

Optimizing a Referral Reward Program on the Online Cab Service

Feng Ouyang^{1, 2†}, Jing Zeng¹

1. School of Business, Shantou University, Shantou 515063, China

2. College of Management, Tongji University, Shanghai 200092, China

[†]Email: yangfeng@stu.edu.cn

Abstract

In this paper, we proposed a referral reward program (RRP) via social interaction mechanism in the online cab service market. Considering other two major strategies on online cab service, we made a comparison to examined under which conditions existed, the RRP dominated the others. We emphasized the impact of two crucial factors, information heterogeneity between informed and less-informed passengers as well as information exchange insufficiency, on the cabdriver's earning. Finally, we made a suggestion to the ISPs which exerted themselves in the online cab service.

Keywords: *Referral Reward Programs; Online Cab Service; E- Business Strategy; Social Interaction*

1 INTRODUCTION

The advancement of information technology facilitated information exchange among the masses and have created many new chances for Internet service providers(ISPs) to implement innovative selling strategies via social interaction. On cab service field, some ISPs which specialized in offering online reserve cab service, such as Uber and Didi, has aroused great concern in masses. It was crucial for those ISPs to design market strategies to increase market share. In this paper, we proposed a Referral Reward Program(RRP) and studied how the RRP dominated another two market strategies on online cab service market under given conditions.

RRP was a prominent market strategy which intended to encourage existing customers to recommend and recruit the companies' service to their inductees via social interaction mechanisms (Biyalogorsky et al. 2001). The early study on RRP emphasized on multiple ways. Some studies proposed RRP under different considerations including impression management (Xiao et al. 2011), monetary and in-kind reward (Jin et al. 2014), customers' budget constraints (Zhou et al. 2015). Some studies focused on how RRP influenced other factors. Kuester et al. (2014) studied the variation of customer value by RRP. Customer lifetime value emphasized the importance of customers who could bring firms additional customers through referral (Kumar et al. 2007). Jing et al (2011) proposed a RRP model on the online purchase market and made a comparison under which conditions existed, RRP dominated the other online purchase strategies. Fan et al. (2014) studied RRP's impact on consumer intent to purchase.

The novelty of this paper was that it incorporated social interaction mechanism, RRP, into ISTPs' market strategy and software design on the online cab service market. Prior studies ignored the RRP's impact on market strategies in online cab service market. For instance, some research has focused on fare structure and fleet size regulation (Schroeter 1983), infrastructure represented by GPS devices (Cheng et al. 2009) on cab service. Some studies focused on another social interaction mechanism, Carpool, and constructed some carpool service systems. CarpoolGlobal, which was web-based and transmitted carpool information to online community platforms, supplied an interfacing service for drivers and passengers. ShareYourRide added a digital GIS to match travel offers to requests. BlueNet-Ride (Huang et al. 2015) was a cloud-based architecture for carpool service. Some research focused on tackling with operation problem on cab scheduling (Huang et al. 2012).

2 THE BASIS OF MODEL

We considered two segments including cabdriver and passenger. The passenger divided into informed ones which

used online cab service via apps and less-informed ones which didn't use it. Our aim was to propose a model to illustrate the cabdriver's earning of RRP and another two online cab service strategies. Because ISPs extracted a proportion of cabdrivers' earning to maintain operation and make profit, for the ISPs, helping cabdrivers earn more money was equal to benefit themselves.

Passengers Behavior. The less-informed passenger accepted a travel price P_0 , while the informed one accepted it $P_0 + \alpha I$, where αI was added travel values for the convenience on the cab service brought by Internet application. Here, $I \geq 0$ was the information gap between informed and less-informed passengers. α measured unit information's important degree.

Major Strategies:

- Special Cab strategy, under which an informed passenger ordered a special cab via cab-hailing apps;
- Carpool strategy, under which an informed passenger, as a sales agent, disseminate travel information, recruited less-informed passengers to carpool via cab-hailing apps for sharing the travel fare;
- RRP.

