COMPETITIVE MOBILE MARKETING AND ITS IMPACT ON THE MOBILE ECO SYSTEM

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COMPETITIVE MOBILE MARKETING AND ITS IMPACT ON THE MOBILE ECO SYSTEM

Research

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Abstract

Targeting mobile consumers is similar to traditional targeting which focuses on stationary consumers in the sense both exploit data about consumers to tailor the marketing strategy. However, factors related to mobility such as travel direction or destination play an important role in a mobile consumer’s evaluation of competing products. This paper focuses on consumer targeting using such mobile data. We seek to answer the following research questions in the above context using a game theoretic model: (i) How are the price competition between sellers, seller profits, consumer surplus, and social welfare affected when one or both sellers acquire the information, and (ii) What are the sellers’ incentives to acquire the information? We do the analysis for the cases when the information includes only consumer location and when it includes both location and travel direction. We find that the ratio of unit time cost to unit transportation cost, which we refer to as the propensity for instant gratification, and the type of information offered by the app – location only or location and direction – shape the competition between sellers and their incentives to acquire the information. The findings have significant implications for the players in the mobile eco system.

Keywords: Mobile marketing, Location-based advertising, Price competition, Game theory.

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1 Introduction

Mobile commerce is now 35% of all eCommerce transactions globally. Mobile commerce accounted for 29% of all eCommerce transactions in the US, and in Japan and South Korea mobile commerce accounts for almost 50% of eCommerce transactions. The UK is performing at Asia levels and has a higher share of mobile transactions than Western countries. According to the mobile marketing firm xAd’s annual Path to Purchase study, more consumers rely on mobile devices than desktops to research purchase information and in the case of restaurants 60% of consumers relied solely on mobile devices in their purchase decision. The same survey further revealed that mobile consumers demonstrated a greater intent to purchase, greater immediacy for purchase, and a greater expectation or desire for a closer purchase location compared to desktop consumers, and these mobile consumer behaviors have strengthened over the years 2012-2015. The increasing significance of mobile commerce and mobile consumers is pushing sellers to develop their mobile marketing strategies.

Marketing products and services to consumers in motion is not new. For instance, billboards on highways advertise gas stations, restaurants, and lodging using information such as how far away the facility is – geographically or temporally. However, such traditional billboard advertising is not targeted or tailored for individual consumers. The unique aspects of mobile marketing relate to the use of data related to consumer mobility in targeting advertising. Even though the technical and business challenges such as location accuracy, pricing issues and privacy concerns (Dhar and Varshney 2011) have hindered its growth, the global mobile advertising market will surpass $100 billion in spending in 2016. Arguably the most widely used mobile data is consumer’ current location when she looks to purchase a product. Most smart devices are equipped with GPS technology that provides precise information about their location. Consequently, location-based services (LBS) have become a cornerstone of mobile marketing strategies. For instance, Best Western’s location-based mobile advertising campaign around airports and nearby competitors’ locations was named as one of the most successful mobile advertising campaigns in 2013 by mobilemarketer.com. However, location is not the only data related to mobility. Other data such as the direction of the travel, the intended destination, and the speed of travel are potentially useful and they can be inferred from the chronological history of the mobile device’s location. According to Google, “… location history allows Google to show you useful information based on where you’ve been with the devices that you’re signed in to with your Google Account. For example, you’ll see predictions for your frequent commutes and better search results. Your location info can also be used by any Google app or service, including the ads you see.” Such information offers opportunities for targeted marketing and revenue generation (Dhar and Varshney 2011).

The enormous promise and potential of mobile marketing has attracted the attention of both academics and practitioners in recent years. At one level, targeting mobile consumers is similar to traditional targeting which focuses on stationary consumers in the sense both exploit data about consumers to tailor the marketing strategy. Therefore, the insights from the large body of research in consumer targeting will likely apply to mobile marketing. However, factors related to mobility such as proximity to the seller, travel direction or destination, and time needed to reach the seller play an important role in a mobile consumer’s evaluation of competing products. These factors have not been explored by prior literature, partly because they are not particularly relevant for a stationary consumer. This paper examines how

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2 http://streetfightmag.com/2015/11/05/the-path-to-purchase-is-more-mobile-than-ever-xad-study/ [Accessed on March 22, 2016]
competitive consumer targeting using mobile information impacts the mobile eco system, specifically the price competition, seller profit.

