Economics of Daily-deal Business Models

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Abstract

Daily-deal business model is a type of performance-based advertising wherein a publisher provides advertising space to a merchant who pays a proportion of revenue generated on the website to the publisher. We develop a two-period model to capture the strategic interaction between a publisher and a merchant where consumers are heterogeneous in their willingness to pay for quality and awareness about a merchant's product offering. In our Stackelberg game, publisher is the leader who decides the revenue sharing ratio and the merchant is the follower who responds by choosing appropriate discount rate of the deal offering and whether to offer a deal on the publisher's website. Our analysis shows that s merchant may increase or decrease discount rate on the website depending on the trade-offs associated with four effects -- advertising, sampling, cannibalization and revenue sharing. Surprisingly, the effect of a daily-deal publisher's revenue sharing contract on a merchant's participation strategy may not vanish even when the publisher's revenue sharing ratio is zero. We recommend that a publisher should take into account the merchant's marginal cost, proportion of informed consumers and consumer characteristics in formulating appropriate customized revenue sharing contract.

Keywords: Daily-deal business model, performance based advertising, revenue sharing, sampling, cannibalization

1. Introduction

Daily-deal business model came to limelight with the advent of Groupon in 2008 which became the fastest online business to reach one billion dollar valuation in history (Steiner, 2010). What differentiates this business model from the traditional ecommerce is that though buyers purchase goods online, they receive or consume them offline. Therefore, this business model is essentially based on first attracting consumers online and then directing them to offline local stores. Moreover, this business model is different from traditional advertising models because the purchase loop is completed on the daily-deal publisher's website. Since the purchases are completed on the publisher's website, the publisher, like Groupon or Living Social, can monitor revenue generated, and, hence, can offer a revenue sharing contract which may not be viable in the case of traditional advertising. In a revenue sharing contract, a merchant pays to the daily-deal publisher for the advertising services only when a transaction has been completed. In that sense the daily-deal business model is a performance-based online advertising model.

With the rapid emergence of technologies enabling Location Based Service (LBS) and Social, Local, Mobile (SOLOMO) services, the mobile commerce is expected to grow to $31 Billion in 2016 from a level of around $3 Billion in 2010 (Forrester, 2011). This presents unprecedented opportunities for the local businesses to connect to consumers who are online 24x7 through their Smartphone. Moreover, given that 58% of consumers in the US research products and services online before purchase (Jansen, 2010), it is becoming increasingly critical for local brick-and-mortar businesses like restaurants to advertise their offerings on the mobile platforms. For example, Groupon claims that its deals are inherently local and their distinguishing feature is that they are designed for mobile commerce platforms[1].

A daily-deal publisher provides space on his website for local businesses or merchants to advertise their goods to online consumers in the form of "deals of the day". One feature of these daily-deals is that they are for services, such as restaurants, yoga classes, and tanning salons. Since service is an

[1] See Groupon CEO interview on CNBC on 10/23/2013: http://www.cnbc.com/id/101136815

experience good, some consumers who have not experienced the good before may have a lower quality estimate of the good. Therefore, a merchant may offer price discount (Bagwell, 1990) through a daily-deal publisher to encourage first time consumers to try the experience good, and some of these first-time consumers may become repeat consumers in future.

The unique business model of daily-deal advertising was hailed as the future of online businesses[2] in the beginning. While daily-deal commerce has seen phenomenal growth in the last five years, market analysts have raised concern about its sustainability, growth and profitability (Clifford and Miller, 2012). Furthermore, the business model of daily-deal publishing has itself been questioned (Cohan, 2012; Etter & McMillan, 2012). One critical feature of these business models is that daily-deal publishers often offer standard revenue sharing scheme to all merchants. For example, while Groupon is known to offer standard revenue sharing ratio of 50%, LivingSocial's standard revenue sharing ratio is known to be 40%. It is surprising that the revenue sharing contract in which revenue sharing ratio is decided by the publisher does not vary across merchants because merchants who advertise on daily-deal publisher's website and decide discount rates for deals, are heterogeneous in term of marginal costs, proportion of existing consumers, and first time consumers' quality estimate. Though the daily-deal advertising model is becoming increasingly important for offline merchants providing services, there is very little academic research that has studied the ecosystem of daily-deal advertising business model. Furthermore, there is little information available in industry reports about how do heterogeneous merchants decide discount rate for the daily-deal and how does publisher decide the revenue sharing ratio.

In this paper, we develop a two-period analytical model to abstract the ecosystem of daily-deal publishing where participating merchants sell goods at the regular price directly to consumers or in the direct channel, and offer deals on the publisher's website or the publisher channel. We model the strategic interaction between the daily-deal publisher and an advertising merchant as a leader-follower game where the daily-deal publisher is the leader and the merchant is the follower. More specifically, we answer the

[2]http://techland.time.com/2010/12/01/the-future-of-e-commerce-groupon-becomes-social-shopping-network/

following questions: (i) What are the benefits and costs to a advertising merchant in offering a deal on a daily-deal publisher's website? (ii) What is the optimal discount rate strategy for a merchant? (iii) How does a daily-deal publisher's revenue sharing ratio affect a merchant's optimal discount rate strategy? (iv) What types of merchants should offer deals on a daily-deal publisher's website? and (v) How do merchants' characteristics affect a daily-deal publisher's choice of revenue sharing ratio?

The daily-deal advertising model is different from the traditional coupon based advertising model wherein merchants also offer discount to coupon receiving consumers. However, the traditional coupon based advertising is nonperformance-based advertising because a merchant pays a lump sum amount to an advertiser for a certain number of views/exposures. On the other hand, in the context of daily-deal advertising, an advertising merchant pays based on revenue generated from consumer purchases. Daily-deal advertising is also different from pay-per-click sponsored search advertising model, where a merchant pays when a consumer clicks on the link. Moreover, in sponsor search advertising, a merchant's advertising cost per click is determined through an auction mechanism, and not by the publisher.

In the context of daily-deal advertising, each merchant faces a market consisting of two consumer segments, namely, *informed consumers* and *uninformed consumers*. While the *informed consumers* are aware about the merchant and the quality of the experience good, the *uninformed consumers* are not aware about the merchant, and under-estimate the quality of the experience good on the publisher's website.

A local merchant can offer a deal to reach out to *uninformed consumers* who are on the publisher's website. Exposure to these *uninformed consumers* is the advertising effect of daily-deal business model to the merchant. Moreover, *uninformed consumers* on the publisher's website are incentivized to purchase the merchant's experience good through an attractive deal which offers discount. Those *uninformed consumers*, who buy the deal, realize the true quality of the experience good, and their willingness to pay in the next period increases. Some of these of the first period may buy the experience good at regular price in the second period (Rothschild and Gaidis, 1981). This aspect of daily-deal publishing is akin to the introductory pricing strategy of under-estimated experience goods (Shapiro 1983), and is the sampling effect of daily-deal business model. Moreover, some of the *informed consumers* of a merchant, who would have bought at the regular price in the direct channel, may purchase the deal at a discounted price in the publisher channel. This leads to cannibalization effect, which is revenue loss to a merchant from *informed consumers*. In addition, a merchant pays to the daily-deal publisher a proportion of revenue generated on the website according to the revenue sharing contract. This payment is the merchant's cost of offering a deal on the publisher's website.

Merchants value these effects of daily-deal publishing differently because of their inherent heterogeneities in proportion of *informed consumers*, marginal cost, and the quality estimate of the uninformed consumers on the publisher' website. Therefore, a merchant's profit of offering a deal on a daily-deal publisher's website depends on the trade-off between the positive effects of advertising and sampling and the negative effects of cannibalization and revenue sharing.

We find that show that a merchant' optimal discount rate strategy is driven by marginal cost, and *uninformed consumers*' quality estimate about the experience good, proportion of informed consumers (merchant type), and the publisher's revenue sharing ratio. In determining the optimal discount strategy, a merchant trades off positive benefit of advertising and sampling with the negative impact of revenue cannibalization and revenue sharing. We also find that the impact of the publisher's revenue sharing ratio on the merchant's optimal discount rate is non-monotonic. More specifically, a merchant, who has low marginal cost and has low proportion of informed consumers, increases discount rate on the publisher channel as publisher increases revenue sharing ratio. On the other hand, a merchant, who has higher marginal cost or has high proportion of informed consumers, decreases discount rate on the publisher channel as publisher increases the revenue sharing ratio. In turn, a merchant's participation strategy is driven by the merchant's optimal discount rate strategy. A merchant with low proportion of *informed consumers* and low marginal cost may participate even if the publisher has a very high revenue sharing ratio. This is because that the merchant has relatively large positive advertising benefit and relatively small negative cannibalization effect. Finally, we find that a publisher's optimal revenue sharing ratio depends on a merchant's characteristics, such as the proportion of *informed consumers*, marginal cost, and *uninformed consumers*' quality estimate. The real world implication of this is that the current industry practice of one size fits all – one revenue sharing ratio for all merchants, is suboptimal. We recommend that a daily-deal publisher can improve profit by offering customized revenue sharing contract.

There are four broad streams of literature that are relevant to our paper: pricing strategy of experience goods, product sampling, performance-based advertising, and daily-deal publishing business model. The first stream of literature - pricing strategy of experience goods- posits that the first time consumers (in our setup, *uninformed consumers* on the publisher's website) learn the true quality of an experience good only upon consumption (Nelson 1970). Shapiro (1983) and Goering (1985) develop two-period models wherein consumers under estimate the quality of an experience good, and recommend that a firm should charge lower price in the first period to encourage consumers to purchase the good. After consumption, consumers learn the true quality which leads to increase in their willingness to pay, and hence, the firm should charge a higher price in the second period. This introductory pricing strategy is similar to a merchant offering price discount on a daily-deal publisher channel to incentivize *uninformed consumers* to purchase in the first period. However, in the context of daily-deal publishing model, a merchant faces a mix of *informed* and *uninformed consumers* on the publisher's website while the extant literature(Shapiro, 1983; Goering, 1985) consider a case of one consumer segment – *uninformed consumers*, in the first period. Our setting of two consumer segments in the first period is similar to Bils (1989) which studies a market with a mix of consumers - first time consumers who are uncertain about the product quality and repeat consumers who know the product quality-, and finds that an optimal pricing strategy should consider the trade-offs between exploiting repeat consumers and attracting first time consumers. However, papers in this stream of literature do not model a setting in which a merchant needs a third part - a daily-deal publisher- to access the mass of *uninformed consumers*. In other words, though the pricing of experience goods literature informs our research, it does not model a setting where a merchant requires a daily-deal publisher to access to first time consumers.

