Groupon and Groupon Now : participating firm' s profitability analysis

Ong, Jenn-Bing; Ng, Wee Keong; Vorobev, Artem; Ho, Thanh-Nghia

2017

Ong, J.-B., Ng, W. K., Vorobev, A., & Ho, T.-N. (2019). Groupon and Groupon now :
participating firm' s profitability analysis. *Computational Economics*, 53(2), 617-632.
doi:10.1007/s10614-017-9736-y

<https://hdl.handle.net/10356/143180>

<https://doi.org/10.1007/s10614-017-9736-y>

© 2019 Springer Science+Business Media. This is a post-peer-review, pre-copyedit version
of an article published in *Computational Economics*. The final authenticated version is
available online at: <http://dx.doi.org/10.1007/s10614-017-9736-y>

Downloaded on 26 Apr 2023 15:46:11 SGT

Groupon Versus Flashon: A Profitability Analysis

JENN-BING ONG and WEE-KEONG NG, Nanyang Technological University

ARTEM VOROBEOV, Tyumen State University

THANH-NGHIA HO, Nanyang Technological University

Author's address: W. K. Ng, Computer Science and Engineering, Nanyang Technological University, Singapore; email: wkn@pmail.ntu.edu.sg.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage, and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s). Copyright is held by the author/owner(s).

EC'16, July 24–28, 2016, Maastricht, The Netherlands.

ACM 978-1-4503-3936-0/16/07.

<http://dx.doi.org/10.1145/XXXXXXX.XXXXXXX>

The business model of Groupon has been categorized by many to be a case of daily deals or discount offerings to consumers. It is static (not responsive to business fluctuations and demands) and operates in batch mode (period-based availability). A new business model called “Flashon” is proposed to be distinct from Groupon in that Flashon is dynamic and real-time. This model is more responsive to business fluctuations—firms may choose to offer deals during business downtime and likewise withhold deals during business uptime. As and when deals are offered by firms, consumers receive deal notifications real-time. A time-continuum model for profitability analysis based on the two-period Groupon model developed by [Edelman et al. 2014] is introduced for systematic comparison of the profitability between Flashon, Groupon, and firm normal operations without offering discount vouchers. Simple case studies of the customer-demand fluctuations of different business cycles show consistent results that the Flashon model is more profitable than the Groupon model, which are both superior to the firm normal operations without offering any discount vouchers. This is given that the consumers are generally interested in purchasing the firm products or services and can be easily stimulated with attractive incentives such as the discount vouchers. The profitability analysis also provides quantitative proof that offering high discount rates or even free products or services with added values to small target fraction of the population may attract more consumers and hence generate high profit for participating firms with high popularity among the consumers.

CCS Concepts: •**Information systems**→ **Online shopping**; E-commerce infrastructure; •**Computing methodologies**→ *Modeling methodologies*;

Additional Key Words and Phrases: Voucher discounts, Groupon, Flashon, experience goods, repeat purchase, profitability analysis, value proposition, customer heterogeneity

1. INTRODUCTION

Being found in 2008, Groupon brings coupon deals online where local merchants have a chance to improve their profitability using a combination of price discrimination service to attract customers with lower valuation, promotional service to target different market segments, and prepayment service to start or expand firms’ operations [Arabshahi 2011]. Merchants benefit from Groupon transactions because of a large in-

flux of customers in the short-term and repeat customers or referrals in the long-term. Groupon assures the customers the firms' products or services quality by promising refund of any online purchases. Essentially, Groupon functions as an arbitrage platform without carrying the risks to accumulate inventory or assume the firm obligations. The firm revenue from the original customers is protected by continually showing them the original price, additional revenue is generated from the price-sensitive customers who would otherwise stay away provided that the vouchers' revenue is higher than the marginal cost of the products or services [Arabshahi 2011]. An in-depth analysis of the Social, Legal, Economic, Political, Technological, Ecological / Environmental, and Competitive (SLEPTEC) aspects of the Groupon business model is provided by [Ayodeji et al. 2015]. Having the first-mover advantage, Groupon continues to expand and improve their service globally by leveraging the social media and internet technology, and personalised the deal recommendations based on factors such as the locations and price-sensitivity. However, after retailers' euphoria of using such service, some crucial drawbacks are revealed. Not only the Groupon commission rates were incredibly high for retailers (up to 50% of the discounted price) for ironically so-called price discrimination service, but also the redemption issue, where the overwhelming demands at redemption centres frustrate the coupon holders and creates negative impression that may eventually affect future buying decisions, this suggests that the merchant capabilities to fulfill the redemption must be considered before any deals are marketed [Ayodeji et al. 2015]. We henceforth propose an online voucher-service solution that is responsive to the business fluctuations and consumer demand, in contrast to Groupon model that is static and deals availability are period-based. The main contributions of this work can be summarized as follows.

— A Flashon model that is dynamic and provides real-time deal notifications is proposed to be distinct from the Groupon model. Flashon voucher-service may help to

ease the overwhelming demands at redemption centres because firms can choose to offer deals during business downtime and withdraw deals during business uptime. Flashon reduces the effects of novelty decay [Ye et al. 2012] by providing real-time deal notifications which lasts for limited duration and simultaneously is more responsive to business fluctuations such as the change of price and marginal cost of the firms' products or services.

- A time-continuum model based on the two-period Groupon model developed by [Edelman et al. 2014] is introduced for profitability analysis of firm subject to business fluctuations and consumers demand.
- Profitability analysis of Flashon model, Groupon model, and firm normal operations without offering discount vouchers is performed for different business cycles.
- A model is proposed to simulate the advertising and social effects of firm ratings on firm profit.
- A model of temporary increase of consumers return probability is proposed to simulate the word-of-mouth benefits of offering discount vouchers, wherein voucher-users tell their friends who then purchase from the firm.

The organization of this paper is as follows. Literature survey of related work is given in Section 2. Section 3 introduces a time-continuum model based on the two-period Groupon model developed by [Edelman et al. 2014] for systematic comparison of the profitability between Flashon, Groupon, and firm normal operations without offering discount vouchers. Section 4 summarizes the model parameters configuration and the business cycles used for the case studies. The results and discussion are included in the same section. Section 5 provides the conclusions and future work of this study.

