the surplus with Nash bargaining model in numerical example.

**Proposition 5.**

\[ n^*_2(\sigma) > n^*_1(\sigma), \quad a^*_2(\sigma) > a^*_1(\sigma), \quad q^*_2(\sigma) > q^*_1(\sigma), \quad \sigma^*_2 < \sigma^*_1, \quad \pi^*_2 > \pi^*_1, \quad \pi^*_R > \pi^*_M. \]

**Proof of Proposition 5.**

\[
\frac{\delta^2 \pi_1^*(\sigma)}{\delta a_2^*(\sigma)} = -\frac{(\sigma p_0 - c) \beta \delta \sigma^{\sigma^*} (1 + \delta) \sigma^{\sigma^*} n^{-2-\delta}}{\delta a_1^*(\sigma)} = -\frac{(\sigma p_0 - c) \beta \gamma \delta \sigma^{\sigma^*} a^{-1-\gamma} n^{-1-\delta}}{\delta a_1^*(\sigma)}
\]

\[
\frac{\delta^2 \pi_1^*(\sigma)}{\delta n_2^*(\sigma)} = -\frac{(\sigma p_0 - c) \beta \gamma \delta \sigma^{\sigma^*} (1 + \gamma) \sigma^{\sigma^*} a^{-2-\gamma} n^{-2-\delta}}{\delta n_2^*(\sigma)}
\]

We have

\[
AC - B^2 = (\sigma p_0 - c)^2 \beta^2 \gamma \delta \sigma^{\sigma^*} a^{-2-\gamma} n^{-2-\delta}
\]

\[
(1 + \gamma + \delta) > 0
\]

and $A < 0$, so point $(n^*_2(\sigma), a^*_2(\sigma))$ is the maximum point. The corresponding total profits of the whole supply chain $(\pi^*_2)$ is the maximum profits of the whole supply chain.

When the manufacturer and retailer take cooperative strategy, all the advertising level of the manufacturer and retailer, the ordering quantity, the deduction, the manufacturer’s profits and the retailer’s profits are larger than those without cooperation. The increase of the demand of consumers results in the increase of the manufacturer’s and retailer’s profits. It is clear that the manufacturer’s(retailer’s) profits are higher, the national(local) advertising level is higher.

**5 Numerical Example**

Take P&G and Wal-Mart for example. They take vertical cooperative advertising to publicize a sort of shampoo of P&G. We assume the relative parameters as follows:
\( \alpha = 100, \ \beta = 10, \ \gamma = 0.2, \ \delta = 0.5, \ \zeta = 2.6, \ h = 2000, \ e = 500, \ \phi_M = 0.5, \ \phi_R = 0.6, \ \lambda_M = 0.6, \ \lambda_R = 0.4. \)

From Table 1 and Table 2, we derive the following observations:
When the unit cost \( (c) \) of the manufacturer increases, the optimal national advertising level, local advertising level, ordering quantity, manufacturer’s profits, retailer’s profits and the total profits of the supply chain decrease. In Stackelberg equilibrium, owing to the increase of \( c \), the manufacturer reduces the national advertisement and the local advertising allowance to the retailer. It results in the decrease of local advertising level, so the demand of consumers decreases. In Nash co-op equilibrium, owing to the increase of \( c \), all the national advertising level, local advertising level and deduction decrease.

Comparing the two tables each other, we find that the cooperative situation is better than the non-cooperative situation. In Table 2, \( n, a, q, \pi_M, \pi_R \) and \( \pi_T \) are larger than those in Table 1, and \( \sigma \) is smaller than that in Table 1. It indicates that supply chain members should coordinate and collaborate to seek more profits.

6 Conclusion

In this paper, we study vertical cooperative advertising of a two-echelon supply chain when the retailer offers discount to consumers. The major contributions of the paper include: (1) We establish a model that reveals the relationship between the expected market demand and some important factors. The factors which influence the demand function include the national advertising level, local advertising level and the price discount. (2) We investigate Stackelberg equilibrium when the manufacturer is a leader and Nash co-op equilibrium. We obtain the optimal advertising strategies respectively. (3) The optimal discount is obtained in the two models. We find that the cooperative model achieves better channel coordination than the non-cooperative Stackelberg model.