The second stream of literature - product sampling - has studied the strategy of offering free samples for introduction and promotion of new products (Bettinger et al. 1979; Freedman 1986; Jain et al, 1995; Heiman et al., 2001). Offering free samples to new consumers has a direct experiential effect that reduces the risk of product uncertainty (Heiman et al., 2001), and it is akin to introductory pricing strategy for uninformed consumers, in our setup, with zero prices in the first period. Information System researchers have specifically studied sampling and pricing strategy related to digital experience goods[3] (Chellappa & Shivendu, 2005; Dey & Lahiri, 2013). However, digital goods are characterized by zero marginal cost, while in the context of daily-deal publishing, a merchant sells an experience good with varying levels of marginal costs. Though our research is informed by this sampling literature, in the context of daily-deal publishing, there is a key difference that a merchant faces consumers with heterogeneous quality estimates in the publisher channel in the first period. Moreover, in our setup, a merchant can sell in the direct channel and in the publisher channel in the first period, and has full control over the pricing decisions in both channels. Note this setting is different from the dual channel distribution literature where a manufacturer has access to two channels- direct channel and retailer channel- but has control over the pricing decision only in the direct channel, and the retailer decides the pricing in the retailer channel (Chiang et al., 2003; Tsay and Agrawal, 2004).

The third relevant stream of literature that informs our research relates to online performance-based advertising models. This literature has primarily focused on online keyword search advertising in general, and on auction design (Feldman & Muthukrishnan, 2008, Lahaie et al., 2007; Liu et al., 2009; Yao & Mela, 2009), publisher's effort to improve conversion rates (Hu, 2004; Asdemir et al., 2012), and advertising merchant's strategy (Chen & He 2011; Feng & Xie 2012; Dellarocas, 2012) in particular. Keyword search advertising and the daily-deal publishing business model are both performance-based,

[3] Also see Wu and Niculescu with network externality.

there are three key differences between the two. The first difference is that while in the keyword search advertising models a merchant can access consumers in the publisher channel only, in the context of daily-deal publishing, a merchant accesses consumers both in the direct and the publisher channels. The second difference is that while in the keyword search advertising models, there is only one period and consumers do not update their quality belief, in our model, there are two periods and uninformed consumers update quality belief upon consumption. The third difference is that while in the auction-based keyword advertising model, a publisher does not determine a merchant's advertising cost per action, in the daily-deal publishing model, the publisher strategically decides the revenue sharing ratio which directly determines a merchant's cost per action (purchase).

The fourth relevant literature stream relates to the ecosystem of daily-deal publishing business models which studies the relationship between design and profitability of daily-deals (Byers et al., 2011), and profitability of advertising merchants (Edelman et al., 2011; Dholakia, 2012; Kumar and Rajan, 2012). The closest paper to our research is Edelman et al. (2011) wherein authors study the price discrimination and advertising effects of a daily-deal website. However, they only focus on the merchants' advertising strategy, and assume away the strategic role played by the publisher. Moreover, in their setting, discount rate is exogenously determined and discount coupon only reaches to the consumer segment with lower valuation, so they neither study merchant's optimal discount rate strategy nor the cannibalization effect.

To our knowledge, this paper is the first one that develops an analytical model to study the dynamics of daily-deal publishing and the strategic interaction between a merchant and a daily-deal publisher. In doing so, we make three signification contributions to literature. First, while the extent literature in pricing of experience goods has considered merchants as the only strategic players, our setup has two strategic players, namely, merchants and a daily-deal publisher, and we specifically model their strategic interaction. We find that not all merchants participate, and merchants with high marginal cost or high proportion of informed consumers offer higher introductory price compared to recommendations of the extant literature (Shapiro, 1983).

Our second contribution is related to performance-based advertising literature (), which models only one period setting. Our two-period model allows us to study not only advertising effect, but also sampling effect. Our research studies the trade-offs that a merchant makes between inter-temporal profits, while single-period models of performance-based advertising (Dellarocas, 2012) are unable to do so. Our analysis of two-period model finds that a merchant's pricing decision in the first period in the publisher channel is non-monotonic in the publisher's pricing decision. This finding is new because the extant literature finds that optimal response of a merchant is to increase price as publisher increases price. Models employed by key word search advertising literature do not consider revenue sharing contract which is key to daily-deal publishing. Hence, those models do not consider revenue sharing effect.

Third, we contribute to the literature of daily-deal publishing business model by showing that a merchant's adoption of daily-deal advertising largely depends on merchant's characteristics, and is impacted by the punisher's revenue sharing contract. We find that the publisher should offer higher (lower) revenue sharing ratio for merchants with lower (higher) proportion of informed consumers and lower (higher) marginal cost.

2. Model

We consider a market consisting of three types of players, a monopolist online daily-deal advertising publisher[4] who publishes only daily-deals, a merchant, and a set of consumers. In our setting, a merchant sells an experience good of quality q which may be a product or service, and the marginal cost of production of the experience good is c. The merchant faces two consumer segments that differ in terms of information about the merchant's offering. The first segment consists of consumers who are aware about the merchant's offering, and we refer to this segment as *informed consumers*. The second segment consists of consumers who are not aware about the merchant's offering, and we refer to this segment as

[4] This conceptualization on monopolistic website offering daily-deals is similar to (Edelman, 2010). We discuss the implications of daily-deal websites competitive setting on our result in §6.

uninformed consumers. We denote a merchant's proportion of *informed consumers* in the market as δ, and we refer to this as merchant type. More specifically, for a merchant of type δ, the proportion of *informed consumers* is δ and the proportion of *uninformed consumers* is $1-\delta$. The merchant's type δ is exogenously given, such that $\delta \in [0,1]$, and is common knowledge.

The market consists of a unit mass of consumers who have heterogeneous valuation for quality. The quality valuation parameter, θ, is consumers' private information, though the distribution $\theta \sim U[0,1]$ is common knowledge. In our model, *informed consumer* segment of a merchant knows the true quality (q) of the experience good. In the absence of daily-deal publisher's website, a merchant sells the experience good directly or in the direct channel to only *informed consumer* segment, since *uninformed consumer* segment is not aware about the merchant in the direct channel. An *informed consumer*'s willingness to pay for one unit of the experience good in the direct channel is θq. It implies that consumers of higher θ have higher willingness to pay for an experience good.

In the presence of the daily deal publisher, the merchant can offer the experience good through two channels: direct channel and publisher channel or daily-deal website. We assume μ proportion of consumers in the market that join the publisher's website, where $\mu \in (0,1)$ and μ is exogenously given. Note that the μ mass of consumers who join the website consists of a mix of *informed* and *uninformed* consumers for each merchant. That implies that the merchant has access to the both consumer segments through the publisher channel. An *informed consumer*'s willingness to pay for one unit of the experience good in the publisher channel is the same as in the direct channel (θq). On the other hand, *uninformed consumers* of a merchant are not aware about the true quality of the experience good. Following Shapiro (1986), we assume that *uninformed consumers*, who are exposed to a merchant for the first time on the daily-deal publisher's website, expect the quality of the merchant's experience good to be R, where $0 < R$. The value of this quality estimate depends on the characteristics of merchant's experience good.

We assume that R is a point expectation, and hence an *uninformed consumer* of type θ in the publisher channel has θR willingness to pay for one unit of the experience good on the publisher's website.

A daily-deal publisher observes merchant's marginal cost (c) as well as uninformed consumers' quality estimate (R), and offers a merchant a revenue sharing contract wherein a merchant pays a proportion of revenue generated on the website to the publisher for the access to consumers in the publisher channel. Since the merchant pays a proportion of revenue per transaction on the publisher's website, so the total payment to the publisher depends on the performance of the merchant's deal. Therefore, this revenue sharing contract is performance based contract. Note that if the daily-deal publisher were to charge an upfront fixed fee from the merchant for accessing consumers on the website, it would be a non-performance based contract. The revenue sharing ratio $s \in [0,1]$ is decided by the daily-deal publisher.

2.1 Purchase decision by consumers

We consider a two-period game. A merchant may offer a deal on the publisher's website in the first period, but does not offer deal in the second period. It means that a merchant can access consumers through dual channel (direct channel and publisher channel) in the first period, and only in direct channel in the second period[5]. Note that in our setup, in the first period, there are four types of consumers. First, there are $\delta\mu$ mass of consumers who are *informed consumers* on the publisher's website. Second, there are $\delta(1-\mu)$ mass of *informed consumers* who not on the publisher's website. Third, there are $(1-\delta)\mu$ mass of *uninformed consumers* who are on the publisher's website. Fourth, there are $(1-\delta)(1-\mu)$ mass of *uninformed consumers* who are not on the publisher's website, and they do not buy in either period.

We assume that the merchant commits to a price in the direct channel for both periods (Edelman et al. 2010) and we denote this regular price as p. A merchant offers discount rate $d \in (0,1)$ on the

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[5] Industry reports show that any particular merchant does not offer regular deals. Groupon requires that there should be a gap of atleast six months between deals offered by a merchant.

publisher's website and hence price on publisher channel is $p(1-d)$ in the first period. A consumer's surplus from buying the experience good in the first period is:

$$U_1(\theta)=\begin{cases}\theta q-p & \text{informed consumers in the direct channel}\\ \theta q-p(1-d) & \text{informed consumers in the publisher channel}\\ \theta R-p(1-d) & \text{uninformed consumers in the publisher channel}\end{cases} \quad (1)$$

Consumers are risk neutral, and consider purchasing one unit of good or nothing in each period. Consumers purchase only if their surplus is non-negative. Note that *uninformed consumers* who are not in the publisher channel ($(1-\delta)(1-\mu)$ mass of consumers) do not buy the good in the first period because they are not aware about product offerings of the merchant.