2. RELATED WORK

The recent proliferation of online discount vouchers has garnered some significant academic literatures. [Edelman et al. 2014] has reviewed the related literature up to early 2014. More recent theoretical work include the signalling effect of daily deal promotion [Zhao et al. 2014], auction mechanism design for daily-deal sites' revenue maximization [Chen et al. 2015a], real-time advertisement bidding optimization for firms' revenue maximization [Balakrishnan and Bhatt 2015], information diffusion and sales prediction [Zhou et al. 2013], threshold discounting effects and optimal design [Marinesi et al. 2013; Wu et al. 2015], price competition [Meir et al. 2014], group-buying auctions [Chen and Chung 2015], group recommendation [Lacerda et al. 2015], group formation [Roy et al. 2015], firm optimal strategies for group-buying [Jiang and Deng 2014; Ni et al. 2015], and bundle discounts [Coviello and Franceschetti 2015]. Recent empirical work include relationship between deal size, advertising effect, and firm's revenue [Bai et al. 2015], and factors affecting consumer benefits creation [Chen et al. 2015b; Yeh et al. 2014].

Our work is based on the framework and model developed by [Edelman et al. 2014]. Important conclusions drawn from [Edelman et al. 2014] and references therein are summarized here. Voucher discounts are likely to be profitable if they predominantly attract new customers who regularly return, paying full price for the products and services, but if vouchers provide discounts to many existing customers, vouchers could sharply reduce the firms' profit. To firms, discount vouchers offer opportunities for price discrimination as well as advertising exposure to new customers and online "buzz." For successful price discrimination, the valuation of consumers with access to vouchers must generally be lower than the consumers who do not have access to vouchers (consumer heterogeneity). For the advertising effects to be important, a firm must begin with sufficiently low recognition among prospective customers. Offering

vouchers tends to be more profitable for firms that are patient or relatively unknown as well as firms with low marginal costs. However, it is unclear whether group buying, in which a certain threshold of consumers must agree to purchase before a deal becomes effective, plays a significant role in the Groupon-style voucher model. As the voucher service grows in popularity, the voucher-users gradually resemble the average existing consumers and consequently become less likely to be consumers with systematically lower valuations. Therefore, voucher services must rely more on advertising benefits than price discrimination benefits as the services grow. Ultimately, it is unsure whether a single voucher service can satisfy diverse firm objectives. Some firms seek price discrimination to offer differing prices to consumers with varying willingness to pay, who do not overlap with the firm's existing customers with higher value. Other firms seek advertising services to help make their offerings broadly known to consumers with similar value to their existing customers. The offerings to these groups may well differ: Facilitating price discrimination, a firm accept multiple repeat visits from a low-value consumer, so long as the consumers net payment on each visit exceeds the marginal cost. The advertising vision calls for a single discount, potentially below marginal cost, followed by multiple full-price visits, making it important to limit vouchers to one-per-customer. It is noted that many voucher services have conflated these approaches, to the detriment of both. Long-term success of discount vouchers will require increased clarity of service function, targeting, and pricing.

3. PROFITABILITY ANALYSIS

For systematic comparison between Groupon, Flashon, and firm normal operations without offering discount vouchers, we introduce a time-continuum model based on the two-period Groupon model developed by [Edelman et al. 2014]. Following the model of [Bils 1989], we assume each consumer i has a probability r_i that the firm's product or

service is a “fit.” Conditional on fit, the valuation of consumer i for the firm’s offering is v_i and the consumer has (at most) unit demand every time. Consumer i purchases the firm product or service at time t if the expected valuation is higher than the price

$$r(t)v_i - p \geq 0 \quad (1)$$

where $r(t)$ is the consumer return probability at time t and p is the price of the product or service. As a result, all consumers with value at least

$$v = \frac{p}{r(t)} \quad (2)$$

purchase at time t . Let $G(v_G)$ and $F(v_F)$ be two distinct cumulative distribution functions for populations with different valuation distribution. Assume the consumers in G population access to voucher service with value systematically lower (more price-sensitive) than consumers in F population. Let $r^G(t)$ and $r^F(t)$ be the return probabilities of G and F population respectively, λ be the firm’s proportion of consumers from G population access to voucher service and $(1 - \lambda)$ be the firm’s proportion of consumers from F population. Let the firm’s discount factor be δ^f , the firm faces demand

$$\delta^f r^G \lambda (1 - G(v_G)) + \delta^f r^F (1 - \lambda) (1 - F(v_F)) \quad (3)$$

where $v_G = \frac{p}{r^G(t)}$ and $v_F = \frac{p}{r^F(t)}$. The firm maximizes profit

$$\left(\delta^f r^G \lambda (1 - G(v_G)) + \delta^f r^F (1 - \lambda) (1 - F(v_F)) \right) (p - c) \quad (4)$$

where c is the firm product or service marginal cost. The optimal price p^* is obtained by solving the first-order optimization problem (see Appendix B)

$$\frac{\partial \pi}{\partial p}(p^*) = 0 \quad (5)$$

Assume fraction γ of the G population receives discount vouchers at price αp at time t , consumers with value at least

$$\hat{v}_G = \frac{\alpha p}{r^G(t)} \quad (6)$$

purchase at time t . Assume the firm's offering at price p^* and receive β of the discounted price using the voucher service; i.e., $\alpha\beta p^*$, the resultant firm profit

$$\begin{aligned} \pi_{\gamma,\alpha} = & \gamma\delta^f r^G \lambda(\alpha\beta p^* - c)(1 - G(\hat{v}_G^*)) \\ & + (1 - \gamma)\delta^f r^G \lambda(p^* - c)(1 - G(v_G^*)) + \delta^f r^F (1 - \lambda)(p^* - c)(1 - F(v_F^*)) \end{aligned} \quad (7)$$

The firm may choose to reoptimize the baseline prices to take into account the effects of discount vouchers, the new optimal price p^{**} (see Appendix C) is a solution of

$$\frac{\partial \pi_{\gamma,\alpha}}{\partial p}(p^{**}) = 0 \quad (8)$$

Let ω be the fraction of non-redeemed vouchers at time t , the firm saves the cost of serving the consumers and hence gains an additional profit

$$\pi_\omega = \pi_{\gamma,\alpha} + \omega\gamma\delta^f r^G \lambda c(1 - G(\hat{v}_G^*)) \quad (9)$$

So far, we consider all consumers are aware of the firm and vouchers serve to facilitate price discrimination only. To account for the advertising effect, let fraction κ of the populations know or recall the firm product or service at time t and is uniformly distributed within each population, the firm original profit is decreased by a multiplicative factor κ and the total profit increases by advertising to fraction $(1 - \kappa)$ of G population through the discount vouchers

$$\pi_\kappa = \kappa\pi_{\gamma,\alpha} + (1 - \kappa)\gamma\delta^f r^G \lambda(\alpha\beta p^* - c)(1 - G(\hat{v}_G^*)) \quad (10)$$

Taking account of both non-redeemed vouchers and advertising effect, the resultant firm profit

$$\pi_{\omega,\kappa} = \pi_{\kappa} + \omega\gamma\delta^f r^G \lambda c(1 - G(\hat{v}_G^*)) \quad (11)$$

4. EXPERIMENTAL EVALUATION

4.1. Experimental Setup

The parameters of the time-continuum model introduced in Section 3 are configured here. These parameters can be estimated from the past history of a business for practical purposes.