We assumed that an informed passenger took Special Cab strategy, while an informed passenger recruited a less-inform one to took Carpool strategy, and the marginal cost was zero. The optimal price (P_S^*, P_C^*) and the corresponding earning (π_S^*, π_C^*) were shown in Eq.1-Eq.2.

$$\text{Special Cab strategy: } P_S^* = P_0 + \alpha I \quad \pi_S^* = P_0 + \alpha I \quad (1)$$

$$\text{Carpool strategy: } P_C^* = 2[P_0 + \alpha^2 I / (\alpha + \beta)] \quad \pi_C^* = 2[P_0 + \alpha^2 I / (\alpha + \beta)] \quad (2)$$

The Eq.2 was the solution by a contract design shown in Eq.3-Eq.5.

$$\max_{P_C, \Delta I} \pi_C = P_C \quad (3)$$

$$\text{s.t. } P_0 + \alpha I - (P_C / 2 + \beta \Delta I) \geq 0 \quad (4)$$

$$P_0 + \alpha \Delta I - P_C / 2 = 0, \quad 0 \leq \Delta I \leq I \quad (5)$$

It was presented as a principle-agent problem between the cabdriver and the informed passenger. To travel at a cheaper price, the informed passenger must exchange travel information with the less-informed passenger. The price discount could be partly viewed as compensation to the informed passenger for their information exchange effort. The compensation, denoted as $\beta \Delta I$, increased with the agent's effort level in information dissemination ΔI . Information exchange inefficiency, $\beta \in (0, 1)$, which measured how difficult it was for the informed passenger to reach and persuade less-informed passengers. The Eq.4 reflected partition for the informed passenger. $P_C / 2$ was each passenger's expenditure, which must be sufficient low to compensate the informed passenger ($P_C / 2 + \beta \Delta I$) for taking the effort to recruit others. The informed passenger was stimulated by the carpool strategy rather than the special cab strategy because of $P_C / 2 + \beta \Delta I \leq P_S^*$. The Eq.5 reflected incentive compatibility for the informed passenger. The agent would choose the minimum ΔI that was sufficient to persuade the less-informed one to carpool.

3 THE MODEL OF RRP

RRP, under which the cabdriver activated passengers who have received special cab service to disseminate travel information to other passengers by offering monetary rewards on successful referrals. In the following part, we illustrated four characters of RRP.

- The interpersonal interaction happened after informed passengers have received cab service, namely in the post-service period;
- Occurrence of recommendation was uncertain which depended on informed passengers' cab service experience;
- On a successful referral, the informed ones who was satisfied with the cab service was compensated by offering rewards, but other passengers who unwilling to recommend travel information payed the high price, P_S^* ;

- The satisfactory cab service increased informed passengers' willing to make a referral, so comparatively lowered the compensation needs the cabdriver offered them to motivate the behavior. The cabdriver could exploit passenger's satisfaction because referral occurred after the cab service.

We assumed that satisfied passengers ascended and dissatisfied passengers descended their valuation in the post-service period. Let U denote the informed passenger's valuation in the post-period. Assumed that the passenger has a probability of $q \in [0,1]$ to be satisfied and increased his valuation by ε while a probability of $1-q$ to be dissatisfied and decreased his valuation by ε' in the post-period. Thus, the post-period evaluation was showed as

$$U = \begin{cases} P_0 + \alpha I + \varepsilon & q \\ P_0 + \alpha I - \varepsilon' & 1-q \end{cases}, \varepsilon > 0, \varepsilon' > 0 \quad (6)$$

We assumed that pre-service valuation was equal to the price of special cab strategy. In the post-service evaluation, the deviation ε and ε' described the impact of cab service quality and passenger's experience, where ε represented positive impact for satisfied passengers and ε' represented negative impact for dissatisfied passengers. The two-sides impact was asymmetric.

We made the following key assumptions on the passenger decision process under RPPs.

Assumption 1(The acceptance of cab service decision) The informed passenger would receive cab service when the individual travel price was not higher than the expected utility in the pre-service period, namely the optimal price of special cab strategy.

Assumption 2(The referral decision) The informed passenger would recommend travel information to less-informed passengers if the post-service utility was higher than pre-service utility (satisfied passenger), and the expected surplus from cab service was not negative.