Uninformed consumers who buy the experience good in the first period in the publisher channel update their willingness to pay from θR to θq upon consumption. Note that in the second period, the mass of *informed consumers* is more than δ , as some *uninformed consumers* who buy in the first period in the publisher channel also become *informed consumers in the second period*. A consumer's surplus from buying the experience good in the direct channel in the second period is:

$$U_2(\theta)=\begin{cases}\theta q-p & \text{informed consumers, and uninformed consumer who bought in first period}\\ \theta R-p & \text{uniformed consumer in the publisher channel who did not buy in first period}\end{cases} \quad (2)$$

2.2 Strategic interaction between daily-deal website and merchant

The merchant know *uninformed consumers*' quality estimate R, and $R<q$. This implies that those *uninformed consumers* in the publisher channel under-estimate the quality of experience good. We will consider a situation where some *uninformed consumers* over-estimate the quality of the experience good; and some *uninformed consumers* under-estimate the quality of the experience good.

The strategic interaction between a publisher and a merchant takes place in a leader-follower setting. The publisher is the leader, and first announces the revenue sharing ratio (s). The merchant is the follower who takes into consideration this revenue sharing ratio in deciding whether to offer a deal on the publisher's website and, if so, the optimal discount rate (d) to offer on the website. Moreover, while the publisher and the merchant make strategic decisions about revenue sharing ratio (s) and discount rate (d) respectively; consumers are price-takers.

In this setting, if a merchant decides not to offer a deal in the publisher channel, then, in the first period, she offers the experience good only in the direct channel. We refer to this case as the benchmark case. In this case the merchant decides the optimal price p in the direct channel to maximize profit over two periods. We denote the demand proportions from the *informed consumers* in the first period as $D_{1\mathrm{i}}^{B}$ and as $D_{2\mathrm{i}}^{B}$ in the second period. Therefore, in the benchmark case, the profit function of a merchant of type δ over the two periods is:

$$\pi^{B}(p,\delta)=\delta(D_{1\mathrm{i}}^{B}+D_{2\mathrm{i}}^{B})(p-c)\,, \tag{3}$$

The marginal consumer ($\hat{\theta}$) who is indifferent from purchasing and not purchasing is such that $\hat{\theta}q=p$, and hence $\hat{\theta}=\frac{p}{q}$. All consumers whose $\theta\geq\hat{\theta}$ purchase the experience good. Since informed consumers' valuation for quality is $\theta \sim U[0,1]$, the demand from the informed consumers in each period is: $D_{1\mathrm{i}}^{B}=D_{2\mathrm{i}}^{B}=1-\frac{p}{q}$.

When a merchant decides to offer a deal in the publisher channel, she offers a deal with a regular price, p, and a discount rate d, on the publisher's website, and hence, the effective price on the publisher's website is $p(1-d)$. Let the demand proportions of *informed* and *uninformed consumers* on the publisher's website in the first period be $D_{1\mathrm{i}}^{W}$ and $D_{1\mathrm{u}}^{W}$ respectively. Let the demand proportion of *informed consumers* in the direct channel in the first period be $D_{1\mathrm{i}}^{O}$. The first period profit function of a merchant of type δ is:

$$\pi_1=\mu\delta D_{1\mathrm{i}}^{W}(p(1-d)(1-s)-c)+\mu(1-\delta)D_{1\mathrm{u}}^{W}(p(1-d)(1-s)-c)+(1-\mu)\delta D_{1\mathrm{i}}^{O}(p-c) \tag{4}$$

, where $D_{1\mathrm{i}}^{W}=(1-\frac{p(1-d)}{q})$, $D_{1\mathrm{u}}^{W}=(1-\frac{p(1-d)}{R})$, and $D_{1\mathrm{i}}^{O}=(1-\frac{p}{q})$.

In the second period, the merchant offer the experience good only in the direct channel regular price p. *Uninformed consumers*, who buy in the first period in the publisher channel, update their quality estimate to true quality (p), and update their willingness to pay from θR to θq . Some of these *uninformed consumers* who bought the experience good in the first period may also buy at the regular price in the second period. Moreover, it is easy to see that an *uninformed consumer*, who did not buy at a discounted price in the first period in the publisher channel, will not buy in the second period at the regular price in the direct channel. Let the demand from *informed consumers* in the second period be $D_{2\mathrm{i}}^{O}$. We denote the proportion of *uninformed consumers* who buy in the second period as $D_{2\mathrm{u}}^{O}$, where $D_{2\mathrm{u}}^{O} \leq D_{1\mathrm{u}}^{W}$. The profit function of a δ type merchant in the second period is:

$$\pi_2 = \delta D_{2\mathrm{i}}^{O}(p-c) + \mu(1-\delta) D_{2\mathrm{u}}^{O}(p-c) \tag{5}$$

, where $D_{2\mathrm{i}}^{o} = (1-\dfrac{p}{q})$.

Now we can write the two-period profit function of a merchant of type δ , who offers a deal on the publisher channel as:

$$\pi_M(\delta,d) = \pi_1 + \pi_2 = \mu(\delta D_{1\mathrm{i}}^{W} + (1-\delta) D_{1\mathrm{u}}^{W})(p(1-d)(1-s)-c) + (1-\mu)\delta D_{1\mathrm{i}}^{O}(p-c) + (\delta D_{2\mathrm{i}}^{O} + \mu(1-\delta) D_{2\mathrm{u}}^{O})(p-c) \tag{6}$$

Thus, a merchant's profit maximization problem is $\max_{\{d\}} \pi_M(\delta,d)$. Let $d = d^*$ be the solution to this profit maximization problem, and the optimal profit for a merchant of type δ be $\pi_M(\delta,d^*)$. A merchant offers a deal on the publisher's website only if the profit from offering a deal is not less than the profit from the benchmark case, that is $\pi_M(\delta,d^*) \geq \pi_M^B(\delta)$.

Now, we can write the profit function of a daily-deal publisher who offers a revenue sharing contract with a revenue sharing ratio (s) to a merchant of type δ as:

$$\pi_{\mathrm{W}}(s) = \begin{cases} s\mu(\delta D_{1\mathrm{i}}^{W} p(1-d) + (1-\delta) D_{1\mathrm{u}}^{W} p(1-d)) & \text{if } \pi_M(\delta,d^*) \geq \pi_M^B(\delta) \\ 0 & \text{if } \pi_M(\delta,d^*) < \pi_M^B(\delta) \end{cases} \tag{7}$$

where $\mu(\delta D_{1i}^{W} p(1-d)+(1-\delta)D_{1u}^{W} p(1-d))$ is the revenue generated on the publisher's website when a merchant of type δ offers a deal. The daily-deal publisher chooses a revenue sharing ratio ($s=s^{*}$) which maximizes the profit in (7).

Figure 1 describes the sequence of the two-period game. The summary of notations is provided in Appendix A.

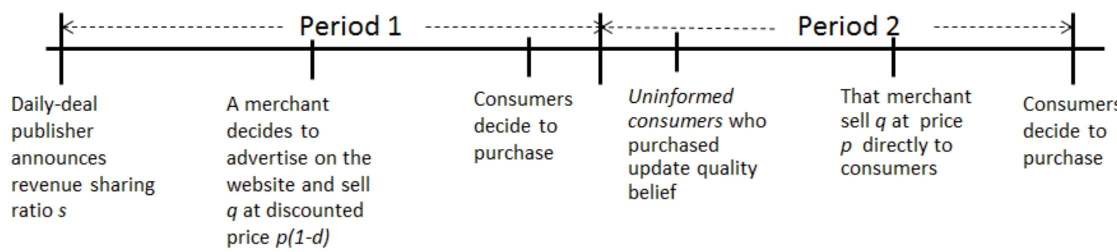

Figure 1: Sequence of the game

3. Merchants' trade-offs in offering a deal

Before we discuss the merchant's and daily-deal publisher's optimal strategies, we first establish the theoretical framework to study a merchant's trade-offs in offering a deal on a daily-deal publisher's website. First, a merchant offers a deal on the daily-deal publisher's website to acquire new consumers, that is, *uninformed consumers*, who are not aware about the merchant in the direct channel. Second, uninformed consumers who purchased the experience good in the publisher channel update their willingness to pay in the second period. Third, the informed consumers who are on the publisher channel may also buy the deal at a discounted price, though they have high willingness to pay for the experience good. In addition, the merchant shares a proportion of revenue generated on the publisher channel with the publisher. We explain these aspects that impact the merchant's profit of offering a deal on the publisher's website in the following paragraphs.

When a merchant offers a deal on the daily-deal publisher's website, u*ninformed consumers* are informed about the merchant's experience good. Note that these uninformed consumers do not know the merchant in the direct channel. Therefore, by offering a deal on the daily-deal publisher's website, a merchant is able to reach out to uninformed consumers who are on the website. We characterize this impact of reaching out to uninformed consumers on the publisher's website as advertising effect. This effect is positive for the merchant, and it increases the merchant's market size in both periods. If the merchant were to offer the experience good on the website at the regular price (p), then in the first period, the demand from *uninformed consumers* who are on the website is $\mu(1-\delta)(1-\frac{p}{R})$. Those *uninformed consumers* who buy in the first period also buy in the second period. The merchant's advertising effect is the gain in profit from having access to *uninformed consumers* on the publisher's website. Therefore, advertising effect is:

$$F_A = (1-\frac{p}{R})\mu(1-\delta)(p-c) + (1-\frac{p}{R})\mu(1-\delta)(p-c) \ . \tag{8}$$

Note that the advertising effect is stronger, (1) if the merchant has lower proportion of *informed consumers* (δ), or (2) if *uninformed consumers* have a larger quality estimate (R), or (3) if merchant has a smaller marginal cost (c), or (4) if the mass of consumers on the publisher's website (μ) is larger.

When a merchant offers a deal on the daily-deal publisher's website, the merchant offers a price discount (d) in the first period, hence, the price on the publisher's website is $p(1-d)$. Due to this lower price on the publisher's website, some *informed consumers* on the website, who do not buy at the regular price may buy at the discounted price. The demand proportion for these informed consumers is $\mu\delta(\frac{pd}{q})$. However, these *informed consumers* who take the advantage of price discount in the publisher channel do not buy at the regular price in the second period. Furthermore, *uninformed consumers* who are at the website have lower willingness to pay because they have lower quality estimate than the true quality of the experience good ($R < q$). Some *uninformed consumers* who would have not bought the experience good at the regularly price in the first period in the publisher channel, buy at the discounted price. The demand proportion of these uninformed consumers is $\mu(1-\delta)(\frac{pd}{R})$. Since uninformed consumers who buy in the first period update their quality belief may buy at the regular price in the second period and the demand proportion of such repeat consumers is $\mu(1-\delta)D_{2u}^{o}$. We characterize this impact of offering price discount in the publisher channel on the merchant's profit as sampling effect. More formally, the sampling effect is:

$$F_S = (\frac{pd}{q})\mu\delta(p(1-d)-c) + (\frac{pd}{R})\mu(1-\delta)(p(1-d)-c) + D_{2u}^{o}\mu(1-\delta)(p-c). \quad (9)$$

Note that the sampling effect is stronger, (1) if the merchant has lower proportion of *informed consumers* (δ), or (2) if *uninformed consumers* have a smaller quality estimate (R),or (3) if merchant has a smaller marginal cost (c), or (4) if the mass of consumers on the publisher's website (μ) is larger.