Our context is the following. A mobile platform or an app has access to the location history of its users and is able to infer various mobile information such as travel direction for any specific user. The specific mobile information we consider is the consumer’s location and the travel direction. A user consults the app to search for a seller when she needs to buy a product. The sellers of the product compete for this user’s business using targeted promotions. The app displays the two nearest sellers, their locations, and offers to the user who is a potential consumer. A consumer’s net utility for a product depends not only on the price of the product but also on the transportation cost and the time to reach the seller. The app shares the mobile information about the consumer to sellers that have entered into an information-sharing contract with the app. Only a seller that has acquired the information will be able to use that information to decide the price to be offered to the consumer. The consumer evaluates the competing offers and chooses the one that provides a higher surplus.

We seek to answer the following research questions in the above context using a game theoretic model: (i) How are the price competition between sellers, seller profits, consumer surplus, and social welfare affected when one or both sellers acquire the information, and (ii) What are the sellers’ incentives to acquire the information? We perform the analysis for the cases when the information includes only consumer location and when it includes both location and travel direction. Furthermore, we consider two contracting arrangements. In the first arrangement, the app enters into an information sharing contract with only one of the two competing sellers. In the second arrangement, the app enters into an information sharing contract with both sellers.

The rest of the paper is organized as follows. Section 2 reviews the related literature in mobile marketing. We present our model framework and benchmark scenario in which there is no mobile marketing in Section 3. We analyze the impact of mobile information on the competition between sellers in section 4. We consider two mobile marketing scenarios: one in which the information includes only consumer location and one in which the information includes both location and travel direction and compare location-only and location-and-direction results. In section 5, we analyze sellers’ incentives to acquire the mobile information. Section 6 concludes with a summary and directions for future research.

2 Literature Review

Research on the economics of mobile marketing is recent and limited but a vast literature exists on the technical aspects of mobile computing. LBS and applications built around location-based advertising have dominated the technical research in mobile marketing, but ongoing research on trajectory data analysis and mobility knowledge discovery (Zheng 2015) suggest that LBS applications enhanced with real-time destination (Xue et al. 2013) and mobility prediction capabilities (Giannotti, 2011) are likely to become common in the not so distant future. Dhar and Varshney (2011) discuss potential business models for various types of services based on mobile data. They identify various stakeholders in the mobile ecosystem such as wireless service provider, location-tracking service provider, advertisers, and customers, and articulate the need of the business models to consider each stakeholder’s interest.

Research on the economics of mobile marketing has largely been either conceptual or empirical. Shankar and Balasubramanian (2009) provide a review of mobile marketing and discuss the drivers of mobile service adoption, the impact of mobile marketing on consumer decision making and formulation of an effective mobile marketing strategy. Ghose et al. (2013) find that ranking effects and location effects are higher on mobile device than on personal computers. Luo et al. (2014) find that mobile marketing such as temporal targeting and geographical targeting increase purchases, and there is a strong interaction between the effects of these two types of targeting if employed simultaneously. Li et al. (2014) find that advertising based on consumer’s mobile trajectory is more effective on average than location-based advertising alone. Fang et al. (2015) show that location-based mobile promotions have a significant impact on both impulsive purchases and planned purchases. Much of the research in this stream is based
on empirical and field experimental data. In contrast, we employ an analytical modeling approach to identify the impacts on mobile advertising on various players in the mobile eco system.