The value distribution of the populations are modeled by the exponential distribution. Their cumulative distribution functions (cdf) are

$$G = 1 - \exp\left(-\frac{v_G}{V_G}\right) \quad (12)$$

$$F = 1 - \exp\left(-\frac{v_F}{V_F}\right) \quad (13)$$

and the probability distribution functions (pdf) are

$$\frac{\partial G}{\partial v_G} = \frac{1}{V_G} \exp\left(-\frac{v_G}{V_G}\right) \quad (14)$$

$$\frac{\partial F}{\partial v_F} = \frac{1}{V_F} \exp\left(-\frac{v_F}{V_F}\right) \quad (15)$$

where the decay constants $V_F > V_G$ because the valuation of G population is assumed systematically lower (more price sensitive) than the F population (see Section 3). Figure 1 shows the cdf and pdf of two population distributions with different decay constants. The population is dominated by consumers with low valuation followed by an exponential decay at higher value. Higher decay constant implies slower exponential decay. The probability of consumers with negative value are zero.

Fig. 1. Top: population cumulative distribution functions (cdf) and probability distribution functions (pdf), the decay constants in the exponential distribution are 1 (solid lines) and 2 (dashed lines) respectively. Bottom: fraction $\kappa(q)$ of the populations who know or recall the firm product or service (solid lines) and $q(t)$ is the time-dependent consumers average rating in fraction of the highest rating (dashed lines).

Let $q(t)$ be the time-dependent consumers average rating of the firm in fraction of the highest rating, T_κ be the time scale of information spread due to the advertising and social effect when the change of consumers average rating $q(t) - q(t_0) = 1$, fraction κ of the populations recall the firm product or service is modelled by

$$\kappa = \kappa_0(q(t) - q(t_0)) \left(1 - \exp \left(- (q(t) - q(t_0)) \frac{t - t_0}{T_\kappa} \right) \right) + \kappa(t_0; q(t_0)) \quad (16)$$

where $t_0 = \sup \{t' : t' < t, \frac{dq}{dt}(t') \neq 0\}$ and κ_0 is the scaling constant. Figure 1 shows fraction κ with different consumers average rating $q(t)$. The initial surge or plummet of κ due to the change of consumers average rating is modelled by the exponential growth or decay of Equation 16 with time scale $\frac{T_\kappa}{q(t) - q(t_0)}$ and eventually κ saturates at value $\kappa_0 q(t)$.

The return probability of G population, r^G is modelled by a constant value 0.5 because the consumers from G population have neutral interest to the firm's product or service but are willing to purchase whenever attractive incentives such as discount vouchers are offered, whereas the return probability of F population, r^F fluctuates with the business cycles and modelled as in Figure 2. We model the daily cycle by three peak periods during the mealtimes, the weekly cycle by the weekend effect, monthly cycle by the surge at the beginning of the month after payday, and the yearly cycle by the peak period in preparation for the Christmas and New Year celebration. Note that these simplified business cycles are purely hypothetical for our theoretical analyses because the actual business cycles vary with the industries and the context of the region. In practice, these business cycles can be analyzed with the techniques in time-frequency analysis such as the short-time Fourier transform. By computing at the same time resolution, the business cycles can be combined as shown in Figure 3 with the daily cycles at typical weekend computed for the seasonal high, medium, and low.

Additionally, we assume vouchers have word-of-mouth benefits (see footnote of page 7 in [Edelman et al. 2014]) that increase the return probability of both voucher and non-voucher users, the temporary increase of G and F populations return probability are modelled by

$$\Delta r_{temp}^G = r_0^G (1 - r^G) \left(1 - \exp \left(- (\gamma + (1 - \alpha)) \right) \right) \quad (17)$$

$$\Delta r_{temp}^F = r_0^F (1 - r^F) \left(1 - \exp \left(- (\gamma + (1 - \alpha)) \right) \right) \quad (18)$$

where r_0^G and r_0^F are the scaling constants controlling how easily the consumers can be stimulated to purchase the firm product or service by offering incentives such as the

Fig. 2. Hypothetical business cycles of F population with the daily cycle modelled by peak periods during the mealtimes, the weekly cycle by the weekend effect, the monthly cycle by the high at the beginning of the month after payday, and the yearly cycle by the festival preparation for the Christmas and New Year celebration.

discount vouchers. The resultant firm profit

$$\begin{aligned}
 \pi_{\gamma, \alpha} = & \gamma \delta^f \lambda (r^G + \Delta r_{temp}^G) (\alpha \beta p^* - c) (1 - G(\hat{v}_G^*)) \\
 & + (1 - \gamma) \delta^f \lambda (r^G + \Delta r_{temp}^G) (p^* - c) (1 - G(v_G^*)) \\
 & + \delta^f (1 - \lambda) (r^F + \Delta r_{temp}^F) (p^* - c) (1 - F(v_F^*))
 \end{aligned} \tag{19}$$

Given γ , we find the corresponding optimal α^* by solving the first-order optimization problem and vice versa given α (see Equation 20, Equation 21 and Appendix D). Optimization maximizes the firm profit by offering discount vouchers with optimal α^* or γ^* . Other model parameter values are summarized in Table I.

F population return probability, r^F

Fig. 3. The F population return probability with the hypothetical business cycles, as shown in Figure 2, combined at the same time resolution in minute. Daily cycles are computed at typical weekend during seasonal high (top), medium (middle), and low (bottom).

$$\frac{\partial \pi_{\gamma, \alpha}}{\partial \alpha}(\alpha^*) = 0 \quad (20)$$

$$\frac{\partial \pi_{\gamma, \alpha}}{\partial \gamma}(\gamma^*) = 0 \quad (21)$$

4.2. Results and Discussion

The time-varying optimal price $p^*(t)$ for firm normal operations is a solution of the optimization problem in Equation 5. To find a fix-value optimal price p_{fix}^* that maximizes the firm profit, we compute the profit of the optimal prices within the range of the time-varying solutions and search for the one that yields maximum total profit over time. Figure 4 shows the firm normal operations profit over time computed using

Table I. Model parameter values.