The advertising effect and sampling effect result in increase in profit to a merchant who offers a deal on the daily-deal publisher's website, and hence, both are beneficial effects. However, offering a deal on the daily-deal website also imposes two types of costs on a participating merchant.

When a merchant offers a discount on the daily-deal publisher's website, she incurs loss of revenue from those consumers who have high valuation for quality (θ), because they would have bought the experience good at the regular price. More formally, the cannibalization effect is:

$$F_C = (1-\frac{p}{q})\mu\delta pd + (1-\frac{p}{R})\mu(1-\delta)pd, \quad (10)$$

where the first and second terms of equation (10) are the loss of revenue from *informed consumers* and *uninformed consumers* respectively due to discount in the publisher channel. The cannibalization effect is stronger, (1) if a merchant has higher proportion of *informed consumers* (δ), or (2) if the merchant offers higher discount rates (d), or (3) if *uninformed consumers* have a smaller quality estimate (R), or (4) if the mass of consumers on the publisher's website (μ) is larger. Note that the magnitude of the cannibalization effect does not depend on the merchant's marginal cost (c).

A merchant also shares s proportion of revenue generated on the daily-deal website with the publisher in the first period. This is the cost to the merchant for getting access to *uninformed consumers* on the publisher's website. We characterize this as the revenue sharing effect, more formally, it is:

$$F_R = (1-\frac{p(1-d)}{R})(1-\delta)\mu(p(1-d)s) + (1-\frac{p(1-d)}{q})\delta\mu(p(1-d)s), \quad (11)$$

The first term of equation (11) is the revenue from *uninformed consumers* in the publisher channel that a merchant pays to the publisher in the first period. The second term of equation 11 is the revenue from informed consumers in the publisher channel that a merchant pays to the publisher in the first period. The revenue sharing effect is stronger, (1) if a merchant has higher proportion of *informed consumers* (δ), or (2) if *uninformed consumers* have a larger quality estimate (R), or (3) if the mass of consumers on the publisher's website (μ) is larger, or (4) if the revenue sharing ratio (s) is larger. Note that the magnitude of the revenue sharing effect does not depend on the merchant's marginal cost (c).

A merchant's discount rate strategy is driven by the trade-off between these four effects. In Section 4, we analyze a merchant's optimal discount rate strategy.

4. Merchant' Discount Rate Strategy

Before we present our analysis regarding a merchant's optimal discount rate strategy in offering a deal on the daily-deal publisher's website, we establish the regular price, the demand proportion and optimal profit under the benchmark case where a merchant sells the experience good only in the direct channel.

4.1 Benchmark case: a merchant sells only in the direct channel

When a merchant sells the experience good only in the direct channel, she has access only to the informed consumers who know the true quality of the experience good. To keep our exposition simple, we normalize the quality of the experience good $q=1$ in the subsequent analysis. An *informed consumer* who has θ valuation for quality buys the experience good in both periods if $\theta - p \geq 0$. More formally, since $\theta \sim U[0,1]$, we have the demands in two periods as $D_{2i}^B = D_{1i}^B = 1-p$. Now, we can rewrite the merchant's benchmark profit function over the two periods as:

$$\pi^B(p) = 2\delta(1-p)(p-c) \quad (12)$$

A merchant of type δ maximizes her profit in (12) by choosing the optimal price p^*. Solution to the merchant's optimization problem gives the optimal price, demand in two periods and profit in the benchmark case as: $p^* = (1+c)/2$, $D_{1i}^{B*} = D_{2i}^{B*} = (1-c)/2$, $\pi^{B*} = \delta(1-c)^2/2$. This establishes the regular price as $p^* = (1+c)/2$.

4.2 Merchant's optimal discount rate strategy in offering a deal

A merchant considers the trade-offs between the positive and negative effects of offering a deal on the daily-deal publisher's website in the first period to determine the optimal discount rate (d^*). Note that the regular price offered by a merchant in the direct channel is the merchant's optimal price in the benchmark case, that is $p^* = (1+c)/2$. It is so because in the direct channel, the merchant sells only to the *informed consumer* segment. A merchant who offers a deal with discount rate d sells the experience good at the discounted price $p^*(1-d)$ in the publisher channel.

The *uninformed consumers,* who are in the daily-deal publisher channel $(\mu(1-\delta))$, underestimate the quality of the experience good, such that their quality estimate (R) is lower that the true quality. Therefore, we can write the demand proportion for the experience good from the *uninformed consumers* in publisher channel as $D_{1u}^{W} = 1 - \frac{p^*(1-d)}{R}$. Note that this demand proportion increases when merchant's discount rate increases, as well as when *uninformed consumers*' quality estimate increases. It is straightforward to see that those *uninformed consumers* ($\theta < \frac{p^*(1-d)}{R}$) who do not buy the experience good at the discounted price in the publisher channel in the first period, do not buy at the regular price in the direct channel in the second period ($\theta < \frac{p^*}{R}$). On the other hand, depending on the merchant's discount rate, some *uninformed consumers* who buy at the discounted price in the publisher channel in the first period ($\theta > \frac{p^*(1-d)}{R}$), may not buy at the regular price in the direct channel in the second period ($\theta < p^*$), that is $D_{2u}^{O} \le D_{1u}^{W}$. Before we discuss the optimal discount rate strategy of a merchant, Proposition 1 reports the boundary that the optimal discount rate is bounded with a range.

PROPOSITION 1: *A merchant's optimal discount rate* d^* *is bounded such that* $\max\left[\ 1-\frac{2R}{1+c},\ 0\right] \le d^* \le 1-R$.

When a merchant offers discount rate at $d = 1-R$, the demand proportion from uninformed consumers in the publisher channel is $D_{1u}^W = 1 - p^*$. Those *uninformed consumers*, who buy at the discounted price in the first period, also buy at the regular price in the second period ($\theta > \frac{p^*(1-d)}{R}|_{d=1-R} = p^*$). It is easy to see that if a merchant offers a discount rate $d > 1-R$, then some *uninformed consumers*, who buy at discounted price in the first period, do not buy at the regular price in direct channel in the second period. This implies that the benefit to the merchant due to the sampling effect does not increase when the discount rate is $d > 1-R$. On the other hand, by offering a higher discount rate, the cost to the merchant due to the cannibalization effect increases. Hence, the highest discount rate that a merchant considers offering in the publisher channel is $d = 1-R$. When a merchant offers the highest discount rate ($d = 1-R$), the merchant gets the maximum demand proportion of *uninformed consumers* in both periods, which is given as $D_{1u}^W = D_{2u}^O = \frac{1-c}{2}$.

A merchant's sampling effect is zero when the discount rate is $\text{d} \le 1 - \frac{2R}{1+c}$, since no *uninformed consumers* buy at the discounted price in the publisher channel ($D_{1u}^W = 0$). However, the merchant still incurs cost due to the cannibalization effect, as some of informed consumers, who would have bought at the regular price in the direct channel, buy at the discounted price in the publisher channel. Therefore, the lowest discount rate that a merchant consider offering in the publisher channel is $\text{d=max}(1-\frac{2R}{1+c},0)$. Next, Lemma 1 reports the optimal discount rate offered by a merchant, within the constraint specified in Proportion 1, in the daily-deal publisher's channel.

LEMMA 1: *There exists a lower merchant type* $\underline{\delta}$ *and a higher merchant type* $\bar{\delta}$ *such that (i) for a merchant of type* $\delta \in [0, \underline{\delta})$ *the optimal discount rate is* $d^* = 1-R$*; (ii) for a merchant of type* $\delta \in [\underline{\delta}, \bar{\delta}]$ *the* *optimal discount rate is* $d^* = \hat{d} = \frac{(1-c+2(1-R)(1-s))(1-\delta)-2cs(1-(1-R)\delta)}{2(1+c)(1-s)(1-(1-R)\delta)}$*; and (iii) for a merchant of type* $\delta \in (\bar{\delta},1]$ *the optimal discount rate is* $d^* = 0$. *The lower merchant type* $\underline{\delta}$ *and the higher merchant type* $\bar{\delta}$ *are:* $\underline{\delta} = \begin{cases} \frac{1-c(3-2R(1-s))}{1-c-2(1-R)(c-R(1+c)(1-s))} & s \le s' \\ 0 & s' < s \end{cases}$, $\bar{\delta} = \begin{cases} 1-\frac{2csR}{1-c+2(1-R)(1-s(1+c))} & 0 \le c \le c' \\ \frac{1-3c+2R(1-s)}{1-c-2(1-R)(c-2R(1-s))} & c' < c < 1 \end{cases}$,

where $s' = \frac{1-3c+2cR}{2cR}$, *and* $c' = 2R-1$.

Lemma 1 outlines the optimal discount rate for a merchant of type δ. Recall that for a merchant of type δ, *informed consumer* segment is δ, and *uninformed consumer* segment is $1-\delta$. First, there are two threshold merchant types, lower merchant type $\underline{\delta}$ and higher merchant type $\bar{\delta}$, which influence merchant's optimal discount rate strategy. In turn, while, $\underline{\delta}$ critically depends on the daily-deal publisher's choice of revenue sharing ratio s, $\bar{\delta}$ critically depends on the merchant's marginal cost. Second, a merchant with low δ has larger benefit from the sampling effect compared to loss due to the cannibalization effect as discount rate increases in the publisher channel. Hence, a merchant of type $\delta \in [0,\underline{\delta})$ offers the maximum discount rate $d^* = 1-R$. Third, as a merchant's informed consumer segment (δ) increases, the loss due to the cannibalization effect increases, and thus, the merchant lowers the discount rate. Hence, for a merchant with moderate $\delta \in [\underline{\delta},\bar{\delta}]$, the optimal discount rate ($d^* = \hat{d}$) is lower than maximum discount rate, and decreases in δ. This optimal discount rate depends on *uninformed consumers'* quality estimate R, marginal cost c, and the daily-deal publisher's revenue sharing ratio s. Fourth, a merchant with high proportion of informed consumers, loss due to cannibalization effect dominates the net benefits from the advertising and sampling effects, hence, a merchant of type $\delta \in (\bar{\delta},1]$ offers zero discount rate.