Our work is related to the vast literature on targeted advertising that uses the analytical modeling approach (see e.g., Shaffer and Zhang 1995, Chen et al. 2001, Chen and Iyer 2002, Iyer et al. 2005). Much of this literature assumes competing sellers that choose their targeting strategies based on information they have about consumers. Contextual advertising with the help of a common intermediary has also been examined (Gal-Or and Gal-Or 2005, Zhang and Katona 2012). Gal-or and Gal-or show that revenues as well as consumer welfare are higher when the degree of customization is higher. Zhang and Katona (2012) show that the targeting accuracy chosen by the intermediary depends on the intensity of the competition. Our work differs from this literature in that we examine the specific context of mobile marketing by modeling specific mobility related factors such as location, direction of travel, and time to reach the seller and analyze the impacts of these different types of data. Furthermore, while targeting advertising literature focuses on a scenario in which the sellers adopt a push-type strategy and control the advertising intensity, timing, and location whereas in our setup we focus on a pull-type strategy in which consumers determine the timing and location by initiating the search for a seller. Pai and Li (2014) was the only paper that we could find in the literature that examines location-based advertising and promotion using an analytical model. They show that the sellers will advertise more and provide higher discounts when the proportion of consumers with a mobile device increases, and that there are incentives to be a first mover to adopt location-based advertising. In contrast to this work, we focus on pure mobile marketing where all consumers use the mobile device, and model factors such as travel direction and time to reach seller. Furthermore, we consider a setting in which a mobile app, and not the sellers, has these mobile data and that sellers can obtain these data only from the mobile app. In essence, unlike prior studies, in this paper we consider consumers on the move in a context where the mobile data are owned by a party that is different from the sellers of products and services.

3 Model

We consider a physical marketplace where sellers are stationary sellers but consumers are mobile. The sellers offer a homogenous product and compete for consumers. We use Hotelling’s linear city model of infinite length. Sellers are located unit distance apart on the line. Without loss of generality, we normalize the number of consumers to 1. The consumer is equally likely to be traveling travelling either from left to right or from right to left. The need to consume the product for the consumer can arise at any random location. When the need arises, the consumer uses a mobile app to search for a seller. The app knows the current location and the travel direction (which it infers from the mobile trajectory of the consumer) of the consumer as well as locations of sellers. The app displays the two nearest sellers to the consumer when she uses the app. Clearly, one of the displayed sellers will be located to the right of the consumer and the other will be located to the left. We denote the seller located to the left as $A$ and the one to the right as $B$. The display from the app includes the consumer’s location, the sellers’ locations and the price charged by the sellers (i.e., the sellers’ offers). The consumer buys from the seller that offers a higher net utility. We assume that the intended destination of the consumer traveling in the L-R direction is to the right of B and that of the consumer traveling in the R-L direction is to the left of A. The consumer has a unit demand for the product.

The product offers the consumer a consumption utility of $v$. The consumer incurs three types of costs: (i) price: we denote the price charged by seller $i$ as $p_i$, (ii) transportation cost: this is the additional transportation cost incurred by the consumer to reach the seller, excluding the transportation necessary to reach her final destination from the current position. We denote the transportation cost per unit distance as $t$, and (iii) time cost: this represents the cost related to the time it takes for the consumer to reach the seller and consume the product. We denote the unit time cost as $\beta$.

We denote the distance between the consumer and $A$ as $\lambda$. We assume that $\lambda$ is distributed uniformly between 0 and 1, implying that the need for search occurs randomly over this interval. The transportation
cost incurred by a consumer located at $\lambda$ distance from A at the time of search and traveling L-R is $2\lambda t$ if she buys from A and zero if she buys from B. Note that seller B is on the way of this consumer’s travel to her destination and hence the consumer does not incur any additional transportation cost to buy from B, but she has to take a detour that covers an additional distance if she buys from A. On the other hand, if the consumer located at $\lambda$ distance from A is traveling R-L, then the transportation cost is zero if she buys from A and $2(1-\lambda)t$ if she buys from B. Essentially, proximity to one seller does not imply that the transportation cost is lower to consume from that seller. A consumer that is equi-distant from both sellers faces a higher transportation cost from A (B) than from B (A) if she is traveling L-R (R-L).

We assume that the time cost to reach a seller is directly proportional to the distance between the consumer and the seller. Without loss of generality, we assume that the proportionality constant is 1 so that for a consumer located at $\lambda$ distance from A, the time cost to reach A is $\beta \lambda$ and the time cost to reach B is $\beta(1-\lambda)$, regardless of the travel direction. Thus, proximity to one seller implies a smaller time cost to consumer from this seller than the other. We denote the ratio $r = \beta / t$ as the propensity for instant gratification. A higher value of $r$ implies that a faster consumption is relatively more important than additional transportation.