The model of the RPP was described in Eq.7-Eq.9 in terms of cabdriver's optimal solution to maximize his expected earnings.

$$\max_{P_R, R, \Delta I_R} E[\pi_R] = P_R + q(P_R - R) \quad (7)$$

$$\text{s.t. } P_0 + \alpha I + \varepsilon - (P_R + \beta \Delta I_R - R) \geq 0, R \geq 0 \quad (8)$$

$$P_0 + \alpha \Delta I_R - P_R = 0, 0 \leq \Delta I_R \leq I \quad (9)$$

In the Eq.7, P_R denoted individual cab service price for the informed passenger, R denoted referral rewards, qP_R denoted the expected bonus to cabdriver from the ISPs if the cabdriver was successfully recommended to less-informed passengers, and qR represented the expected compensations to the informed passenger from the cabdriver on a successful RRP. Based on Assumption 2, the informed passenger took into consideration his cab service experience and consumption surplus in deciding whether to make a referral. So the Eq.8 was the condition for a satisfied informed passenger to make a successful referral, where the item $P_S^* + \varepsilon$ represented post-service valuation for the informed passenger, the item $P_R - R + \beta \Delta I_R$ represented actual payment for the informed passenger in which R denoted referral rewards from the cabdriver and $\beta \Delta I_R$ denoted the cost of dissemination information for recruiting, and the decision whether to make a referral was that the former item's value was no less than the latter item's value (consumption surplus). The Eq.9 illustrated that informed passenger exchanged information with the less-informed one to ensure him accept the cab service, where ΔI_R represented the information exchange level under the RPP. The Eq.9 ensured that the reward was sufficient to compensate the sale agent for recruiting new passengers. In addition, based on Assumption 1, we noted that the decision whether informed passenger accepted the cab service in the pre-service period should be under the condition of $P_S^* \geq P_R$. However, this condition was buried in the Eq.8-Eq.9. The referral process was introduced as follows, (a) If $P_0 + \alpha I \geq P_R$, then informed passenger accepted special cab strategy and moved to step(b), else quit out; (b) If $U = P_0 + \alpha I$, then informed passenger satisfied cab service and moved to step(c), else quit out; (c) If $U - (P_R - R + \beta \Delta I_R) \geq 0$, then informed passenger recommended the cabdriver to less-informed passengers and moved to step (d); (d) If $P_0 + \alpha \Delta I_R - P_R \geq 0$, then novice passenger accepted the recommendation, else quit out.

We solved the above model and showed the optimal solution in Lemma 1.

Lemma 1. Under the RRP, the service provider managed referral to cabdrivers and passengers by three heterogeneity mechanisms, shown as follows.

TABLE 1 THREE REFERRAL MECHANISMS OF THE RRP

Referral Mechanisms	Conditions	Price Cut	Referral Rewards	Expected Earning $E[\pi_R^*]$
Self-Activated	$0 \leq \beta \leq \beta_1$	0	0	$(1+q)P_R^* - C$
Rewards-Activated	$\beta_1 < \beta \leq \beta_2$	0	$\beta I - \varepsilon$	$(1+q)P_R^* - q(\beta I - \varepsilon)$
Price Cut-Activated	$\beta > \beta_2$	$\alpha(\beta I - \varepsilon)/(\alpha + \beta)$	0	$(1+q)P_R^* - \alpha(1+q)(\beta I - \varepsilon)/(\alpha + \beta)$

Lemma 1 introduced how information exchange inefficiency affected the superiority of each mechanism relative to others.

- A Self-Activated mechanism which offered neither price cut nor referral reward, $\Delta P_R = 0$, $R^* = 0$, was optimal when information exchange was really efficient, $0 \leq \beta \leq \beta_1$. In this case, referral occurred as a spontaneous process only by message rather than bonus;
- A Rewards-Activated mechanism which offered referral rewards only, $\Delta P_R = 0$, $R^* > 0$, was optimal when information exchange efficiency was in the mid-range, $\beta_1 < \beta \leq \beta_2$;
- A Price Cut-Activated mechanism which offered price cut rather than referral rewards, $\Delta P_R > 0$, $R^* = 0$, was optimal when information exchange was really inefficient, $\beta > \beta_2$. In this case, a lower cab service price did not only led to a higher level of consumption surplus which compensated the informed one for the referral behavior but also descended the effort level from the informed one to make a successful referral, and the latter consideration was dominating. So when the β was very low, the cabdriver was better off choosing the Price Cut-Activated mechanism over the Rewards-Activated mechanism to appease the difficulty of referral.