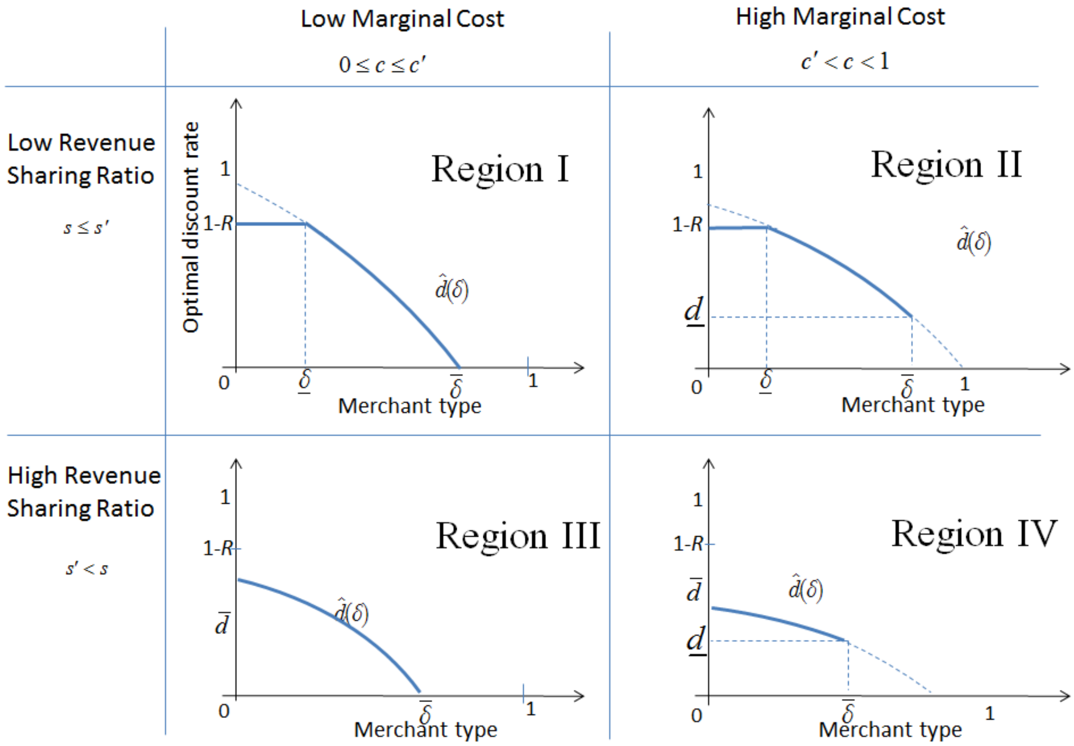

Figure 2: Optimal discount rates for different types of merchants

Figure 3 illustrates the discount rate strategy of a merchant (reported in Lemma 1) with reference to the merchant's marginal cost and the publisher's revenue sharing ratio. In the Region I and II, the publisher's revenue sharing ratio is relatively low, $s \le s'$. In this case, for a merchant with relatively low $\delta \in [0, \underline{\delta})$, the loss due the cannibalization effect and also the revenue sharing effect is low. Hence, some merchant with relatively low $\delta \in [0, \underline{\delta})$ offers the maximum discount rate $d^* = 1 - R$. On the other hand, when the publisher's revenue sharing ratio is relatively high, $s > s'$, the loss due to revenue sharing effect increases, therefore, a merchant decreases discount rate to reduce the loss due to revenue sharing effect and cannibalization effect. Hence, in the Region III and IV, a merchant of any type offers discount rate $d^* < 1 - R$.

In Region III and IV, the highest discount rate offered by a merchant is denoted by $d^* = \bar{d}$. The values of $\bar{d}$ is derived as a special case of Lemma 1, and is $\bar{d} = \dfrac{3 - c - 2R - 2(1 + c - R)s}{2(1 + c)(1 - s)}$ (Proof is in the

Appendix). Note that $\bar{d}$ decreases, as *uninformed consumers*' quality estimate (R) increases, or the merchant's marginal cost (c) increases.

In the Region I and III, a merchant of type $\delta = \bar{\delta}$ offers the lowest discount rate $d^* = 0$. Since the marginal cost is relatively low in these two regions ($0 \le c \le c'$), the merchant's price is low, and hence, she attracts some *uninformed consumers* to buy in the publisher channel even when the discount rate is zero. On the other hand, the merchant's marginal cost is relatively high ($c' < c < 1$) in the Region II and IV, leading to a higher regular price. If a merchant offers a discount rate lower than $\underline{d} = 1 - \frac{2R}{1+c}$ (Proposition 1), no uninformed consumer buys in the publisher channel. Hence, a merchant has no benefit from sampling effect, and incurs loss due to the cannibalization effect. This implies that it is never optimal for a merchant to offer discount rate lower than $\underline{d}$.

4.3 Impact of revenue sharing ratio on a merchants' discount rate strategy

As we show in Lemma 1 that a merchant's optimal discount rate depends on the daily-deal publisher's revenue sharing ratio. It is because the publisher's revenue sharing ratio directly decides the revenue sharing effect, and also indirectly influences the sampling and cannibalization.

Intuitively, a merchant needs to balance off the four effects of offering a deal on the publisher's website. The merchant will decrease the discount rate if the rate of decrease in the net effect of cannibalization and revenue sharing is faster than the decrease in the sampling effect; on the other hand, a merchant will increase the discount rate if the rate of increase in sampling effect is faster than the increase in the net effect of cannibalization and revenue sharing effect.

When the daily-deal publisher increases revenue sharing ratio (s), the merchant shares larger proportion of revenue generated in the publisher channel with the publisher, hence, the cost to the merchant due to the revenue sharing effect increases. The merchant can respond to this increase in cost of offering a deal by adjusting the discount rate on the publisher channel, which in turn impacts the magnitude of benefit from sampling effect and loss from cannibalization effect. Before we analyze the impact of the revenue sharing ratio on the merchant's optimal discount rate, first, we analyze the impact of the revenue sharing ratio on the two critical threshold values of merchant type, that is lower merchant type ($\underline{\delta}$) and higher merchant type ($\overline{\delta}$).

PROPOSITION 2 (a): *When the revenue sharing ratio (s) increases, the lower merchant type $\underline{\delta}$ (i) increases when marginal cost is relatively low, $c < \tilde{c}$, (ii) decreases when marginal cost is relatively high, $c > \tilde{c}$, and (iii) does not change when marginal cost $c = \tilde{c}$, where* $\tilde{c} = \dfrac{3-2R-\sqrt{9-8(2-R)R}}{2R}$.

Recall from Lemma 1, a merchant of type $\delta \in [0, \underline{\delta})$ offers optimal discount rate $d^* = 1 - R$, a merchant of type $\delta \in [\underline{\delta}, \overline{\delta}]$ offers optimal discount rate $d^* = \hat{d}$, and a merchant of type $\delta \in (\overline{\delta}, 1]$ offer optimal discount rate $d^* = 0$. Increase in $\underline{\delta}$ implies that some merchants, who offer discount rate $d^* = \hat{d} < 1 - R$, may offer the highest discount rate $d^* = 1 - R$. Conversely, decrease in $\underline{\delta}$ implies that some merchants, who offer highest discount rate $d^* = 1 - R$, may offer lower discount rate $d^* = \hat{d} < 1 - R$.

Proposition 2 reports that the impact of revenue sharing ratio (s) on lower merchant type ($\underline{\delta}$) is mediated by merchant's marginal cost (c). When the marginal cost is relatively low ($c < \tilde{c}$), the merchant's benefit from each *uninformed consumer* who buys the experience good in either period is high. This implies that for such a merchant, advertising and sampling effect is strong. Note that while the revenue gain to the merchant from sampling and advertising effects is in both periods, revenue loss to the merchant due to the cannibalization and revenue sharing effects is limited only to the first period. Therefore, when revenue sharing ratio (s) increases, some merchant type with lower marginal cost, who was offering a discount rate lower than the highest discount rate, increases the discount rate to gain more from sampling effect than incurring the loss due to increase in cannibalization effect. Hence, in this situation, lower merchant type ($\underline{\delta}$) increases as revenue sharing ratio (s) increases. On the other hand, when the marginal cost is relatively high ($c > \tilde{c}$), the revenue gain to the merchant from sampling and advertising effect is small in both periods. In this situation, when revenue sharing ratio (s) increase, some merchant type with higher marginal cost, who was offering the highest discount rate, decrease the discount rate to reduce cannibalization effect. This leads to decrease in lower merchant type ($\underline{\delta}$).

Note that the value of $\tilde{c}$ decreases in R, and $\lim_{R \to 0} \tilde{c} = 1/3$. This implies that irrespective of value of R, a merchant with marginal cost $c > 1/3$, who was offering discount rate $d^* = \hat{d} < 1 - R$ will continue to offer a discount rate lower than the highest discount rate.

PROPOSITION 2 (b): *When the revenue sharing ratio (s) increases, higher merchant type $\bar{\delta}$ decreases.*

Proposition 2 (b) illustrates the effect of the publisher's revenue sharing ratio on higher merchant type $\bar{\delta}$. Recall that for a merchant of type $\delta \in [0, \bar{\delta})$, the optimal discount rate is positive, and the higher merchant type ($\bar{\delta}$) offers zero discount rate. This implies that for a merchant of type $\bar{\delta}$, the cannibalization effect and sampling effect is zero, and the loss due to revenue sharing effect is equal to the gain from advertising effect. As revenue sharing ratio increase, the loss to a merchant due to revenue sharing effect increases. Therefore, as the revenue sharing ratio increases, the merchant of type $\bar{\delta}$ decreases, leading to decrease in the loss due to revenue sharing effect and increase in the gain from advertising effect. Note that a merchant has a higher advertising effect when the merchant type is lower.