Model Parameters	Description	Numerical Values
(V_G, V_F)	Decay constants in the G and F populations exponential distribution respectively	(1, 2)
δ^f	Firm's discount factor	1
λ	Proportion of consumers from G population access to the voucher service	0.7
β	Firm fraction of revenue received using the voucher service	0.8
c	Firm product or service marginal cost	0.2
ω	Fraction of non-redeemed discount vouchers	0.2
q	Consumers average rating in fraction of the highest rating	0.7
κ_0	Scaling constant in κ expression	1
T_κ	Time scale of the information spread thanks to the advertising and social effect	7 days
r^G	Return probability of G population	0.5
(r_0^G, r_0^F)	Maximum fractional increase in return probability of G and F populations respectively thanks to the word-of-mouth benefits of offering discount vouchers	(0.2, 0.2) (0.5, 0.2) (0.8, 0.5)

the fix-value optimal and suboptimal prices. The fix-value optimal price p_{fix}^* yields the maximum profit at all time for all business cycles compared to the suboptimal prices.

To further improve the profit margin, the firm may offer discount vouchers to attract consumers from the G population with lower valuation. The model parameters r_0^G and r_0^F that characterize how easily the G and F population consumers can be stimulated to purchase the firm product or service by offering incentives such as discount vouchers are set as 0.5 and 0.2 respectively. Given a target fraction γ of the G population purchasing the discount vouchers, we compute the time-varying optimal $\alpha^*(t)$ (1-discount rate) by solving the optimization problem in Equation 20. Such time-varying solutions may not be practical because firms usually offer fix discount rate or fix discounted price for their products or services. Similar to the approach of finding the fix-value optimal

Fig. 4. The optimal price $p_{fix}^* \approx 0.69$ yields the maximum normal operations profit as shown in solid lines. The dashed and dotted lines are profits computed using the suboptimal prices $p = 0.60$ and 0.80 respectively.

price p_{fix}^* , we search the range of solutions of the time-varying optimal $\alpha^*(t)$ to locate a fix-value optimal α_{fix}^* that yields the maximum total profit over time. Using α_{fix}^* , we then compute the time-varying optimal target fraction $\gamma^*(t)$ by solving the optimization problem in Equation 21. Figure 5 shows the results of optimal $\alpha^*(t)$, α_{fix}^* , and $\gamma^*(t)$. $\alpha^*(t)$ is lower during the peak periods for all business cycles, which means higher discount rates to be offered. With slight differences ($< 5\%$) of the α_{fix}^* between the different business cycles, the resultant $\gamma^*(t)$ shows large differences ($> 100\%$) especially if comparison made between the peaks of different business cycles. This suggests the intricate structures of the phase space, which is sensitive to slight perturbations. For all business cycles, $\gamma^*(t)$ is higher during the peak period that implies more discount vouchers should be offered by the firm during business high time. However, it will be shown later that these results are not universal but subject to the change of model parameter values.

Fig. 5. Dashed lines in red are the time-varying optimal $\alpha^*(t)$ (1-discount rate) given target fraction $\gamma = 0.25$ of G population purchasing the discount vouchers. The solid lines in red are the fix-value optimal α_{fix}^* that yield the maximum total profit over time selected from the range of $\alpha^*(t)$ values. The solid lines in blue are the time-varying optimal $\gamma^*(t)$ computed using α_{fix}^* in the optimization.

Figure 6 and 7 show the profit time series for firm offering fix-value optimal α_{fix}^* (1-discount rate) with target fraction $\gamma = 0.25$ and time-varying optimal $\gamma^*(t)$ respectively. To prove that the optimization improves the profit margin, comparison is made between the profit time series of optimal and suboptimal values. The results show that the optimal values yield the maximum profit at all time for all business cycles. Figure 8 compares the firm normal operations profit π , profit with discount vouchers offered at fix-value optimal α_{fix}^* and target fraction $\gamma = 0.25$, $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$, and time-varying optimal $\gamma^*(t)$, $\pi_{\gamma, \alpha}(\gamma^*(t))$. $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$ is used to simulate the profit time series of a Groupon model, which offers fix discounted price for a period of time ranges from a day to a week, whereas $\pi_{\gamma, \alpha}(\gamma^*(t))$ is used to simulate the profit time series of a Flashon model, which offers fix discounted price with real-time target fraction $\gamma^*(t)$ of G population to

Fig. 6. Given a target fraction $\gamma = 0.25$ of G population purchasing the discount vouchers, the corresponding fix-value optimal $\alpha_{fix}^* = 0.52 \pm 0.01$ (1-discount rate) yields the maximum profit at all time for all business cycles compared to the suboptimal α values at 0.7 (dashed lines) and 0.3 (dotted lines).

purchase the discount vouchers. Firms may offer or withhold deals to target consumers subject to factors such as improvement in the profit margin and consumers interest. The results show that $\pi_{\gamma, \alpha}(\gamma^*(t))$ (Flashon) $>$ $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$ (Groupon) $>$ π (firm normal operations) at all time for all business cycles, which suggests Flashon model is more profitable compared to the Groupon model and firm normal operations without offering discount vouchers.

For non-redeemed discount vouchers, firm saves the cost of the product or service to the consumers. Let the fraction of non-redeemed discount vouchers $\omega = 0.2$ and using Equation 9 to compute the resultant firm profit, π_{ω} , the results in Figure 9 show that there is slight improvement in profit margin because of the low firm's marginal cost $c = 0.2$. Assume the firm is new to the consumers with average consumers rating $q = 0.7$, we model the fraction κ of the populations who know or recall the firm product or

Fig. 7. Given the $\alpha_{fix}^* = 0.52 \pm 0.01$ (1-discount rate), the corresponding time-varying optimal $\gamma^*(t) < 0.04$ yields the maximum profit compared to the suboptimal γ values at 0.1 (dashed lines) and 0.2 (dotted lines).

service using Equation 16 and the resultant firm profit, π_{κ} , using Equation 10. Assume the time scale of the advertising and social effect, $T_{\kappa} = 7 \text{ days}$, the effects on the profit margin is large at the beginning of the firm operations and slowly approaching $0.7\pi_{\gamma, \alpha}$ after weeks. Considering both fractions ω and κ , the resultant firm profit $\pi_{\omega, \kappa}$ is computed using Equation 11. $\pi_{\omega, \kappa}$ does not vary too much from π_{κ} because the effect of non-redeemed discount vouchers on the profit margin is small as mentioned before.

