Salesforce Incentive under A Three-layer Supply Chain with Two Dimensional Sales Effort

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Abstract
This paper studies salesforce compensation on a three-layer supply chain comprising a manufacturer, a retailer and a salesperson. The salesperson’s sales effort is divided into two kinds. The problem is solved using a two-stage game. In the first stage, the firm gives the compensation contract and the salesperson decides two kinds of effort. In the second stage, sales are realized and payments are made. From our analysis of the symmetric and asymmetric information cases, we find that in the symmetric information case, long term effort is more than short term effort; both incentive coefficient and salary paid to the salesperson decline as discount factor increases. For the asymmetric information case, the relationship of the two kinds of effort depends on risk aversion and discount factor parameters; incentive coefficient and commission have opposite changing trend; salary decreases in discount factor but increases in risk aversive parameter.

Key words: salesforce incentive; sales effort; supply chain

1. INTRODUCTION

Firms rely on salesforce to increase product sales, and design incentive contracts to motivate them. Firms in the United States spent as much as $800 billion on salesforce costs (Zoltners et al. 2008), which attains to 40% of the firm’s sales revenues (Albers and Mantrala, 2007). There is an extensive literature that has enhanced our understanding of salesforce compensation (Coughlan and Sen 1989, Albers 1996, Chen and Xiao 2012, Dai and Chao 2013). However, this literature has typically assumed that sales effort has one dimension. In fact, sales effort can be divided into multi dimensions. For example, high-pressure sales tactics and post-purchase explanations of how best to use a product are different kinds of effort (Hauser et al, 1994). Different kinds of effort have different effect. So it is important to design appropriate salesforce compensation and utilize the best of its effort.

To study these issues, we have interviewed sales managers of one famous automotive manufacturer and learned that they have launched a Millionaire Program. It is that the manufacture gave incentive to the retailer’s salesperson based on customer satisfaction. This program had a great incentive on improving the working enthusiasm of the retailer’s salesperson. At the meantime of improving sales, it also enhanced customer satisfaction. Survey data showed that the scheme to improve its annual sales by 15%, the degree of satisfaction rising from 14th to 8th (Zheng and Ye, 2015). The aim of this paper is to investigate mechanism of the program.

We consider a three-layer model with a manufacture, a retailer and a salesperson, where the manufacture and the retailer are risk neutral and the salesperson is risk averse. We analyze salesforce compensation considering multidimensional sales effort in symmetric and asymmetric information under which the retailer can’t observe the salesperson’s effort. For both information scenarios, a bi-principal-agent model is constructed which induces the salesperson to work hard. It shows that long term effort is more than short term effort; both the incentive coefficient and the salary paid to the salesperson decline as discount factor increases in the scenario of symmetric information. But it is not always right in the scenario of asymmetric information.

The current paper contributes to this literature as follows. Firstly, we study the salesforce compensation problem in a three-layer supply chain. Secondly, we consider the supply chain members collaborate to motivate the salesperson. Thirdly, we characterize sales effort by two dimensions.

The reminder of this paper is organized as follows. Section 2 describes the literature review. Section 3 determines models. Section 4 derives optimal compensation plans for firms. Section 5 presents numerical study and analysis. We summarize our results and conclusions in section 6.

2. LITERATURE REVIEW

The salesforce compensation problem has attracted wide attention of economics, marketing and operations scholars. Economics Holmstrom and Milgrom (1987) gave a linear contract. Marketing scholar Basu et al. (1985) studied the moral-hazard problem in salesforce contracting context by principal agency theory, which provided a theoretical basis for an analysis of risk aversion, marginal cost and other parameters on compensation scheme.

All these studies above are limited to a two-layer supply chain. In supply chains such as auto, computer hardware and retailing, manufacturers sell products to retailers who then rely on their salespeople to send to the market. So we consider salesforce compensation in a three-layer supply chain. Calderaro and Coughlan (2007) study a supply chain consisted of manufactures, rep firms and salespeople and found that manufactures are beneficial of spiffs, which forms an important foundation for this research. However, it assumes that the salesperson has one kind of effort. In practice, the salesforce efforts have components that are both short and long (Hauser et al., 1994). So we considered two kinds of effort which has been underexplored in the literature of salesforce compensation.