After establishing the impact of revenue sharing ratio on the two critical merchant types, lower merchant type ($\underline{\delta}$) and higher merchant type ($\bar{\delta}$), we study the impact of revenue sharing ratio on the optimal discount rate strategy of a merchant type $\delta \in (\underline{\delta}, \bar{\delta})$.

PROPOSITION 3 (a): *If marginal cost is relatively low, $c < \tilde{c}$, then as revenue sharing ratio (s) increases, (i) the optimal discount rate offered by a merchant of type $\delta \in (\underline{\delta}, \tilde{\delta})$ increases; (ii) the optimal* *discount rate offered by a merchant of type $\delta \in (\tilde{\delta}, \bar{\delta})$ decreases; and (iii) the optimal discount rate offered by a merchant of type $\delta = \tilde{\delta}$ does not change, where $\tilde{\delta} = \dfrac{1-3c}{1-3c+2cR}$.*

As revenue sharing ratio (s) increases, a merchant's first period profit decreases because payment to the publisher increases. When the marginal cost is relatively low ($c < \tilde{c}$), a merchant has relatively high benefit from advertising and sampling effects. Moreover, a merchant with relatively low proportion of *uninformed consumers* (relatively low type, $\delta \in (\underline{\delta}, \tilde{\delta})$), has stronger sampling effect and has weaker cannibalization effect. This is so because proportion of *informed consumers*, for this low type merchant, who may buy at the discounted price in the publisher channel, is low. Hence, when the publisher increases revenue sharing ratio, a merchant can respond either by increasing discount rate to increase the gain from sampling effect, or by decreasing discount rate to reduce the loss due to cannibalization effect. The optimal strategy for a merchant of relatively low type ($\delta \in (\underline{\delta}, \tilde{\delta})$) is to increase the discount rate because she gains more from increased sampling effect than the loss due to increased cannibalization effect.

On the other hand, a merchant with relatively high proportion of *uninformed consumers* (relatively of high type, $\delta \in [\tilde{\delta}, \underline{\delta})$, has weaker sampling effects and has stronger cannibalization effect. This is so because the merchant's proportion of *informed consumers* in the publisher channel is high. Hence, when publisher increases revenue sharing ratio, a merchant of relatively high type ($\delta \in [\tilde{\delta}, \underline{\delta})$) responds by decreasing discount rate, because she gains more from decreased cannibalization effect than the loss due to decreased sampling effect.

Therefore, when the marginal cost is relatively low ($c < \tilde{c}$), the impact of increase in revenue sharing ratio on a merchant's optimal discount rate is non-monotonic (left panel, Figure 3). Note that the value of critical merchant type, $\tilde{\delta}$, decreases as quality estimate of uninformed consumers (R) increases, and marginal cost (c) increases, as long as $c < \tilde{c}$ where $\max \tilde{c} = 1/3$.

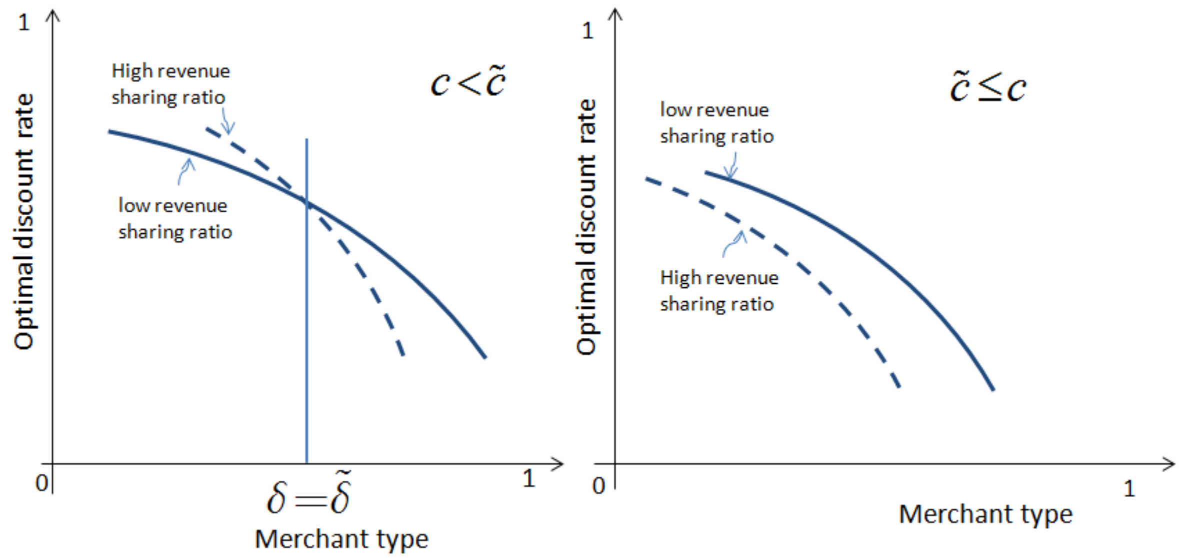

Figure 3: Impact on optimal discount rates when revenue sharing ratio increases

PROPOSITION 3 (b): *When marginal cost is relatively high, $c \geq \tilde{c}$, as revenue sharing ratio (s) increases, the optimal discount rate of a merchant of type $\delta \in (\underline{\delta}, \bar{\delta})$ decreases.*

When the marginal cost is relatively high ($\tilde{c} \leq c$), a merchant has relatively low benefit from advertising and sampling effects. For such a merchant, sampling effect is weak even if the merchant type is relatively low. Hence, when the publisher increases revenue sharing ratio, a merchant can respond either by increasing discount rate to increase the gain from sampling effect, or by decreasing discount rate to reduce the loss due to cannibalization effect. Since the sampling effect is weak, the optimal strategy for a merchant of type ($\delta \in (\underline{\delta}, \bar{\delta})$) is to decrease the discount rate because she gains more from decreased cannibalization effect than the loss due to decreased sampling effect.

The analysis above highlights that the changes in the daily-deal publisher's revenue sharing ratio have non-monotonic effects on a merchant's optimal discount rate strategy depending on the merchant type and the marginal cost. In the next sub-section, we study a merchant's optimal discount strategy when a publisher adopts a non-performance based scheme, and compare this with the optimal discount strategy under performance based scheme.

4.4 Merchant's discount rate strategy under non-performance based scheme

When the daily-deal publisher adopts a non-performance based scheme, the publisher charges a membership fee from each participating merchant who offers a deal on the publisher's website. In this situation, the membership fee paid by a merchant to the publisher is independent of the revenue generated in the publisher channel. If the membership fee charged by the publisher is f, then the two-period profit function of a merchant of type δ who offers a deal with discount rate d^{NP} in the publisher channel is:

$$\pi_M^{NP} = \mu(\delta D_{1i}^W + (1-\delta)D_{1u}^W)(p(1-d^{NP})-c) + (1-\mu)\delta D_{1i}^O(p-c) + (\delta D_{2i}^O + \mu(1-\delta)D_{2u}^O)(p-c) - f \quad (13)$$

, where $D_{1i}^W = (1-\frac{p(1-d^{NP})}{q})$, $D_{1u}^W = (1-\frac{p(1-d^{NP})}{R})$, and $D_{1i}^O = (1-\frac{p}{q})$.

Thus, the profit maximization problem is $\max_{\{d^{NP}\}} \pi_M^{NP}$. Comparing a merchant's profit function under a non-performance based scheme given in (13) with that under a performance based scheme given in (6), it is easy to see that the solution to this profit maximization problem is $d^{NP} = d^{NP*} = d^*(s=0)$. This implies that the optimal discount rate of a merchant under the non-performance based scheme is a special case of the optimal discount rate under the performance based scheme with zero revenue sharing ratio.

PROPOSITION 4: *If the daily-deal publisher adopts a non-performance based advertising, then compared to a performance based advertising scheme, a) if* $c < \tilde{c}$*, then a merchant of type* $\delta \in [\underline{\delta}^{NP}, \tilde{\delta})$ *offers a lower discount rate, that is,* $d^{NP*} < d^*$*, and b) if* $c < \tilde{c}$ *and merchant type is* $\delta \in [\tilde{\delta}, \bar{\delta}^{NP})$ *or if* $c \geq \tilde{c}$ *and merchant type is* $\delta \in [\underline{\delta}^{NP}, \bar{\delta}^{NP})$*, then such merchant offers a weakly higher discount rate, that is,* $d^{NP*} \geq d^*$.

First note that the merchant of type $\tilde{\delta}$ is defined in Proposition 3(a), and two critical merchant types in the case of non-performance based scheme, lower merchant type ($\underline{\delta}^{NP}$) and higher merchant type ($\bar{\delta}^{NP}$), are derived from Lemma 1, such as $\underline{\delta}^{NP} = \underline{\delta}(s=0)$ and $\bar{\delta}^{NP} = \bar{\delta}(s=0)$. The optimal discount rate under a performance based scheme (Lemma 1) may be higher or lower compared to non-performance based scheme, depending on merchant's marginal cost (c)and type (δ). This implies that adoption of non-performance based scheme has non-monotonic impact on the optimal discount rate of a merchant under some conditions. The economic intuition is as follows. When the publisher adopts a non-performance based scheme, a merchant does not incur the cost due to the revenue sharing effect. The merchant can respond either by increasing discount rate to increase the gain from sampling effect, or by decreasing discount rate to reduce the loss due to cannibalization effect. The optimal strategy for a merchant of relatively low type ($\delta \in [\underline{\delta}^{NP}, \tilde{\delta})$) and lower marginal cost ($c < \tilde{c}$) is to decrease the discount rate because she gains more from decreased cannibalization effect than the loss due to decreased sampling effect. On the other hand, the optimal strategy for a merchant of relatively high type ($\delta \in [\tilde{\delta}, \bar{\delta}^{NP})$) or higher marginal cost ($c \geq \tilde{c}$) is to increase the discount rate because she gains more from increased sampling effect than the loss due to increased cannibalization effect.