We have observed that the $\gamma^*(t)$ is sensitive to the choice of α_{fix}^* used in the optimization. Figure 10 shows the profit $\pi_{\gamma, \alpha}$ contour projected on the γ and α values to illustrate this point. The plots differ in the values of r^F, r_0^G , and r_0^F where r^F is the F population return probability, r_0^G and r_0^F are the parameters that control how easily the consumers can be stimulated to purchase the firm product or service by offering incentives such as the discount vouchers for G and F population respectively. Higher

Fig. 8. The firm profit for normal operations π (black), profit with discount vouchers offered at fix-value optimal α_{fix}^* (1-discount rates) given the target fraction $\gamma = 0.25$, $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$ (red), and profit with discount vouchers offered at time-varying optimal $\gamma^*(t)$ given α_{fix}^* , $\pi_{\gamma, \alpha}(\gamma^*(t))$ (blue). Note that $\pi_{\gamma, \alpha}(\gamma^*(t))$ (Flashon) $>$ $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$ (Groupon) $>$ π (firm normal operations without offering discount vouchers) at all time for all business cycles.

r_0^G and r_0^F mean that the consumers are generally interested in the firm product or service and can be easily stimulated to purchase. Notice that there are more contour lines perpendicular to the γ axis in the region $\alpha \leq 0.5$ and $\gamma \leq 0.3$, which implies higher variation in firm profit with small changes in γ values. On the other hand, the structure is less intricate for $\alpha > 0.5$ with less contour lines and hence less variation in the profit subject to changes in γ or α values. The firm may still improve their profit margin with negative α at low target fraction γ values, that is to provide limited free products or services with added values to consumers to increase their return probability as well as their loyalty to the firm. To our surprise, the highest profit is observed in the region $\alpha < 0$ denoted as red crosses in Figure 10. Higher r^F , r_0^G , and r_0^F in-

Fig. 9. Firm profit with discount vouchers offered, $\pi_{\gamma, \alpha}$ (blue solid lines), profit taking account fraction ω of the non-redeemed discount vouchers, π_{ω} (cyan dashed lines), profit taking account fraction κ of the populations who know or recall the firm product or service, π_{κ} (deep blue solid lines), and profit taking account both fractions ω and κ , $\pi_{\omega, \kappa}$ (deep cyan dashed lines). Note that the effect of non-redeemed vouchers is minimal because the marginal cost $c = 0.2$ and fraction $\omega = 0.2$ are small.

crease the profitability of the firm in general. However, offering high target fraction γ at high discount rate or low α will definitely hurt the firm profitability as observed by the negative profit in the region.

Here, we analyze the firm profitability over a typical weekend during the seasonal high, medium, and low as shown by the fluctuation of the F population return probability in Figure 3. Similar to the analyses before, we first compute the firm normal operations fix-value optimal price p_{fix}^* and profit without offering any discount vouchers. We then compute the time-varying and fix-value optimal α^* (1-discount rate) given a target fraction $\gamma = 0.2$ of the G population purchasing the discount vouchers offered by the firm, and the time-varying optimal $\gamma^*(t)$ is computed using the fix-value opti-

Firm profit $\pi_{\gamma, \alpha}$ contour, y-axis: γ , x-axis: α

Fig. 10. Contour plot of the firm profit with discount vouchers offered, $\pi_{\gamma, \alpha}$. The y-axis is γ , target fraction of G population consumers purchasing the discount vouchers. The x-axis is α , 1-discount rate of the firm product or service. The red crosses denote the positions of the maximum profit in each contour plots. The plots differ by the F population return probability, r^F , and the parameters controlling how easily the G and F populations can be stimulated in purchasing by offering discount vouchers, r_0^G and r_0^F respectively.

mal α_{fix}^* in the optimization to maximize the firm profit. Figure 11 shows the results of $\alpha^*(t)$, α_{fix}^* , and $\gamma^*(t)$. The F population return probability has little influence on the optimal α^* , but higher r_0^G and r_0^F increase the discount rate results in lower optimal α^* . Apart from falling within the range of values $\gamma^* \lesssim 0.12$, $\gamma^*(t)$ does not show consistent patterns or trends and sensitive to the changes of model parameters and α_{fix}^* used in the optimization. Figure 12 shows the firm normal operations profit (π), profit with discount vouchers offered at α_{fix}^* and $\gamma = 0.2$ ($\pi_{\gamma,\alpha}(\alpha_{fix}^*)$), and profit with discount vouchers offered at α_{fix}^* and $\gamma^*(t)$ ($\pi_{\gamma,\alpha}(\gamma^*(t))$). $\pi_{\gamma,\alpha}(\alpha_{fix}^*)$ and $\pi_{\gamma,\alpha}(\gamma^*(t))$ are used to simulate the profit time series of the Groupon and Flashon models respectively. Results show that the Flashon and Groupon models are superior to firm normal operations without offering discount vouchers and may yield profit up to two times the normal operations profit. This is given that the consumers are generally interested in purchasing the firm product or service and can be easily stimulated with attractive incentives such as the discount vouchers. In particular, the Flashon model yields higher profit compared to Groupon model most of the time for all the model parameters configuration.

The assumptions made in the time-continuum model introduced in Section 3 include consumer heterogeneity that the G population access to voucher service with valuation systematically lower than the F population. Additionally, the target fraction γ of the G population purchasing the discount vouchers and fraction κ of the populations who know or recall the firm product or service are assumed uniformly distributed within each population. With limited assumptions made, the time-continuum model is deemed generic and relaxes the limited time constraint of the two-period Groupon model proposed by [Edelman et al. 2014]. In the experimental studies to compare the profitability of Flashon, Groupon, and the firm normal operations without offering discount vouchers, several assumptions have been made which include using the

Optimal α^* (red, left y-axis) and γ^* (blue, right y-axis) over time (min)

Fig. 11. The red solid and dashed lines are the fix-value and time-varying optimal α^* respectively given $\gamma = 0.2$. The fix-value optimal α_{fix}^* is selected from the range of time-varying optimal $\alpha^*(t)$ that maximizes the total profit over time. The time-varying optimal $\gamma^*(t)$ is computed using α_{fix}^* in the optimization. The plots differ in the model parameters r_{peak}^F (seasonal high, medium, or low), r_0^G , and r_0^F where higher r_0^G and r_0^F mean that there is general interest among the consumers to buy the firm product or service and can be easily stimulated with attractive incentives the discount vouchers.