Compared the cabdriver's earnings of the three online cab service strategies, the conditions under which one dominated the other were summarized in Proposition 1.

TABLE 2 COMPARISON

Optimal Strategy	Conditions	
	Information inefficiency	Optimal price of less-informed passenger
Carpool	$\beta < \beta_0$	
	$\beta_0 \leq \beta \leq \beta_1$	$P_0 > \tilde{P}_0'$
	$\beta \geq \beta_1$	$P_0 > \tilde{P}_0''$
Referral Rewards	$\beta_0 \leq \beta \leq \beta_1$	$P_0 \leq \tilde{P}_0'$
	$\beta \geq \beta_1$	$P_0 \leq \tilde{P}_0''$

Proposition 1(Comparison of the RRP). (a)When information exchange insufficiency was low enough, $\beta < \bar{\beta}$, the cabdriver should pay more attention on the carpool strategy and the RRP than the special cab strategy on account of higher earning on the former two; (b)When (a) held, the optimal strategy was determined by the two factors, which was the information exchange inefficiency and the optimal price of less-informed passenger, showed in the Table 2.

Proposition 1(a) illustrated a key condition for earning more monetary of any strategy, which kept high information exchange efficiency. As information technology advanced, the social interaction schemes became more attractive than individual transaction schemes for cabdrivers to exploit these information exchange influences.

Proposition 1(b) illustrated conditions under which each social interaction mechanism dominated the other, which were vividly described in Figure 1. The optimal social interaction mechanism was jointly determined by two dimensions, β and P_0 .

First, when information exchange was really efficient, $\beta < \beta_0$, carpool strategy dominated all three RRP mechanisms. For the explanation, the cabdriver saw a greater opportunity in using social interaction to expand the market and it was better

off by accepting carpool strategy to ensure the market expansion at a certain cost. However, somebody said that self-motivated RRP made social interaction without generating cost for the cabdriver, so it was better than carpool strategy. But based on the assumption, this type of social interaction was a kind of probabilistic not necessary behavior for informed passengers, so the cabdriver should avoid the unpredictable risks. In general, information exchange efficiency would descend the cost disadvantage of carpool strategy and made it more attractive than the RRP.

Second, when information exchange efficiency was in the mid-range, $\beta_0 \leq \beta \leq \beta_1$, the relative advantage of carpool strategy over RRP depended on the value of less-informed passengers reachable through social interaction, P_0 . Carpool strategy dominated when P_0 was large enough. For the reason, compared with RRP, carpool strategy was advantageous in making a larger size of social interactions, but disadvantageous in exploiting passenger's satisfaction and discriminating against less-informed passengers. When less-informed passenger's willingness to join the carpool group was high enough, it made more earning to take the less-efficient scheme, carpool strategy, because the value of the less-informed passengers would ascend the size advantage of carpool and made it more attractive. In contrast, when P_0 became lower, the efficiency disadvantage of carpool strategy dominated its size advantage, and the cabdriver made more earning by adopting the more efficient RRP.