5. Merchant's participation decision

A merchant offers a deal only if the optimal profit in participating in the publisher channel is higher than the profit in the benchmark case, that is $\pi_D^* > \pi_B^*$. It is easy to see that a merchant's optimal profit in the benchmark case, that is, $\pi_B^* = \delta(1-c)^2/2$ (§ 4.1), is linearly increasing in merchant type (δ), and $\pi_B^*(\delta = 0) = 0$. From Lemma 1, we know that a merchant's optimal profit in offering a deal in the publisher channel is driven by the optimal discount rate strategy, which depends on merchant type (δ) and marginal cost (c). We define a merchant type as the indifferent merchant type, $\hat{\delta} \in (0,1)$, for whom the optimal profit of offering a deal in the publisher channel is the same as the optimal profit in the benchmark case, $\pi_D^* (\hat{\delta}) = \pi_B^*(\hat{\delta})$[6].

[6] For a closed form expression of the indifferent merchant type ($\hat{\delta}$), please see the Proof of Lemma 3 in the Appendix.

LEMMA 3: *The optimal profit of a merchant who offers a deal in the daily-deal publisher channel increases in the merchant type,* $\frac{\partial \pi_D^*}{\partial \delta} > 0$*; and the value of the indifferent merchant type (* $\hat{\delta}$ *) decreases as the publisher's revenue sharing ratio (* s *) increases,* $\frac{\partial \hat{\delta}}{\partial s} < 0$.

In the first period in the direct channel, a merchant of higher type has higher proportion of the *informed consumers* only who consider buying. Therefore, a merchant of higher type has higher profit in the direct channel in the first period. Moreover, a merchant of higher type also has higher proportion of *informed consumers* with higher willingness to pay for the experience good in the first period in the publisher channel. Therefore, a merchant of higher type also has higher profit in the publisher channel in the first period. Furthermore, a merchant of higher type, who offers the optimal discount rate, has higher profit in the second period in the direct channel. Hence, as merchant type increases, the merchant's optimal profit in offering a deal in the publisher channel increases.

When the revenue sharing ratio increases, the cost due to the revenue sharing effect increases, thus, the net gain to a merchant from offering a deal decreases. This implies that an increase in the publisher's revenue sharing ratio leads to lowering of a merchant's optimal profit in offering a deal in the publisher channel irrespective of merchant type. Hence, the value of indifferent merchant type ($\hat{\delta}$) decreases as the revenue sharing ratio increases.

For a merchant of type $\hat{\delta}$, the optimal profit of offering a deal in the publisher channel is the same as the optimal profit in the benchmark case, that is, $\pi_D^*(\hat{\delta}) = \pi_B^*(\hat{\delta})$. From the analysis in § 4, we know that for a higher merchant type, the benefits from sampling and advertising effects are lower, and the cost due to cannibalization effect is higher. This implies that the net of gain to a merchant from offering a deal in the publisher channel decreases as the merchant type increases. Since a merchant of type $\delta > \hat{\delta}$, has lower profit in offering a deal in the publisher channel than the profit in the benchmark case, $\pi_D^*(\delta) < \pi_B^*(\delta) \forall \delta > \hat{\delta}$, such merchant does not offer a deal in the publisher channel. Conversely, a merchant of type $\delta \leq \hat{\delta}$ has higher or equal profit in offering a deal in the publisher channel than the profit in the benchmark case, $\pi_D^*(\delta) \geq \pi_B^*(\delta) \forall \delta \leq \hat{\delta}$. Hence, a merchant of type $\delta \leq \hat{\delta}$ offers a deal in the publisher channel.

PROPOSITION 5: *If the marginal cost is relatively low, $c < 1/3$, then there exists a feasible indifferent merchant type $\hat{\delta}$ for any value of revenue sharing ratio. If the marginal cost is relatively moderate, $1/3 \leq c < (1+2R)/3$, then the existence of a feasible indifferent merchant type $\hat{\delta}$ depends on the value of revenue sharing ratio. If the marginal cost is relatively high, $c \geq (1+2R)/3$, then there is no feasible indifferent merchant type $\hat{\delta}$ for any value of revenue sharing ratio.*

The value of the indifferent merchant type $\hat{\delta}$ critically depends on the marginal cost and the publisher's revenue sharing ratio. The net gain to any merchant type from offering a deal decreases as revenue sharing ratio increases. However, the net gain to any a merchant type from offering a deal increases as marginal cost decreases. When a daily-deal publisher charges a revenue sharing ratio close to one, the cost to the merchant due to revenue sharing effect is very high. However, if the marginal cost is low ($c < 1/3$), then even when revenue sharing ratio is close to one, for a merchant of sufficiently low type, the benefits of sampling and advertising effects are higher than the cost to the revenue sharing effect. Therefore, there exists a merchant type who is better off from offering a deal for any feasible value of revenue sharing ratio.

When the marginal cost is moderate ($1/3 \leq c < (1+2R)/3$), the benefits of sampling and advertising effects are moderate to a merchant. If the revenue sharing ratio is high, then for some merchant who has a higher value of δ, the cost due to revenue sharing effect may be more than the benefits of offering a deal on the website. Therefore, for very high value of revenue sharing ratio, no merchant may offer a deal in the publisher channel. When the marginal cost is relatively high ($c \geq (1+2R)/3$), no merchant finds it beneficial in offering a deal in the publisher channel, even if the revenue sharing ratio is zero. This is so because, for a merchant of any type with high marginal cost, the cost due to cannibalization effect is higher than the benefits from sampling and advertising effects.

From Lemma 1, we know that the merchants' discount rate strategy and the optimal profit depend on *uninformed consumers*' quality estimate about a merchant's experience goods R and marginal cost c. Hence, a merchants' participation decision is also impacted by values of R and c. Increase in R leads to increase in the value of indifferent merchant type ($\hat{\delta}$). It is so because a merchant's optimal discount rate decrease if R increases, which leads to decreases in the cannibalization effect and increase in the optimal profit for any merchant type. On the other hand, as marginal cost c increases, benefits due to sampling and advertising effects decreases, and the optimal profit of offering a deal in the publisher channel decreases for any merchant type. Therefore, the value of indifferent merchant type decreases as marginal cost increases.

6. Revenue Sharing Scheme of Daily-Deal Publisher

The publisher's optimal revenue sharing strategy takes into consideration a merchant's response in term of optimal discount rate strategy (§4) and the participation decision (§5) which in turn depends on publisher's revenue sharing ratio. Before we analyze the publisher's optimal revenue sharing ratio, we report some properties of publisher's profit function.

LEMMA 4: *The daily-deal publisher's profit from a participating merchant of type δ, who has marginal cost c and uninformed consumers' quality estimate R, increases in revenue sharing ratio s, that is,* $\frac{\partial \pi_P(s \mid \delta, c, R)}{\partial s} > 0 \forall s \in \{s : \delta \leq \hat{\delta}(c, R \mid s)\}$.

Lemma 4 reports that the daily-deal publisher's revenue increases in revenue sharing ratio from a merchant as long as the revenue sharing ratio is such that the merchant participates, that is, the merchant's optimal profit of offering a deal in the publisher channel is not less than the optimal profit in the benchmark case. The economic intuition for this is as follows. First consider a merchant of type $\delta < \min\{\underline{\delta}, \hat{\delta}\}$. The optimal discount rate for this merchant is $d^* = 1 - R$ (Lemma 1) and this merchant does not reduce the discount rate as revenue sharing ratio increases as long as $\delta < \underline{\delta}$ holds. From such a merchant, the publisher extracts more revenue by increasing revenue sharing ratio (s). Now consider the other case where the merchant type δ is such that $\delta \in (\underline{\delta}, \hat{\delta})$. Even though such a merchant changes the optimal discount rate as publisher increases the revenue sharing ratio (Propositions 3(a) and 3(b)), the publisher's revenue increases in s as long as the merchant participates.

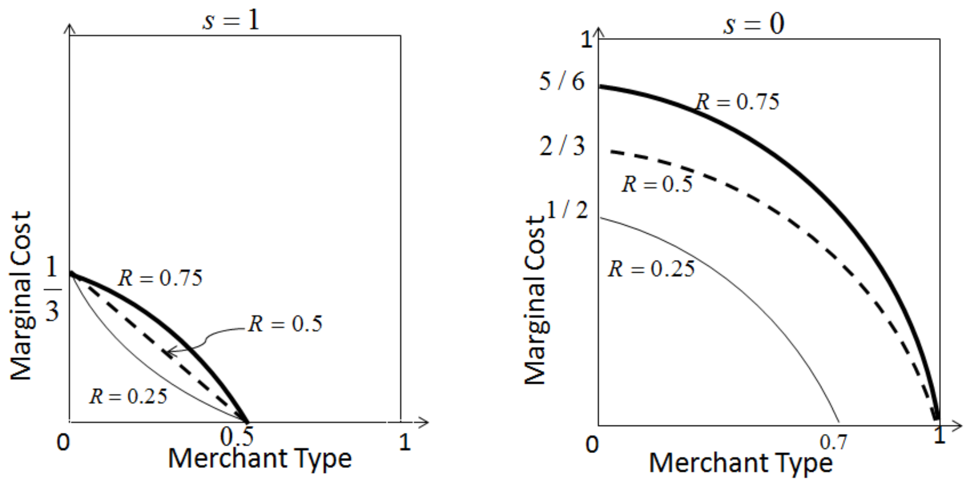

Figure 4: A merchant's participation decision with revenue sharing ratios, $s=0$ and $s=1$.

Before we analyze the optimal revenue sharing ratio of the publisher, we discuss two special cases, 1) $s=1$, and 2) $s=0$ (Figure 4). When the revenue sharing ratio is set to 1 ($s=1$), any merchant who has marginal cost $c > 1/3$ does not participate. Similarly, any merchant of type $\delta > 1/2$ does not participate. This is so because the cost due to the revenue sharing effect is more than the benefits from offering a deal in the publisher channel. A merchant of type $\delta \leq \hat{\delta}(s=1 \mid c, R) = \dfrac{1-4c+3c^2}{2-2c(1+R)+c^2(4-2R)}$ finds it beneficial to offer a deal (under the curve in Figure 4 left plot). As the *uninformed consumers*' quality estimate (R) increases, the set of merchant types who offer deals increases. When the revenue sharing ratio is set to 0 ($s=0$), any merchant whose marginal cost $c > \dfrac{2R+1}{3}$ does not participate. Moreover, any merchant whose type $\delta > \min\{\dfrac{(1+2R)^2}{1+12(1-R)R}, 1\}$ does not offer a deal. A merchant of type

$\delta \leq \hat{\delta}(s=0 \mid c, R) = \dfrac{1-3c(2-3c)+8R-4c(3+c)R-4(1-2c)R^2-4(1-c)(1+c-2R)R}{(1-3c)^2+4(3-c(3+2c))R-4(3-4c)R^2}$ finds it beneficial to offer a deal (under the curve in Figure 4 right plot). As the *uninformed consumers*' quality estimate (R) increases, the set of merchant types who offer deals increases.