Moreover, this paper makes a contribution to the literature on supply chain collaboration. Supply chain collaborations (SCC) means two or more autonomous firms working jointly to plan and execute supply chain operations (Simatupang and Sridharan, 2002). It can deliver substantial benefits and advantages to its partners (Mentzer et al., 2000). Traditionally, collaboration among supply chains (SC) was designed with more focus on movement of materials, information flow, fund flow rather than people flow. However, firms engaging in collaborative activities rely on a number of key employees such as salesforce. The new angle we take in this paper is to understand the collaborative incentive to the salesforce from the manufacturer and the retailer. Thus we specifically develop a model to investigate how the supply chain members motivate the salesforce considering two dimensional sales effort in two information scenarios.

3. MODEL

In our model, a risk-neutral manufacturer sells a product through a risk-neutral retailer, who then relies on her risk-averse salesperson to sell to consumers. For convenience, we will refer to the manufacturer as ‘it’ and the retailer as ‘she’ and the salesperson as ‘he’ hereafter. The supply chain is dominated by the manufacturer.

3.1. Market Demand, Salesperson’s Effort and Customer Satisfaction

Research in the area of salesforce compensation has been focusing primarily on developing models that determine optimal single period decisions for maximizing their profit. However, the static models do not account for the effect of current period marketing decisions of the salesperson on their future action. This issue has received limited attention in the literature. Besides determining dynamic incentive strategies, it is also important for the salesperson to determine her optimal level of marketing effort over time, as effort in any period affects sales not only in that period, but also in future period. Hence, it is essential to design dynamic models to capture such impact on supply chain of different kinds of effort level. In the following we will propose one such dynamic model in this paper.

We consider a two-period framework where the first period represents “now” and the second period represents “future”. The salesperson chooses short term and long term effort in the first period. We make the second period as an ending period with no effort.

3.1.1. Salesperson’s Effort

Some efforts are of ephemeral effects. For example, high-pressure sales tactics, attempts to serve as many customers at once and attempts to sell unnecessary add-ons might be such efforts. Similar to Hauser et al. (1994) we designate the component of effort that has ephemeral impact short-term effort $a_{ij}$. Other components of efforts do not affect the sale today but add to customers’ satisfaction in the future. These efforts have enduring effects. For example, post-purchase explanations of how best to use a product. Consistent with Hauser et al. (1994), we call such components of effort long-term effort $b_{ij}$. The salesperson’s long term effort will make consumers more satisfied and then this will give a potential profit for the manufacturer (Kalra and Shin 2003).

We assume as in the marketing literature that the effort represents a cost to the salesperson and denote it by $C(e_k)$ for effort level $e_k$. Specifically, we adopt the following convex cost function $C(e_k) = \frac{1}{2} e_k^2$.

So the disutility of exerting short term effort and long term effort is $C(a_{ij}) = \frac{1}{2} a_{ij}^2$, $C(b_{ij}) = \frac{1}{2} b_{ij}^2$.

3.1.2. Market Demand

In our model, we assume that the manufacture produces one product. The market demand is determined by a market condition, the salesperson’s service level and a random noise in the following additive form:
\[ q_k = g_k + e_k + \epsilon_k \quad (1) \]

where the intercept \( g_k \) is the base demand which increases with the manufacturer’s reputation. We denote the sales effort as \( e_k = \{a, b\} \). The error term \( \epsilon_{s,j} \sim N(0, \sigma_s^2) \) is a normally distributed random variable with mean zero and variance \( \sigma_s^2 \). So the demand function of the first stage is \( q_{1,j} = g_1 + a_j + \epsilon_{1,j} \), and the demand function of the second stage is \( q_{2,j} = g_2 + b_j + \epsilon_{2,j} \). In order to make the model simple, we assume \( g_k = 0 \).