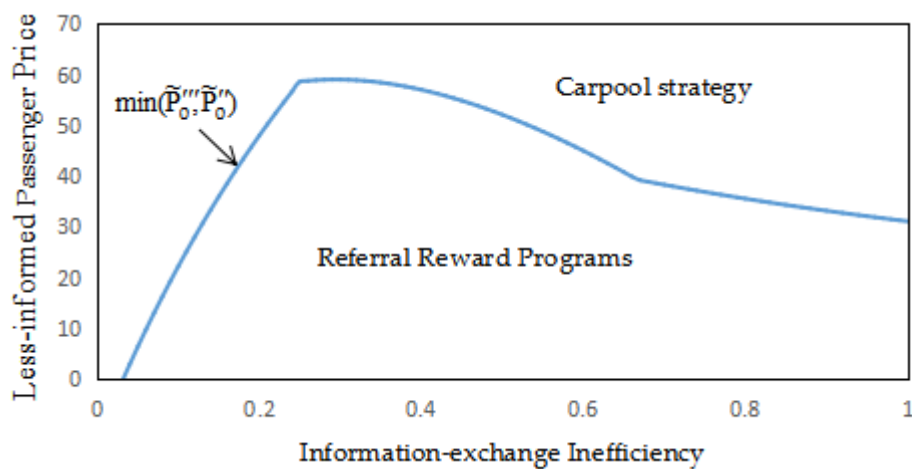


FIG. 1 REFERRAL REWARD PROGRAMS VS. CARPOOL STRATEGY ($\alpha=0.6, I=20, \varepsilon=5, q=0.9$)

Third, as the value of β ascended, the relative attraction between the two social interaction mechanisms fluctuated. For the carpool strategy, the relative attraction first descended and then ascended with β . For the explanation, RRP were implemented by different mechanisms as β changed. When information exchange efficiency in the mid-range, $\beta_0 \leq \beta \leq \beta_1$, the cabdriver would like to free referral through self-motivated mechanism under the RRP but had to compensate information dissemination through a price discount. As information exchange became less efficient, β ascended in the interval of $[\beta_0, \beta_1]$, the compensation under carpool strategy ascended, and carpool became less attractive. As the information exchange efficiency further descended, $\beta \geq \beta_1$, the attraction of carpool strategy ascended. For the reason, the cabdriver was able to exploit passenger satisfaction and to distinct the informed satisfied passenger from the less-informed passenger under the RRP, which led to a higher price (the price of special cab strategy) for less-informed passenger. The high price for less-informed passengers ascended the cost of attaining a successful referral, and this advantage became dominating when the information exchange efficiency was low enough, $\beta \geq \beta_1$.

4 CONCLUSIONS

The paper put forward a Referral Reward Program model via social interaction mechanism on the cab service market. Our effort provided a few valuable perspectives and guidelines, which were hoped to be useful for realizing referral reward on online cab service commercially in the related ISPs. In specification, First, we discussed the impact of two crucial factors, information gap and information dissemination inefficiency, on the travel price and cabdrivers' earning. Second, we made a comparison under which conditions satisfied, referral reward program dominated other two online cab strategies which were universal on the cab service market. The discussion made enlightenment for those ISPs which designed cab-hailing apps. First, we designed a RRP mechanism which customized a possible situation to advocate themselves and expand the

market as a commercial mode for those ISPs' reference. Second, when the ISPs designed the cab-hailing apps, they should measure all parameters by market investigation and operational practice, made full exploitation of the first-hand original data and the pricing methods to calculate the dominating strategy in the distinctive conditions, which was beneficial for them to find out right market orientation and to elaborate right strategic decision in designing market strategies embodied in pricing models of the cab-hailing apps.

APPENDIX

Proof of Lemma 1.

Based on Eq.9, we had $P_R = P_0 + \alpha\Delta I_R$. Substituting P_R into the model of RRP, which became $\max_{R, \Delta I_R} E[\pi_R] = (1+q)(P_0 + \alpha\Delta I_R) - qR$, s.t. $\alpha I + \varepsilon + R - (\alpha + \beta)\Delta I_R \geq 0$, $0 \leq \Delta I_R \leq I$ and $R \geq 0$. The solution showed three situations:

- When $0 \leq \beta \leq \beta_1 = \varepsilon/I$, cabdriver selected the highest information exchange level $\Delta I_R^* = I$ and offered no referral rewards $R^* = 0$. The optimal price was $P_R^* = P_0 + \alpha I$ and the cabdriver's maximum expected earning was $E[\pi_R] = (1+q)(P_0 + \alpha I)$.
- When $\beta > \beta_1$, cabdriver descend agent's effort level, so he made price cut selecting $\Delta I_R^* < I$ and offered referral rewards $R > 0$. We discussed how the cabdriver's earning fluctuated as the ΔI_R ascended from 0. When $\Delta I_R < (\alpha I + \varepsilon)/(\alpha + \beta)$, the constraint Eq.9 satisfied $R = 0$. Thus, the cabdriver's earning $E[\pi_R] = (1+q)(P_0 + \alpha\Delta I_R)$ ascended with ΔI_R . As ΔI_R surpassed $(\alpha I + \varepsilon)/(\alpha + \beta)$, the cabdriver had to offer rewards $R = (\alpha + \beta)\Delta I_R - \alpha I - \varepsilon > 0$ for the constraint Eq.9. Substituting R into the target function, we got $E[\pi_R] = (1+q)P_0 + q\alpha I + q\varepsilon + (\alpha - q\beta)\Delta I_R$.

Thus, we derived two other situations.

- When $\beta \leq \beta_2 = \alpha/q$, the cabdriver's earning would continue to ascend with ΔI_R . Thus, the cabdriver's optimal decision was to select the highest information exchange level $\Delta I_R^* = I$. So, we got $P_R^* = P_0 + \alpha I$, $R^* = \beta I - \varepsilon$, and $E[\pi_R] = (1+q)(P_0 + \alpha I) - q(\beta I - \varepsilon)$.
- When $\beta > \beta_2$, the cabdriver's earning would continue to descend with ΔI_R when $\Delta I_R > (\alpha I + \varepsilon)/(\alpha + \beta)$. Thus, the cabdriver should make $\Delta I_R^* < I$, and we got $P_R^* = P_0 + \alpha(\alpha I + \varepsilon)/(\alpha + \beta)$, $R^* = 0$, and $E[\pi_R] = (1+q)[P_0 + \alpha(\alpha I + \varepsilon)/(\alpha + \beta)]$.

Proof of Proposition 1.

1) RRP vs. Special Cab strategy.

$$E[\pi_R^*] - E[\pi_S^*] = qP_0 - \max\{-q\alpha I, \min[q(\beta - \alpha)I - q\varepsilon, \alpha(\beta I - q\alpha I - \varepsilon - q\varepsilon)/(\alpha + \beta)]\}.$$

$$\text{So } E[\pi_R^*] > E[\pi_S^*] \text{ if } \beta < \max[\varepsilon/I + \alpha, \alpha q + \varepsilon(1+q)/I]; E[\pi_R^*] < E[\pi_S^*] \text{ if}$$

$$P_0 < \tilde{P}_0 = \min\{(\beta - \alpha)I - \varepsilon, \alpha(\beta I - \alpha q I - \varepsilon - q\varepsilon)/[q(\alpha + \beta)]\}.$$

2) Carpool strategy vs. Special Cab strategy.

$$E[\pi_C^*] - E[\pi_S^*] = P_0 + \alpha(\alpha - \beta)I/(\alpha + \beta). \text{ So } E[\pi_C^*] > E[\pi_S^*] \text{ if } \beta < \alpha; E[\pi_C^*] < E[\pi_S^*] \text{ if } P_0 < \tilde{P}_0' = (\beta - \alpha)\alpha I/(\alpha + \beta).$$

Considering (1)-(2), we summarized Proposition 1(a), if $\beta < \bar{\beta} = \max[\varepsilon/I + \alpha, \alpha q + \varepsilon(1+q)/I]$, Special Cab strategy couldn't dominate the other two online cab service strategies.