Firm profit π , $\pi_{\gamma, \alpha}(\alpha^*)$, $\pi_{\gamma, \alpha}(\gamma^*)$ over time

Fig. 12. The firm normal operations profit π is shown in black, the profit with discount vouchers offered at fix-value optimal α_{fix}^* (1-discount rate) and target fraction $\gamma = 0.2$, $\pi_{\gamma, \alpha}(\alpha_{fix}^*)$ is shown in red, and the profit with discount vouchers offered at α_{fix}^* and time-varying optimal $\gamma^*(t)$, $\pi_{\gamma, \alpha}(\gamma^*(t))$ is shown in blue. The plots differ in the model parameters r_{peak}^F (seasonal high, medium, or low), r_0^G , and r_0^F . The firm profit at all time increases with higher r_{peak}^F , r_0^G , and r_0^F . Notice that $\pi_{\gamma, \alpha}(\gamma^*(t))$ (Flashon) $\gtrsim \pi_{\gamma, \alpha}(\alpha_{fix}^*)$ (Groupon) $\gtrsim \pi$ (firm normal operations) most of the time and the difference increases with higher r_0^G and r_0^F . Offering discount vouchers may yield profit up to two times the firm normal operations profit.

exponential distribution to model the valuation of G and F populations, model of the temporary increase in the populations return probability Δr_{temp}^G and Δr_{temp}^F thanks to the word-of-mouth benefits of offering discount vouchers, the simplified business cycles, and finally the model for fraction κ as a function of the consumers average rating. However, using $\pi_{\gamma,\alpha}(\alpha_{fix}^*)$ to model the Groupon profitability remains conservative because Groupon offers discount vouchers for a period of time without considering the surge of demand, deals novelty decay, or having optimal target fraction γ of the G population purchasing the discount vouchers to maximize the firm's profit. The Flashon model proposed in this paper has several advantages over Groupon model such as the real-time deal notifications that allow firms to offer or withhold deals subject to the business fluctuations and consumer demands, and target specific group of consumers with limited offers but attractive discount rates at any instance using the results in this study. The Flashon model maximizes the firm profit by offering deep discounts with time-limited target fraction $\gamma \lesssim 0.1$ of G population purchasing the discount vouchers. Because of the sensitivity of optimal γ^* to the change of model parameters, the optimal range of the target fraction is observed from Figure 10, which contains the highest profit for all parameters. By targeting specific groups which may be interested or regular buyers from the firm with the limited discount vouchers, this may increase the consumers loyalty to both the participating firm and voucher-service provider. With subscription to Flashon, consumers may obtain real-time surprised discount while purchasing without prior knowledge of the deals, this may generate intense excitement that enhances the consumers' shopping experience.

5. CONCLUSIONS AND FUTURE WORK

A time-continuum model for profitability analysis based on the two-period Groupon model developed by [Edelman et al. 2014] is introduced for systematic comparison of

the profitability between Flashon, Groupon, and firm normal operations without offering discount vouchers. Simple case studies of the fluctuation in business cycles show consistant results that the Flashon model is more profitable than the Groupon model, which are both superior to the firm normal operations without offering any discount vouchers. This is given that the consumers are generally interested in purchasing the firm products or services and can be easily stimulated with attractive incentives such as offering discount vouchers. The profitability analysis also shows that offering high discount rates or even free products or services with added values to small target fraction of the population may attract more consumers and hence generate higher profit to the participating firm. Future studies may take account of the time variation of other model parameters such as the product or service marginal cost, fraction of non-redeemed vouchers, voucher service cost, and novelty decay of the offerings [Ye et al. 2012]. Multiple firm products or services can be considered in a package by having a joint return probability distribution and addition of individual marginal costs. The firm capacity may put an upper bound on fulfilling the consumer demand at anytime and should be considered in future studies.

APPENDIX

B. PRICE OPTIMIZATION

The optimal price for firm normal operations p^* is a solution of the optimization problem in Equation 5

$$\begin{aligned}
 \frac{\partial \pi}{\partial p}(p^*) &= r^G \lambda (1 - G(v_G^*)) \\
 &\quad + r^F (1 - \lambda) (1 - F(v_F^*)) \\
 &\quad - r^G \lambda (p^* - c) \left[\frac{\partial G}{\partial v_G}(v_G^*) \right] \left[\frac{\partial v_G}{\partial p} \right] \\
 &\quad - r^F (1 - \lambda) (p^* - c) \left[\frac{\partial F}{\partial v_F}(v_F^*) \right] \left[\frac{\partial v_F}{\partial p} \right] \\
 &= 0
 \end{aligned} \tag{22}$$

where $v_G^* = \frac{p^*}{r^G(t)}$, $v_F^* = \frac{p^*}{r^F(t)}$, $\frac{\partial v_G}{\partial p} = \frac{1}{r^G(t)}$, $\frac{\partial v_F}{\partial p} = \frac{1}{r^F(t)}$.

C. PRICE RE-OPTIMIZATION

For firm offering discount vouchers, the new optimal price is a solution of the optimization problem in Equation 8

$$\begin{aligned}
 \frac{\partial \pi_{\gamma, \alpha}}{\partial p}(p^{**}) &= \gamma \lambda r^G (\alpha \beta) (1 - G(\hat{v}_G^{**})) \\
 &\quad - \gamma \lambda r^G (\alpha \beta p^{**} - c) \left[\frac{\partial G}{\partial \hat{v}_G}(\hat{v}_G^{**}) \right] \left[\frac{\partial \hat{v}_G}{\partial p} \right] \\
 &\quad + (1 - \gamma) \lambda r^G (1 - G(v_G^{**})) \\
 &\quad - (1 - \gamma) \lambda r^G (p^{**} - c) \left[\frac{\partial G}{\partial v_G}(v_G^{**}) \right] \left[\frac{\partial v_G}{\partial p} \right] \\
 &\quad + (1 - \lambda) r^F (1 - F(v_F^{**})) \\
 &\quad - (1 - \lambda) r^F (p^{**} - c) \left[\frac{\partial F}{\partial v_F}(v_F^{**}) \right] \left[\frac{\partial v_F}{\partial p} \right] \\
 &= 0
 \end{aligned} \tag{23}$$

where $\hat{v}_G^{**} = \frac{\alpha p^{**}}{r^G(t)}$, $v_G^{**} = \frac{p^{**}}{r^G(t)}$, $v_F^{**} = \frac{p^{**}}{r^F(t)}$, $\frac{\partial \hat{v}_G}{\partial p} = \frac{\alpha}{r^G(t)}$, $\frac{\partial v_G}{\partial p} = \frac{1}{r^G(t)}$, $\frac{\partial v_F}{\partial p} = \frac{1}{r^F(t)}$.