### 3.1.3. Customer Satisfaction

Customer satisfaction is a measure of a summary evaluative response by the customer. According to Hauser et al (1994), salesperson’s actions and behaviors have an important impact on customer satisfaction. In this paper, we mentioned above that salesperson’s long term effort does not affect the sale today but add to customers’ satisfaction in the future. Thus we assume customer satisfaction is conditional on salesperson’s long term effort. Expected customer satisfaction increases with the salesperson’s long term effort. According to Hauser et al (1994), it can be captured by the formulation

\[ s_j = b_j + \epsilon_{s,j} \quad (2) \]

The error item \( \epsilon_{s,j} \) is a normally distributed random variable with mean zero and variance \( \sigma_s \). We further assume that \( \epsilon_{s,j} \) and \( \epsilon_{k,j} \) are independent.

### 3.2. Manufacturer’s Problem

The manufacturer gives a fixed commission \( \rho \) to the retailer for every unit of sales. We assume the marginal avenue of per unit is 1. The manufacturer gives the salesperson an incentive \( \eta \) per unit customer satisfaction. We define \( \pi_{M,j} \) to be the manufacturer’s profit in period \( k \), then

\[ \pi_{M,j} = (1 - \rho_j)(\bar{q}_{l,j} - \eta_j \bar{s}_j) \]

\[ \pi_{M,j}^2 = (1 - \rho_j)\bar{q}_{2,j} \]

where \( \bar{q}_{k,j} \) is expected sales in period \( k \). \( \bar{s}_j \) is expected customer satisfaction induced by the salesperson’s long-term effort for the manufacturer.

We assume discount factor of the manufacturer and the retailer is 1. Then the manufacturer’s revenue can be expressed as:

\[ \pi_{M,j} = \pi_{M,j}^1 + \pi_{M,j}^2 = (1 - \rho_j)(\bar{q}_{l,j} + \bar{q}_{2,j}) - \eta_j \bar{s}_j \quad (3) \]

### 3.3. Retailer’s Problem

The retailer hires a salesperson to sell the product and compensates it by a combination of salary and commission. According to Holmstrom and Milgrom (1987), linear compensation is the best. So we denote the compensation scheme by \( T_{k,j}(\alpha, \beta) = \alpha_j + \beta_j q_{k,j} \). In the above, \( \alpha_j, \beta_j \) represent salary, sales-based commission rate. The retailer’s problem is to design a commission scheme \( (\alpha_j, \beta) \) to motivate her salesperson. Similar to the case of the manufacturer, we denoted the retailer’s profit function in period \( k \) as \( \pi_{R,j} = (\rho_j - \beta_j)\bar{q}_{l,j} - \alpha_j \), \( \pi_{R,j}^2 = (\rho_j - \beta_j)\bar{q}_{2,j} - \alpha_j \). Then the retailer’s profit \( \pi_{R,j} \) can be expressed as:

\[ \pi_{R,j} = \pi_{R,j}^1 + \pi_{R,j}^2 = (\rho_j - \beta_j)(\bar{q}_{l,j} + \bar{q}_{2,j}) - 2\alpha_j \quad (4) \]

The retailer chooses \( (\alpha_j, \beta_j) \) to maximize her profit.

### 3.4. Salesperson’s Problem

The salesperson’s risk preference is given by a negative exponential utility function \( U(z) = -e^{-rz} \), where \( r > 0 \) is the salesperson’s coefficient of absolute risk aversion and \( z \) is his net income.

The salespeople’s compensation is consisted by two parts, the first part \( \alpha_j + \beta_j q_{k,j} \) is given by the retailer, the second part \( \eta_j \bar{s}_j \) is given by the manufacturer. So the salesperson’s net income in period \( k \) is

\[ \pi_{s,j} = \alpha_j + \beta_j \bar{q}_{l,j} + \eta_j \bar{s}_j - \frac{1}{2} a_j^2 - \frac{1}{2} b_j^2 \]

\[ \pi_{s,j}^2 = \alpha_j + \beta_j \bar{q}_{2,j} \]
We assume discount factor of the salesperson is $\delta$. The whole expected revenue in the two periods is

$$\pi_{s,j} = \pi^1_{s,j} + \delta \pi^2_{s,j} = (1 + \delta)\alpha_j + \beta_j (\overline{q}_{1,j} + \delta \overline{q}_{2,j}) + \eta_j \overline{s}_j - \frac{1}{2} a_j^2 - \frac{1}{2} b_j^2$$  \hspace{1cm} (5)