3) Carpool strategy vs. RRP.

$$E[\pi_C^*] - E[\pi_R^*] = (1-q)V_0 + \alpha I(\alpha - q\alpha - \beta - q\beta)/(\alpha + \beta) + \max[0, \min[q(\beta I - \varepsilon), \alpha(1+q)(\beta I - \varepsilon)/(\alpha + \beta)]]$$

$$E[\pi_C^*] > E[\pi_R^*] \text{ in either of the three cases } \textcircled{1} \beta < \beta_0 = \alpha(1-q)/(1+q), \text{ or } \textcircled{2} \beta_0 \leq \beta \leq \beta_1 = \varepsilon/I,$$

$$P_0 > \tilde{P}_0'' = \alpha I[(1+q)\beta - (1-q)\alpha]/[(1-q)(\alpha + \beta)], \text{ or } \textcircled{3} \beta > \beta_1, P_0 > \tilde{P}_0''' =$$

$$\{\alpha I[(1+q)\beta - (1-q)\alpha]/(\alpha + \beta) - \min[q(\beta I - \varepsilon), \alpha(1+q)(\beta I - \varepsilon)/(\alpha + \beta)]\}/(1-q)$$

$$E[\pi_C^*] < E[\pi_R^*] \text{ in either of the two cases } \textcircled{1} \beta_0 \leq \beta \leq \beta_1, P_0 < \tilde{P}_0'' \text{ or } \textcircled{2} \beta > \beta_1, P_0 < \tilde{P}_0''' .$$

REFERENCES

- [1] Eyal Biyalogorsky, Eitan Gerstner and Barak Libai, "Customer Referral Management: Optimal Reward Programs". Marketing Science 20 (2001): 82–95.
- [2] Ping Xiao, Christopher S. Tangb and Jochen Wirtz, "Optimizing Referral Reward Programs Under Impression Management Considerations". European Journal of Operation Research 215 (2011): 730–739.
- [3] Liyin Jin, Yunhui Huang, "When Giving Money Does Not Work: The Differential Effects of Monetary Versus In-kind Rewards in Referral Reward Programs". International Journal of Research in Marketing 31 (2014): 107–116.
- [4] Dan Zhou, Zhong Yao, "Optimal Referral Reward Considering Customer's Budget Constraint". Future Internet 7 (2015): 516-529.
- [5] Madlen Kuester, Martin Benkenstein, "Turning Dissatisfied into Satisfied Customers: How Referral Reward Programs Affect the Referrer's Attitude and Loyalty Toward the Recommended Service Provider". Journal of Retailing and Consumer Services 21 (2014): 897–904.
- [6] V. Kumar, J. Andrew Petersen and Robert P. Leone, "How Valuable Is Word of Mouth?". Harvard Business Review 85 (2007): 185–196.
- [7] Xiaqing Jing and Jinhong Xie, "Group Buying: A New Mechanism for Selling Through Social Interactions". Management Science 57 (2011): 1354-1372.
- [8] Chia-Lee Fan, Yi-Liang Su, Sue-Ting Chang and Day-Yang Liu, "Exploring How Referral Reward Program Design Affects Consumer Intent to Purchase from a Recipient Perspective". International Journal of Business & Management 9 (2014): 21-30.
- [9] John R. Schroeter, "A Model of Taxi Driver under Fare Structure and Fleet Size Regulation". The Bell Journal of Economics 14 (1983): 81-96.
- [10] Shih-Fen Cheng, Xin Qu, "A Service Choice Model for Optimizing Taxi Service Delivery". Published in: 12th International IEEE Conference on Intelligent Transportation Systems, St. Louis, USA, October 4-7, 2009, pp. 66-71.
- [11] Information on <http://www.carpoolglobal.com>.
- [12] Information on <http://www.shareyourride.net>.
- [13] Shih-Chia Huang, Ming-Kai Jiau and Chih-Hsiang Lin, "Optimization of the Carpool Service Problem via a Fuzzy-Controlled Genetic Algorithm". IEEE Transactions on Fuzzy Systems 23 (2015): 1698-1712.
- [14] Yan Huang, Jason W. Powell, "Detecting regions of disequilibrium in taxi services under uncertainty", in: SIGSPATIAL, Proceedings of the 20th International Conference on Advances in Geographic Information Systems, 2012, pp. 139-148.

AUTHORS



¹**Feng Ouyang** (1961-), male, han nationality, professor, research direction: management information system and E-business.

E-mail: yangfeng@stu.edu.cn

²**Jing Zeng** (1992-), male, han nationality, Ph.D. student, research direction: management science and engineering.

E-mail: 14jzeng1@alumni.stu.edu.cn