Now we provide a general approach that a publisher should follow to offer the optimal revenue sharing ratio to a merchant. Let the merchant type be δ_m, the marginal cost be c_m , and the uninformed consumers' quality estimate be R_m. The approach is as follows.

Step 1: Check $\delta_m \leq \hat{\delta}(s=1 \mid c_m, R_m)$, if yes then the optimal revenue sharing ratio $s^* = 1$; if no, go to Step 2.

Step 2: Check $\delta_m > \hat{\delta}(s=0 \mid c_m, R_m)$, if yes, then this merchant does not participate; if no, then go to Step 3.

Step 3: Offer the optimal revenue sharing ratio $s^* = \hat{\delta}^{-1}(\delta_m \mid c_m, R_m)$, where $\hat{\delta}(s, c, R)$ is given in Lemma 3.

From the above approach that the publisher should offer a customized revenue sharing ratio to merchant whose type is $\delta_m \in \; \hat{\delta}(\; s=1 \mid c_m, R_m) \;, \hat{\delta}(s=0 \mid c_m, R_m)$. Due to operational reasons, this general approach of customized revenue sharing ratio for each merchant may not be feasible. Therefore, to provide some managerial guidelines, we assume that a daily-deal publisher offers two distinct revenue sharing ratios, $s \in \{s_L, s_H\}$, where $0 < s_L < s_H < 1$. The following proposition provides the publisher's revenue sharing ratio strategy.

PROPOSITION 6: *Given a merchant type δ_m, marginal cost c_m and uninformed consumers' quality estimate R_m, the daily-deal publisher's optimal revenue sharing strategy is to offer (a) a revenue sharing* *ratio* $s = s_H$ *to any merchant of type* $\delta_m \le \hat{\delta}(s = s_H \mid c_m, R_m)$ *; and (b) revenue sharing ratio,* $s = s_L$ *, to any merchant of type,* $\hat{\delta}\ (s = s_H \mid c_m, k_m) < \delta_m \le \hat{\delta}(s = s_L \mid c_m, R_m)$ *.*

The optimal revenue sharing strategy of the publisher is illustrated in Figure 5. The daily-deal publisher's optimal revenue sharing ratio is s_H for any merchant of type $\delta_m \le \hat{\delta}(s = s_H \mid c_m, R_m)$ (highlighted in the Region 3 in Figure 5). Note that any merchant in Region 3 has relatively low merchant type and low marginal cost. These types of merchants have strong benefits from advertising and sampling effects and low cost due to cannibalization effect in offering a deal in the publisher channel. Therefore, these merchant types are willing to participate even if the publisher charges a relatively high revenue sharing ratio (s_H) leading to high cost due to revenue sharing effect. A merchant of type $\delta < \hat{\delta}(s_H, c, R)$ gets higher profit of offering a deal in the publisher channel than the benchmark profit.

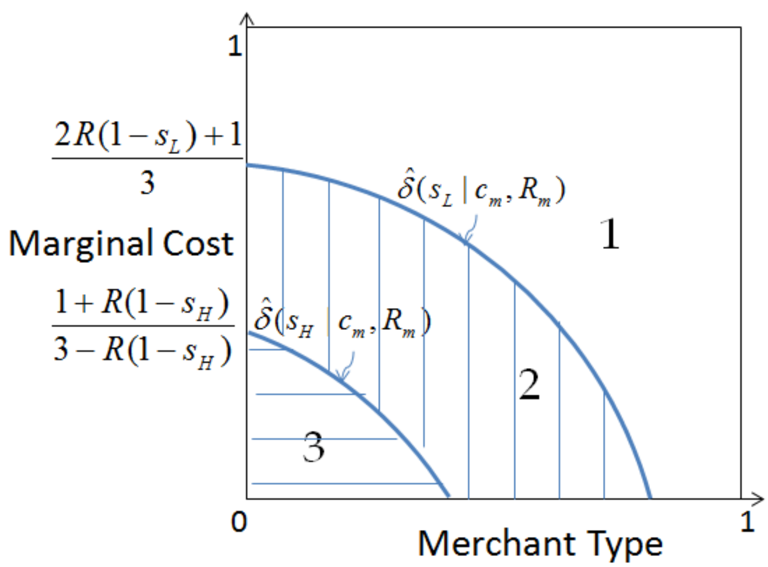

Figure 5: Daily-deal publisher's optimal revenue sharing strategy

The daily-deal publisher's optimal revenue sharing ratio is s_L for any merchant of type $\hat{\delta}(\ s_H \mid c_m, R_m) < \delta_m \le \hat{\delta}(s_L \mid c_m, R_m)$ (highlighted in the Region 2 in Figure 5). Note that any merchant in Region 2 has relatively moderate merchant type. These types of merchants have moderate benefits from advertising and sampling effects which decreases as marginal cost increases. Moreover, these merchant types have moderate cost due to cannibalization effect. Therefore, these merchant types do not participate if the publisher charges a relatively high revenue sharing ratio (s_H), but are better by participating when the publisher offers them lower revenue sharing ratio (s_L). On the other hand, a merchant of relatively high type ($\delta_m > \hat{\delta}(s_L \mid c_m, R_m)$) has low benefits, but high cost due to cannibalization effect. Therefore, these merchant types (Region 1 in Figure 5) do not participate.

7. Discussion

Internet technology has made it increasingly feasible to track the impact of advertising on consumer purchase actions. Performance-based advertising, like pay-per-purchase, allows merchants to pay to a publisher only if consumers' purchases can be credited to a specific advertising stimulus. This has led to popularity of daily-deal business models. Merchants view this business model of performance-based advertising favorably because it limits their risks when investing in new and often untested advertising technologies (Mahdian and Tomak, 2008). In a daily-deal advertising context, merchants pay to the daily-deal publisher only when consumers purchase goods at discounted prices in the publisher channel.

In this paper, we study the impact of performance-based contract on a merchant's discount rate and participation strategy in the context of daily-deal website. We develop a theoretical framework to study the strategic interaction between a merchant and a daily-deal publisher, and how a daily-deal publisher's performance-based revenue sharing contract affects a merchant' discount rate and participation decision. We find that a daily-deal publisher's choice of revenue sharing ratio has non-monotonic impacts on a merchant's discount rate. A merchant increases discount rate if marginal cost and merchant type are relatively low, and decreases discount rate if otherwise. The intuition is that when both marginal cost and merchant type are relatively low, a merchant can benefit from strong advertising and sampling effects by increasing the discount rate which leads to higher demand from *uninformed consumers* in the first and second periods. As the publisher's revenue sharing ratio increases, this merchant's profit decreases in the first period, and lends her more incentive to increase discount rate to acquire more *uninformed consumers*. On the other hand, if marginal cost or merchant type is relatively high, then advertising and sampling effect is not strong, thus a merchant decreases discount rate to reduce cannibalization effect when revenue sharing increases. Nonetheless, in both cases, a merchant deviates from the discount rate that she would set in a nonperformance-based advertising context. Therefore, a daily-deal website's performance-based revenue sharing contract causes distortion in a merchant's discount rate strategy.

We also show that a daily-deal publisher's revenue sharing contract affects a merchant's participation strategy. When a daily-deal publisher increases revenue sharing ratio, a merchant's revenue sharing effect increases, and thus, her profit of offering a deal on the website decreases. Since a merchant participates and offers a deal on the website only if the associated profit is more than the benchmark profit, fewer merchant types will participate compared to a nonperformance-based advertising context. However, this effect exists even in the nonperformance-based advertising context, as it arises due to the presence of both *informed and uninformed consumers* on the website.

Our results offer some insights about the economic dynamics in the context of daily-deal advertising. Our paper provides a daily-deal publisher a guideline about how a merchant would react to a performance-based revenue sharing contract. More importantly, it provides a publisher a direction of how to induce a particular decision from participating merchants. For instance, if a publisher wants to induce merchants to offer high discount rates on the website, she should have different treatments on revenue sharing contract for individual merchants. For some low merchant types, the publisher should increase the revenue sharing ratio; while for some high merchant types, the publisher should decrease the revenue sharing ratio, so that all participating merchants increase their discount rates on the website.

In the context of performance-based advertising, price distortion—price is higher than in a non-performance-based advertising context, may arise when the publishers and merchants make decisions in a decentralized setting (Dellarocas, 2012). In the case of daily-deal advertising, an advertising merchant decides the discount rate, while a daily-deal website decides the revenue sharing ratio, the proportion of merchant's revenue from a sale of deals on the daily-deal website as the payment for the advertising services. This decentralized setting in a daily-deal advertising context may also lead to price distortion. On the other hand, daily-deal advertising is different from the traditional advertising case. By offering price discount to attract new consumers on a daily-deal website, a merchant hopes to convert them into repeat consumers in the future. This implies that a merchant does not try to optimize the current profit, but also the future profit. This merchant's long-sighted perspective may change the dynamics of pricing decision and alter the price distortion in the context of daily-deal advertising.

Our stylized two-period game has some limitations. We do not consider the competition effect on a daily-deal website's strategy. Competition between rival daily-deal websites will potentially exert downward pressure on revenue sharing ratio. Furthermore, we can study a daily-deal website's impact of membership fee structure on its optimal fixed fee contract on transactions by the merchants. We leave these possible extensions for future research.

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Appendix A: Summary of Notation

μ proportion of consumers who are present on the daily-deal website	c marginal cost
δ proportion of *informed consumers* for a merchant	s daily-deal website's revenue sharing ratio
θ consumer valuation for quality	π_B merchant's profit in the benchmark case where there is not daily-deal website
R *uninformed consumers*' quality estimate	π_D merchant's profit in offering a deal in the publisher channel
q true quality of experience goods	D_{ti} merchant's demand from *informed consumers* on the website in period *t*
p merchants' regular price	D_{tu} merchant's demand from *uninformed consumers* on the website in period *t*
d discount rate on the website in the first period	