Similar to literature Kalra et al. (2003), the salesperson’s expected utility can be formulated as

$$\mu(\pi_{s,j}) = \pi_{s,j} - \frac{r}{2} (\beta_j^2 \sigma_1^2 + \eta_j^2 \sigma_s^2 + \delta^2 \beta_j^2 \sigma_2^2)$$  \hspace{1cm} (6)

Where $\frac{r}{2} (\beta_j^2 \sigma_1^2 + \eta_j^2 \sigma_s^2 + \delta^2 \beta_j^2 \sigma_2^2)$ is the salesperson’s risk aversion cost.

In the agency literature, the IR condition requires that the expected utility of the salesperson must be no less than his reservation utility $u_0$, that is

$$\mu(\pi_{s,j}) = \pi_{s,j} - \frac{r}{2} (\beta_j^2 \sigma_1^2 + \eta_j^2 \sigma_s^2 + \delta^2 \beta_j^2 \sigma_2^2) \geq u_0$$  \hspace{1cm} (7)

The salesperson chooses $a$, $b$ to maximize his utility.

3.5. Sequence of Events

At the beginning, the manufacturer gives a contract to the retailer and the salesperson. Then, the retailer gives compensation contract to the salesperson. The salesperson subsequently chooses the contract to participate. Next, the salesperson attempts to give effort to increase consumer demand and customer satisfaction. Lastly, demand is realized and customer is satisfied.

4. COLLABORATIVE INCENTIVE

In supply chain collaborative incentive scenario, the salesperson gets compensation from the manufacturer and the retailer. We discuss the compensation problem under symmetric and asymmetric information scenarios.

4.1. Collaborative Incentive Model with symmetric information

In the supply chain collaborative incentive scenario, the manufacturer gives a compensation contract to the salesperson based on customer satisfaction and the retailer gives a linear compensation contract to the salesperson based on total sales. Then we can derive a three-level model in the scenario of supply chain collaborative incentives with symmetric information as follows:

$$\max_{\alpha_0, \beta_0} \pi_{M,0} = (1 - \rho_0)(\overline{q}_{1,0} + \overline{q}_{2,0}) - \eta_0 \overline{s}_0$$  \hspace{1cm} (8)

s.t. $(\rho_0 - \beta_0)(\overline{q}_{1,0} + \overline{q}_{2,0}) - 2\alpha_0 \geq 0$  \hspace{1cm} (9)

$\alpha_0, \beta_0, \alpha_0, \beta_0 \in \arg \max_{\alpha, \beta} \pi_{R} = (\rho_0 - \beta_0)(\overline{q}_{1,0} + \overline{q}_{2,0}) - 2\alpha_0$  \hspace{1cm} (10)

s.t. $\mu(\pi_{s,0}) \geq \mu_0$  \hspace{1cm} (11)

Equation (8) reflects the manufacturer’s expected revenue. The constraints (9) and (10) are the retailer’s individual rationality and incentive compatibility constraints, respectively. The last constraint (11) is the salesperson’s individual rationality constraint indicating that it is better off participating.

**Proposition 1.** In collaborative incentive with symmetric information, the first-best sharing coefficient, salary and effort follow:

$$\rho_0^* = \frac{2(3 + \delta)}{7 + 10\delta - \delta^2}, \eta_0^* = \frac{2(1 - \delta^2)}{7 + 10\delta - \delta^2}$$  \hspace{1cm} (12)

$$\alpha_0^* = \frac{\mu_0 + \frac{a_0^2 + b_0^2}{2}}{1 + \delta} - \frac{\eta_0 b_0^*}{1 + \delta}$$  \hspace{1cm} (13)

$$\alpha_0^* = \frac{(1 + \delta)(3 + \delta)}{7 + 10\delta - \delta^2}, b_0^* = \frac{(5 - \delta)(1 + \delta)}{7 + 10\delta - \delta^2}$$  \hspace{1cm} (14)