We denote the net utility of a consumer located at $\lambda$ distance from A traveling in direction $d, d \in \{L-R, R-L\}$ and buying from seller $i, i \in \{A, B\}$ as $U_i^d(\lambda)$. Then, we have the following:

\[
\begin{align*}
U^L_R &= v - 2\lambda t - \beta \lambda - p_A \\
U^L_R &= v - \beta(1-\lambda) - p_B \\
U^R_L &= v - \beta \lambda - p_A \\
U^R_L &= v - 2(1-\lambda)t - \beta(1-\lambda) - p_B
\end{align*}
\]

We assume full market coverage, i.e., $v$ is sufficiently large that all consumers buy. We assume that the marginal production cost is fixed and normalized to zero. All players are risk neutral and all know the parameters $v$, $t$, and $\beta$.

While the app knows the consumer’s location and travel direction, sellers do not unless they enter into a contract with the app to obtain these information. Communication of the information from the app to a seller occurs in real time, and therefore a seller obtaining this information from the app uses that information in its pricing decision. We do the analysis for the cases when the information includes only consumer location and when it includes both location and travel direction.

We consider three marketing scenarios - one in which there is no mobile marketing (benchmark) and two mobile marketing scenarios in our analysis. In the first mobile marketing scenario, the app offers only location information to sellers. In the second scenario, the app offers both location and travel direction to sellers. This analysis helps us to isolate the effect of location information and travel direction. We do not present the analysis for the scenario in which the app offers only the travel direction because we believe such a scenario is less likely.

In each mobile marketing scenario, we consider two contracting arrangements. In the first arrangement, which we refer to as the exclusive contract, the app enters into an information sharing contract with only one of the two competing sellers. Hence, only the seller that has entered into the contract with the app will receive the consumer’s mobile information from the app under mobile marketing. In the second arrangement, which we refer to as the non-exclusive contract, the app enters into an information sharing contract with both sellers. Thus, both sellers receive the mobile information under mobile marketing. In Section 4 where we focus on the impact of mobile marketing on the different players, we ignore the sellers’ cost of acquiring the information from the app. However, in Section 5 where we focus on sellers’ incentives to acquire this information, we assume that the app charges a fixed fee to provide the information.

The game sequence is the following. In stage 1, the consumer launches the app to buy the product. In stage 2, the app contacts the two nearest sellers about the potential consumer, and also sends the
consumer’s mobile information (no information under no mobile marketing, consumer’s location only or consumer’s location and direction under mobile marketing, depending on the scenario considered) to the seller(s) that has entered into a contract with the app. In stage 3, the sellers send their prices to the app which are then displayed to consumer. The consumer makes the purchase decision in stage 4 and payoffs are realized.

### 3.1 Benchmark Scenario

We use the scenario in which there is no mobile marketing as the benchmark to analyze the impact of mobile marketing. The following result characterizes the equilibrium when neither seller has access to the location or the travel direction of the consumer, where we use the superscript * to indicate the equilibrium outcome in the benchmark scenario.

**Lemma 1:** The equilibrium outcomes when neither seller has the consumer’s location nor the travel direction are given in Table 1.

<table>
<thead>
<tr>
<th>Price Charged by Sellers</th>
<th>$p_A^* = p_B^* = t + \beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Demand</td>
<td>$d_A^* = d_B^* = \frac{1}{2}$</td>
</tr>
<tr>
<td>Expected Seller Profit</td>
<td>$\pi_A^* = \pi_B^* = \frac{t + \beta}{2}$</td>
</tr>
<tr>
<td>Expected Consumer Surplus</td>
<td>$CS^* = v - \frac{5(\beta + t)}{4}$</td>
</tr>
<tr>
<td>Expected Social Welfare</td>
<td>$W^* = v - \frac{(\beta + t)}{4}$</td>
</tr>
</tbody>
</table>

**Table 1. Equilibrium Outcomes in the Benchmark Scenario**

{Proofs for all results are suppressed for lack of space.}

The results in Table 1 are similar to those found for the standard Hotelling model. If travel direction does not play any role in the transportation cost and there is no time cost, then we obtain results that are identical to those found in standard Hotelling model.