The analysis of this paper can be extended in several directions. First, there are multiple manufacturers and retailers in reality. One can develop a multi-manufacturers and multi-retailers supply chain model. Second, we assume that the market demand is certain. In reality, we face uncertain demand. Finally, we investigate the situation where the information between the manufacturer and the retailer is symmetric. It is interesting to study cooperative advertising with asymmetric information.

Table 1: Stackelberg game optimal advertising strategy when the manufacturer's cost increases

<table>
<thead>
<tr>
<th>( c )</th>
<th>( w )</th>
<th>( p )</th>
<th>( \sigma )</th>
<th>( a )</th>
<th>( n )</th>
<th>( t )</th>
<th>( q )</th>
<th>( \pi_M )</th>
<th>( \pi_R )</th>
<th>( \pi_T )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1633</td>
<td>0.1021</td>
<td>0.117</td>
<td>58.77</td>
<td>373.97</td>
<td>368.74</td>
<td>742.71</td>
</tr>
<tr>
<td>2.1</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1622</td>
<td>0.1013</td>
<td>0.107</td>
<td>58.53</td>
<td>368.10</td>
<td>366.63</td>
<td>734.73</td>
</tr>
<tr>
<td>2.2</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1610</td>
<td>0.1001</td>
<td>0.096</td>
<td>58.30</td>
<td>362.26</td>
<td>364.48</td>
<td>726.74</td>
</tr>
<tr>
<td>2.3</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1599</td>
<td>0.0999</td>
<td>0.085</td>
<td>58.05</td>
<td>356.44</td>
<td>362.30</td>
<td>718.74</td>
</tr>
<tr>
<td>2.4</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1587</td>
<td>0.0992</td>
<td>0.074</td>
<td>57.81</td>
<td>350.65</td>
<td>360.07</td>
<td>710.72</td>
</tr>
<tr>
<td>2.5</td>
<td>12</td>
<td>20</td>
<td>0.975</td>
<td>0.1576</td>
<td>0.0985</td>
<td>0.063</td>
<td>57.56</td>
<td>344.88</td>
<td>357.81</td>
<td>702.69</td>
</tr>
</tbody>
</table>

Table 2: Nash co-op game optimal advertising strategy when the manufacturer's cost increases

<table>
<thead>
<tr>
<th>( c )</th>
<th>( w )</th>
<th>( p )</th>
<th>( \sigma )</th>
<th>( a )</th>
<th>( n )</th>
<th>( q )</th>
<th>( \pi_M )</th>
<th>( \pi_R )</th>
<th>( \pi_T )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>12</td>
<td>20</td>
<td>0.163</td>
<td>0.8192</td>
<td>0.5120</td>
<td>9551.2</td>
<td>5751.3</td>
<td>4849.9</td>
<td>10600.8</td>
</tr>
<tr>
<td>2.1</td>
<td>12</td>
<td>20</td>
<td>0.171</td>
<td>0.7825</td>
<td>0.4891</td>
<td>8385.6</td>
<td>5258.3</td>
<td>4441.7</td>
<td>9699.7</td>
</tr>
<tr>
<td>2.2</td>
<td>12</td>
<td>20</td>
<td>0.179</td>
<td>0.7490</td>
<td>0.4681</td>
<td>7404.7</td>
<td>5024.9</td>
<td>4083.4</td>
<td>8907.9</td>
</tr>
<tr>
<td>2.3</td>
<td>12</td>
<td>20</td>
<td>0.187</td>
<td>0.7183</td>
<td>0.4489</td>
<td>6573.1</td>
<td>4441.9</td>
<td>3766.8</td>
<td>8208.3</td>
</tr>
<tr>
<td>2.4</td>
<td>12</td>
<td>20</td>
<td>0.195</td>
<td>0.6901</td>
<td>0.4312</td>
<td>5863.0</td>
<td>4101.4</td>
<td>3485.7</td>
<td>7586.8</td>
</tr>
<tr>
<td>2.5</td>
<td>12</td>
<td>20</td>
<td>0.203</td>
<td>0.6641</td>
<td>0.4150</td>
<td>5252.8</td>
<td>3798.1</td>
<td>3235.5</td>
<td>7033.2</td>
</tr>
</tbody>
</table>

**References**