**Proposition 2.** In the scenario of symmetric information, long term effort is more than short term effort.

4.2. Collaborative Incentive Model with asymmetric information

Similar to the case in the supply chain collaborative incentives with symmetric information, we can get the
model in collaborative incentive with asymmetric information as follows:

\[
\max_{\rho, \beta} \pi_{M,1} = (1 - \rho_i)(\overline{q}_{i,1} + \overline{q}_{i,2}) - \eta_i \overline{s}_i
\]  
(15)

s.t. \((\rho_i - \beta_i)(\overline{q}_{i,1} + \overline{q}_{i,2}) - 2\alpha_i \geq 0\)  
(16)

\[\alpha_i, \beta_i \in \arg \max_{\alpha_i, \beta_i} \pi^*_R = (\rho_i - \beta_i)(\overline{q}_{i,1} + \overline{q}_{i,2}) - 2\alpha_i\]  
(17)

s.t. \(\mu(\pi_{S,1}) \geq \mu_0\)  
(18)

\[a_i, b_i \in \arg \max_{a_i, b_i} \mu(\pi_{S,1})\]  
(19)

Equation (15) reflects the manufacturer’s expected revenue. The constraints (16) and (17) are the retailer’s individual rationality and incentive compatibility constraints, respectively. The last two constraints (18) and (19) are salesperson’s individual rationality and incentive compatibility constraints indicating that the effort level is optimal for the salesperson and it is better off participating.

**Proposition 3.** In collaborative incentive with asymmetric information, the first-best sharing coefficient, collaborative compensation coefficient, salary and effort follow:

\[\rho^*_i = \left\{2(t(1+\delta)^2)[\delta-\delta^2]-1\right\}t(1-\delta^2)c + c\} m, \eta^*_i = t(1+\delta)^2[c + 2t(1-\delta^2) - 2]m\]  
(20)

\[\alpha^*_i = \frac{\mu_0 - \frac{a^2_i + b^2_i}{2} + \frac{r}{2}[(\sigma^2_1 + \sigma^2_2 + \sigma^2_3 + \sigma^2_2)\beta^2_i + \sigma^2_2\eta^2_i]}{1+\delta}, \beta^*_i = t(\rho^*_i(1+\delta)^2 - \eta^*_i(1-\delta))\]  
(21)

\[a^*_i = \beta^*_i, b^*_i = \delta \beta^*_i + \eta^*_i\]  
(22)

where

\[t = \frac{1}{4\delta + 2r(\sigma^2_1 + \sigma^2_2)}, c = t[\delta(1+\delta)^2 - (1-\delta^2)] + 1, m = \frac{1}{c^2 + 4t(1+\delta)^2[t(\delta-\delta^2)-1]}\]

**Proposition 4.** In the scenario of asymmetric information, there exists \(\delta_0\) and \(r_0\), long term effort is strictly greater than short term effort when \(r > r_0\) or \(r < r_0\) and \(\delta_0 < \delta < 1\); short term effort is higher than long term effort if \(r \leq r_0\) and \(0 < \delta < \delta_0\), where

\[\delta_0 = \frac{-1 + \sqrt{1-4r\sigma^2_2(r\sigma^2_1-1)}}{2r\sigma^2_2}, r_0 = \frac{\sigma^2_2 + \sqrt{4\sigma^2_2 + \sigma^2_2}}{2\sigma^2_1\sigma^2_2} .\]

This proposition is a direct result of the fact that if the salesperson discounts more, he is willing to make short term effort. It is not surprising that he is willing to make long term effort if he discounts less and is motivated by the manufacture based on customer satisfaction constrained by long term effort.