### 4 Impact of Mobile Information

In this section, we explore the impact of mobile information by comparing equilibrium outcomes in the mobile marketing scenarios with those in the benchmark.

#### 4.1 Location-only Marketing

In this scenario, mobile app offers only location information to sellers. Therefore, the targeting of consumers is based only on consumer’s location. Much of the current mobile marketing strategies such as location-based advertising falls under this category. We use $L_c$ and $L_m-c$ to denote the equilibrium outcomes in the exclusive location-only and non-exclusive location-only scenarios respectively.

4.1.1 Exclusive Contract

We assume, without loss of generality, only seller A enters into a contract and receives the consumer’s mobile information from the app.

**Lemma 2:** The equilibrium outcomes under exclusive location-only marketing strategy are given in Table 2.

| $r \leq 4$ | $r > 4$ |
and 3(β + 2t)
4(t + β)
otherwise

\[ p^b_t(λ) = \begin{cases} 
\frac{3(β + 2t)}{4(t + β)} & \text{if } λ ≥ \frac{3β}{4(t + β)} \\
\frac{3β - 2t}{4(t + β)} & \text{if } \frac{3β - 2t}{4(t + β)} ≤ λ < \frac{3β}{4(t + β)} \\
\frac{3β - 2t}{4(t + β)} & \text{otherwise}
\end{cases} \]

\[ p^b_t(λ) = \frac{3β + 2t}{4(t + β)} \]  
\[ p^b_t(λ) = \frac{β + 2t}{4(t + β)} \]

Expected Demand

\[ d^A = \frac{4t^2 + 7β}{8(t + β)} \]  
\[ d^B = \frac{4t + β}{8(t + β)} \]

Expected Seller Profit

\[ π^A = \frac{1}{32} \left( \frac{48t^2 + 56βt + 17β^2}{t + β} \right) \]  
\[ π^B = \frac{1}{16} \left( \frac{4t + β)^2}{16(t + β)} \right) \]

Expected Consumer Surplus

\[ CS^A = v - \frac{5t}{2} - \frac{β(t + 4β)}{4(t + β)} \]  
\[ CS^B = v - 2t + \frac{β(t - 4β)}{4(t + β)} \]

Expected Social Welfare

\[ W^A = v - \frac{β}{32} \left( \frac{16t + 13β}{t + β} \right) \]  
\[ W^B = v - \frac{4t^2 + 8βt + 5β^2}{16(t + β)} \]

Table 2. Equilibrium Outcomes under Exclusive Location-only Marketing Strategy

The interesting aspects of the equilibrium deal with the impacts of propensity for instant gratification. If the propensity for instant gratification is not high such that \( r ≤ 4 \), then A, by using targeted pricing, is able to attract all consumers regardless of their travel direction if they are located within a distance of \( \frac{3β}{4(t + β)} \), and attract only those that travel in its direction (i.e., R-L) if they are located beyond a distance of \( \frac{3β}{4(t + β)} \). On the other hand, when the propensity for instant gratification is sufficiently high such that \( r > 4 \), then A is able to attract all consumers regardless of their travel direction if they are located within a distance of \( \frac{3β - 2t}{4(t + β)} \), attract only those that travel in its direction (i.e., R-L) if they are located between a distance of \( \frac{3β - 2t}{4(t + β)} \) and \( \frac{3β}{4(t + β)} \), and unable to attract any consumer beyond a distance of \( \frac{3(β + 2t)}{4(t + β)} \) even with a zero price. Intuitively, when \( r > 4 \), for a consumer located beyond a distance of \( \frac{3(β + 2t)}{4(t + β)} \) finds that even taking a detour to B and paying a positive price to B is more profitable than incurring the cost of additional delay in consuming product A compared to product B. Interestingly, the survey by xAd revealed the tradeoff between when the consumers intend to purchase (which could be viewed as a proxy for the propensity for instant gratification) and distance they are willing to travel to reach the seller. The survey reported that 40% of consumers that expect to make a purchase within the hour prefer a seller within 5 miles and 9% prefer a seller within 1 mile of their locations. Among those consumers that expect to make a purchase within the day these numbers were respectively 33% and 5%.