D. OPTIMAL α^* AND γ^*

Given a target fraction γ of the G population purchasing the discount vouchers, the optimal α^* (1-discount rate) is a solution of the optimization problem in Equation 20

$$\begin{aligned}
\frac{\partial \pi_{\gamma, \alpha}}{\partial \alpha}(\alpha^*) &= \gamma \lambda (r^G + \Delta r_{temp}^G) (\beta p^*) (1 - G(\hat{v}_G^*)) \\
&+ \gamma \lambda \left[\frac{\partial \Delta r_{temp}^G}{\partial \alpha}(\alpha^*) \right] (\alpha \beta p^* - c) (1 - G(\hat{v}_G^*)) \\
&- \gamma \lambda (r^G + \Delta r_{temp}^G) (\alpha \beta p^* - c) \left[\frac{\partial G}{\partial \hat{v}_G}(\hat{v}_G^*) \right] \left[\frac{\partial \hat{v}_G^*}{\partial \alpha}(\alpha^*) \right] \\
&+ (1 - \gamma) \lambda \left[\frac{\partial \Delta r_{temp}^G}{\partial \alpha}(\alpha^*) \right] (p^* - c) (1 - G(v_G^*)) \\
&- (1 - \gamma) \lambda (r^G + \Delta r_{temp}^G) (p^* - c) \left[\frac{\partial G}{\partial v_G}(v_G^*) \right] \left[\frac{\partial v_G^*}{\partial \alpha}(\alpha^*) \right] \\
&+ (1 - \lambda) \left[\frac{\partial \Delta r_{temp}^F}{\partial \alpha}(\alpha^*) \right] (p^* - c) (1 - F(v_F^*)) \\
&- (1 - \lambda) (r^F + \Delta r_{temp}^F) (p^* - c) \left[\frac{\partial F}{\partial v_F}(v_F^*) \right] \left[\frac{\partial v_F^*}{\partial \alpha}(\alpha^*) \right] \\
&= 0
\end{aligned} \tag{24}$$

Similarly, given an α (1-discount rate), the optimal target fraction γ^* is a solution of the optimization problem in Equation 21

$$\begin{aligned}
\frac{\partial \pi_{\gamma, \alpha}}{\partial \gamma}(\gamma^*) &= \lambda(r^G + \Delta r_{temp}^G)(\alpha \beta p^* - c)(1 - G(\hat{v}_G^*)) \\
&+ \gamma^* \lambda \left[\frac{\partial \Delta r_{temp}^G}{\partial \gamma}(\gamma^*) \right] (\alpha \beta p^* - c)(1 - G(\hat{v}_G^*)) \\
&- \gamma^* \lambda (r^G + \Delta r_{temp}^G)(\alpha \beta p^* - c) \left[\frac{\partial G}{\partial \hat{v}_G}(\hat{v}_G^*) \right] \left[\frac{\partial \hat{v}_G^*}{\partial \gamma}(\gamma^*) \right] \\
&- \lambda(r^G + \Delta r_{temp}^G)(p^* - c)(1 - G(v_G^*)) \\
&+ (1 - \gamma^*) \lambda \left[\frac{\partial \Delta r_{temp}^G}{\partial \gamma}(\gamma^*) \right] (p^* - c)(1 - G(v_G^*)) \\
&- (1 - \gamma^*) \lambda (r^G + \Delta r_{temp}^G)(p^* - c) \left[\frac{\partial G}{\partial v_G}(v_G^*) \right] \left[\frac{\partial v_G^*}{\partial \gamma}(\gamma^*) \right] \\
&+ (1 - \lambda) \left[\frac{\partial \Delta r_{temp}^F}{\partial \gamma}(\gamma^*) \right] (p^* - c)(1 - F(v_F^*)) \\
&- (1 - \lambda) (r^F + \Delta r_{temp}^F)(p^* - c) \left[\frac{\partial F}{\partial v_F}(v_F^*) \right] \left[\frac{\partial v_F^*}{\partial \gamma}(\gamma^*) \right] \\
&= 0
\end{aligned} \tag{25}$$

where

$$\begin{aligned}
\hat{v}_G^* &= \frac{\alpha p^*}{r^G + \Delta r_{temp}^G} \\
v_G^* &= \frac{p^*}{r^G + \Delta r_{temp}^G} \\
v_F^* &= \frac{p^*}{r^F + \Delta r_{temp}^F} \\
\frac{\partial \hat{v}_G^*}{\partial \alpha} &= \frac{p^*}{r^G + \Delta r_{temp}^G} - \frac{\alpha p^*}{(r^G + \Delta r_{temp}^G)^2} \frac{\partial \Delta r_{temp}^G}{\partial \alpha} \\
\frac{\partial v_G^*}{\partial \alpha} &= -\frac{p^*}{(r^G + \Delta r_{temp}^G)^2} \frac{\partial \Delta r_{temp}^G}{\partial \alpha} \\
\frac{\partial v_F^*}{\partial \alpha} &= -\frac{p^*}{(r^F + \Delta r_{temp}^F)^2} \frac{\partial \Delta r_{temp}^F}{\partial \alpha} \\
\frac{\partial \hat{v}_G^*}{\partial \gamma} &= -\frac{\alpha p^*}{(r^G + \Delta r_{temp}^G)^2} \frac{\partial \Delta r_{temp}^G}{\partial \gamma} \\
\frac{\partial v_G^*}{\partial \gamma} &= -\frac{p^*}{(r^G + \Delta r_{temp}^G)^2} \frac{\partial \Delta r_{temp}^G}{\partial \gamma} \\
\frac{\partial v_F^*}{\partial \gamma} &= -\frac{p^*}{(r^F + \Delta r_{temp}^F)^2} \frac{\partial \Delta r_{temp}^F}{\partial \gamma} \\
\frac{\partial \Delta r_{temp}^G}{\partial \alpha} &= -r_0^G (1 - r^G) \exp(-(\gamma + (1 - \alpha))) \\
\frac{\partial \Delta r_{temp}^F}{\partial \alpha} &= -r_0^F (1 - r^F) \exp(-(\gamma + (1 - \alpha))) \\
\frac{\partial \Delta r_{temp}^G}{\partial \gamma} &= r_0^G (1 - r^G) \exp(-(\gamma + (1 - \alpha))) \\
\frac{\partial \Delta r_{temp}^F}{\partial \gamma} &= r_0^F (1 - r^F) \exp(-(\gamma + (1 - \alpha)))
\end{aligned} \tag{26}$$

ELECTRONIC APPENDIX

The electronic appendix for this article can be accessed in the ACM Digital Library.