5. NUMERICAL STUDY

5.1. Symmetric information

Due to high mathematical complexity, it is fairly difficult to describe changing trend of the optimal compensation plan. In this section, we perform numerical experiments to investigate the effect of discount factor and risk aversion on the optimal parameters of the compensation scheme and different kinds of effort. Setting \(\sigma_1 = 1.2\), \(\sigma_2 = 1.0\), \(\sigma_3 = 1.0\), \(\mu_0 = 0.09\). We let \(\delta^*\) vary from 0 to 1 and \(r = \{0.4, 0.5, 0.6, 0.7\}\).
Figure 1. The impact of discount factor on compensation scheme

Figure 1 indicates that both the incentive coefficient and the salary paid to the salesperson decline as discount factor increases. If the salesperson pays much attention on revenue in the future (discount factor is bigger), the manufacture need not to give too much incentive.

Figure 2. The impact of discount factor on effort level

Figure 2 illustrates how effort changes with discount factor. From this figure, we find that when discount factor is smaller, incentive coefficient of the manufacture is bigger, so the salesperson prefers to give more long term effort. The manufacture reduces incentive coefficient when discount factor increases, so the salesperson decreases long term effort, and they equal when discount factor is one.

5.2. Asymmetric information

In this section, we perform numerical experiments to investigate the effect of discount factor and risk aversion on the optimal parameters of the compensation scheme and different kinds of effort under asymmetric information.
Figure 3. The impact of discount factor on incentive coefficient

Figure 3 illustrates that incentive coefficient increases with risk averse parameter given discount factor; incentive coefficient increases in discount factor given risk averse parameter when it is small but decreases when it is large. For example, incentive coefficient increases in discount factor when discount factor is less than 0.7; while it is just opposite when discount factor is more than 0.7. This is because when discount factor is bigger enough, the salesperson values revenue in the future nearly the same as now. So the salesperson is willing to give long term effort, and the manufacture can reduce the incentive coefficient. It is just opposite when discount factor is small. So the manufacture should know much more about the salesperson that it can give proper incentive to him.

Figure 4. The impact of discount factor on $\alpha$
Figure 5. The impact of discount factor on $\beta$

From picture 4 and 5, we find that salary increases; commission decreases when risk averse parameter increases. This is consistent with Dai and Chao (2016). Given risk averse parameter, salary decreases with discount factor, while commission is convex. This is because if the salesperson is more risk averse, he needs more stable income to offset the uncertainty of commission.

We have analyzed the effect of risk averse and discount factor on incentive contract. We give the effect on different kinds of effort below and choose parameters as follows: $\sigma_1 = 1.2$, $\sigma_2 = 1.0$, $\sigma_3 = 1.0$, $\mu_0 = 0.09$. To achieve the above goal, we let $\delta$ vary from 0 to 1 with step size 0.1 and $r = \{0.4, 0.5, 0.6, 0.7\}$. We depict the results in table 1.

Table 1. Impact of different values of $\delta$ and $r$ on efforts

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<th>$\delta$</th>
<th>0</th>
<th>0.1</th>
<th>0.2</th>
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Table 1 illustrates that, given risk averse parameter, long term effort increases with discount factor; there exists discount factor $\delta_2$, taking $r = 0.4$ for example, $\delta_2 = 0.3694$, when $\delta_2 < \delta < 1$, long term effort is more than short term effort, while it is opposite when $0 < \delta < \delta_2$.

6. CONCLUSION

This paper aims to examine how the firm motivates salesforce on symmetric and asymmetric information. We have studied a collaborative model composed of a manufacture, a retailer and a salesperson. For both information scenarios, the compensation contracts are designed and comparison analyses are conducted. An interesting finding is that long term effort is more than short term effort in the scenario of symmetric information, but it is not always right in the scenario of asymmetric information. Long term effort is bigger when the salesperson’s risk averse parameter is more than a certain value or risk averse parameter is less but discount factor is more than a threshold; short term effort is bigger when risk averse parameter and discount factor is both less.

For ease of analysis in this paper we ignored the inventory cost in our study. The analysis will be much more involved when inventory cost is explicitly included, and it will be interesting to investigate the impact of inventory cost in salesforce compensation considering multidimensional sales effort.
REFERENCES