Clearly, for any given consumer location, both A and B charge a lower price when \( r > 4 \) than when \( r ≤ 4 \). Thus, the competitive advantage enjoyed by A resulting from its exclusive access to the consumer location information diminishes and the competition between the sellers intensifies when the propensity for instant gratification is high. This is because travel direction provides a form of differentiation between
sellers (in addition to location), but a high $r$ reduces the relative significance of travel direction and hence the differentiation between the two sellers.

**Proposition 1:** Compared to the benchmark, under exclusive location-only marketing strategy:

a) the average price paid by a consumer of the seller that does not have a contract is higher if and only if $r < \frac{2}{11}(3+\sqrt{97}) = 2.34$ or $r > 4$,
b) the demand is higher only for the seller that has the exclusive contract,
c) the payoff of the seller that has the exclusive contract is higher, but the payoff of the seller that does not have the contract is higher if and only if $r < \frac{2}{7}(2+3\sqrt{2}) = 0.64$,
d) consumer’s surplus is higher if and only if $r > \frac{1}{2}(1+\sqrt{21}) = 2.79$, and
e) social welfare is higher if $r < \frac{2}{5} \approx 1.27$.

Proposition 1 shows that the demand and profit of the seller that has the exclusive contract are higher under the exclusive location-only marketing than in the absence of mobile marketing. A noteworthy finding is that the price competition is not necessarily more intense under the exclusive LBM than under no mobile marketing. The exclusive contract can benefit both sellers relative to the benchmark case if $r < 0.64$. Finally, consumers benefit from exclusive location-only marketing only when $r$ is moderate or high, the society benefits only when $r$ is sufficiently low. These are the direct results of how $r$ affects competition between sellers. More importantly, when $1.27 < r < 2.79$, the seller that has the exclusive contract benefits at the expense of everyone else.

4.1.2 Non-Exclusive Contract

In this sub section, we derive the outcome for the scenario in which both sellers acquire location information.

**Lemma 3:** Under non-exclusive location-only marketing strategy, there is a mixed strategy equilibrium. The equilibrium outcomes are given in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>$r \leq 2$</th>
<th>$r &gt; 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average</strong>&lt;br&gt;Price Paid</td>
<td>$p_A^{\pi_\ast} = p_B^{\pi_\ast} = 3t - \frac{\beta^2}{4(t + \beta)}$</td>
<td>$p_A^{\pi_\ast} = p_B^{\pi_\ast} = \frac{\beta(6t + \beta)}{2(t + \beta)}$</td>
</tr>
<tr>
<td><strong>Expected</strong>&lt;br&gt;Demand</td>
<td>$d_A^{\pi_\ast} = d_B^{\pi_\ast} = \frac{1}{2}$</td>
<td>$d_A^{\pi_\ast} = d_B^{\pi_\ast} = \frac{1}{2}$</td>
</tr>
<tr>
<td><strong>Expected</strong>&lt;br&gt;Seller Profit</td>
<td>$\pi_A^{\pi_\ast} = \pi_B^{\pi_\ast} = \frac{3t}{2} - \frac{\beta^2}{8(t + \beta)}$</td>
<td>$\pi_A^{\pi_\ast} = \pi_B^{\pi_\ast} = \frac{\beta(6t + \beta)}{4(t + \beta)}$</td>
</tr>
</tbody>
</table>

Table 3. Equilibrium Outcomes under Non-Exclusive Location-Only Marketing Strategy

{The probability distribution functions for A’s price and B’s price, consumer surplus and welfare expressions which are mathematically complex are suppressed because of lack of space}

**Proposition 2:** Compared to the benchmark, under non-exclusive location-only marketing:

a) Each seller’s price is higher if $r < \frac{2}{5}(1+\sqrt{11}) \approx 1.73$ and lower otherwise.
b) Each seller’s demand is the same as the benchmark demand.
c) Each seller’s payoff is higher if $r < 1.73$ and is lower otherwise.
d) Consumer’s surplus is lower.
e) Welfare is lower.
The comparison of key equilibrium quantities with those of the benchmark case has some similarities and some sharp differences in the exclusive and non-exclusive location-only scenarios. For instance, compared to the benchmark, the price competition is lower and seller profits are higher when $r$ is sufficiently small (although the threshold value of $r$ varies) under both exclusive and non-exclusive location-only scenarios. Both sellers benefit from mobile marketing in a larger range of $r$ in the non-exclusive scenario compared to the exclusive scenario. However, relative to the benchmark, while the seller that has the information is never hurt in the exclusive scenario, both sellers are hurt when $r > 1.73$ in the non-exclusive scenario. A key impact of non-exclusive scenario is that consumers and the society are always hurt, which implies that sellers can benefit at the expense of consumers and society when $r < 1.73$.