REFERENCES

- A. Arabshahi. 2011. Undressinggroupon: An Analysis of the Groupon Business Model. Working Paper. (2011), 1–16.

- O Ayodeji, N Tunde, and A E Adebowale. 2015. An Appraisal Of Groupon E-Business Model. *International Journal of Scientific & Technology Research* 4, 01 (2015), 291–297.
- Xue Bai, James R Marsden, William T Ross Jr., and Gang Wang. 2015. Relationships Among Minimum Requirements , Facebook Likes , and Groupon Deal Outcomes. *ACM Transactions on Management Information Systems* 6, 3 (2015). DOI : <http://dx.doi.org/10.1145/2764919>
- Raju Balakrishnan and Rushi P. Bhatt. 2015. Real-time Bid Optimization for Group-Buying Ads. *ACM Transactions on Intelligent Systems and Technology* 5, 4 (2015), 1–20. DOI : <http://dx.doi.org/10.1145/2532441>
- Mark Bils. 1989. Pricing in a Customer Market. *Quarterly Journal of Economics* 104, 4 (1989), 699–718. DOI : <http://dx.doi.org/10.2307/2937863>
- Binyi Chen, Tao Qin, and Tie-yan Liu. 2015a. Mechanism Design for Daily Deals. *Proceedings of the 2015 International Conference on Autonomous Agents and Multiagent Systems* (2015), 327–335.
- Chien Chin Chen and Meng-Chieh Chung. 2015. Predicting the success of group buying auctions via classification. *Knowledge-Based Systems* 89 (2015), 627–640. DOI : <http://dx.doi.org/10.1016/j.knosys.2015.09.009>
- Yi-Cheng Chen, Jen-Her Wu, Lifang Peng, and Ron Chuen Yeh. 2015b. Consumer benefit creation in online group buying: The social capital and platform synergy effect and the mediating role of participation. *Electronic Commerce Research and Applications* 6 (2015). DOI : <http://dx.doi.org/10.1016/j.elerap.2015.07.003>
- Lorenzo Coviello and Massimo Franceschetti. 2015. Group buying with bundle discounts: computing efficient, stable and fair solutions. (2015), 27. <http://arxiv.org/abs/1506.0682>
- Benjamin Edelman, Sonia Jaffe, and Scott Duke Kominers. 2014. To Groupon

- or Not to Groupon : The Profitability of Deep Discounts To Groupon or Not to Groupon : The Profitability of Deep Discounts. *Marketing Letters* (2014), 15. DOI : <http://dx.doi.org/10.1007/s11002-014-9289-y>
- Xuan Jiang and Shiming Deng. 2014. Optimal Strategy for Selling on Group-Buying Website. *Journal of Industrial Engineering and Management* 7, 4 (2014), 769–784.
- Anisio Lacerda, Rodrygo L. T. Santos, Adriano Veloso, and Nivio Ziviani. 2015. Improving daily deals recommendation using explore-then-exploit strategies. *Information Retrieval Journal* 18, 2 (2015), 95–122. DOI : <http://dx.doi.org/10.1007/s10791-014-9249-4>
- Simone Marinesi, Karan Girotra, and Serguei Netessine. 2013. Operational Advantages and Optimal Design of Threshold Discounting Offers. Working Paper. (2013).
- Reshef Meir, Tyler Lu, Moshe Tennenholtz, and Craig Boutilier. 2014. On the value of using group discounts under price competition. *Artificial Intelligence* 216, 0 (2014), 163–178. DOI : <http://dx.doi.org/10.1016/j.artint.2014.07.002>
- Guanqun Ni, Li Luo, Yinfeng Xu, Jiuping Xu, and Yucheng Dong. 2015. Optimal decisions on group buying option with a posted retail price and heterogeneous demand. *Electronic Commerce Research and Applications* 14, 1 (2015), 23–33. DOI : <http://dx.doi.org/10.1016/j.elerap.2014.10.005>
- Senjuti Basu Roy, Laks V S Lakshmanan, and Rui Liu. 2015. From Group Recommendations to Group Formation. *Proceedings of the 2015 ACM SIGMOD International Conference on Management of Data* (2015), 1603–1616. DOI : <http://dx.doi.org/10.1145/2723372.2749448>
- Jiahua Wu, Mengze Shi, and Ming Hu. 2015. Threshold Effects in On-line Group Buying. *Management Science* 61, 9 (2015), 2025–2040. DOI : <http://dx.doi.org/10.1287/mnsc.2014.2015>
- Mao Ye, Chunyan Wang, Christina Aperjis, Bernardo a Huberman, and Thomas Sand-

- holm. 2012. Collective Attention and the Dynamics of Group Deals. *Proceedings of the 21st international conference companion on World Wide Web WWW 12 Companion* (2012), 1205. DOI:<http://dx.doi.org/10.1145/2187980.2188262>
- Ron Chuen Yeh, Yi-cheng Chen, Management Systems, Li-min Lin, and Jen-her Wu. 2014. Factors Affecting Consumers Value Creation in Online Group Buying. *18th Pacific Asia Conference on Information Systems (PACIS 2014)* (2014). <http://pacis2014.org/data/PACIS>
- Ming Zhao, Yulan Wang, and Xianghua Gan. 2014. Signalling effect of daily deal promotion for a start-up service provider. *Journal of the Operational Research Society* (2014), 1–14. DOI:<http://dx.doi.org/10.1057/jors.2014.47>
- Geng Zhou, Kaiquan Xu, and Stephen S Y Liao. 2013. Do starting and ending effects in fixed-price group-buying differ? *Electronic Commerce Research and Applications* 12, 2 (2013), 78–89. DOI:<http://dx.doi.org/10.1016/j.elerap.2012.11.006>