## 4.2 Location and Direction Marketing

In this scenario, mobile app offers location and direction information to sellers. We use $L+D_e$ and $L+D_{n,e}$ to denote the equilibrium outcomes in the exclusive location and direction marketing and non-exclusive location and direction marketing scenarios respectively.

### 4.2.1 Exclusive Contract

We derive the equilibrium outcome for the scenario in which only one of the sellers acquires location and direction information. We assume, without loss of generality, seller A acquires the location and direction information.

**Lemma 4:** The equilibrium outcomes under exclusive location and direction marketing strategy are given in Table 4.

<table>
<thead>
<tr>
<th>Regions</th>
<th>$r &lt; 1$</th>
<th>$r \geq 1$</th>
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<tbody>
<tr>
<td><strong>Price Charged by Sellers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$p_A^{L+D} =$ &amp; $p_A^{L+D} =$</td>
<td>&amp; $p_A^{L+D} =$</td>
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<tr>
<td>If $d = L - R$, &amp; If $d = L - R$, &amp; If $d = L - R$,</td>
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Table 4. Equilibrium Outcomes under Exclusive Location and Direction Marketing Strategy

**Proposition 3:** Compared to the benchmark, under exclusive location and direction marketing strategy:

a) the average price of only the seller that has the exclusive contract is higher,

b) the demand of only the seller that has the exclusive contract is higher,

c) the payoff of only the seller that has the exclusive contract is higher,

d) consumer's surplus is higher if and only if \( r \geq 1 \), and

e) social welfare is higher if and only if \( r < \frac{2}{5} \left( -1 + \sqrt{6} \right) \leq 0.58 \).

Proposition 3 shows that the seller that has the exclusive contract is better off under the location and direction marketing strategy than under the benchmark case on demand, average price, and profit dimensions whereas the seller that does not have the contract is worse off in all these dimensions. Clearly, the seller that has location and travel direction information has a dominant competitive advantage over the one that does not have any information. These results are regardless of the value of consumers’ propensity for instant gratification. Consumers benefit from exclusive location and direction marketing strategy only when \( r \) is sufficiently high. This is the result of the seller that has the information competing more aggressively for consumers when \( r \geq 1 \) than when \( r < 1 \). The society benefits only when \( r \) is sufficiently low, implying that the seller that has the contract with the app benefits at the expense of everyone else in the region \( 0.58 < r < 1 \). Furthermore, there is no region where all players in the mobile ecosystem benefit under the exclusive location and direction marketing strategy.

4.2.2 Non-exclusive Contract

**Lemma 5:** The equilibrium outcomes under non-exclusive location and direction marketing strategy are given in Table 5.

<table>
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<th>Expected Social welfare</th>
<th>( W^{I,0} = v - \frac{t}{8} \beta \left( \frac{13\beta + 16t}{t + \beta} \right) )</th>
<th>( W^{I,0} = v - \frac{t}{16} \beta \left( \frac{9t + 5\beta}{t + \beta} \right) )</th>
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| Price charged by sellers | \( p^{L,G_{\lambda}} = \)
|--------------------------|-------------------------------------------------|
| If \( d = L - R \), | \( 0 \) if \( \lambda < -\frac{\beta}{2(t + \beta)} \)
|                         | \( -2\lambda t + \beta(1 - 2\lambda) \) otherwise |
| If \( d = R - L \), | \( 0 \) if \( \lambda > \frac{\beta + 2t}{2(t + \beta)} \)
|                         | \( 2t(1 - \lambda) + \beta(1 - 2\lambda) \) otherwise |
| Expected Demand | \( q^{L,G_{\lambda}} = q^{L,G_{\lambda}} = \frac{1}{2} \) |
Table 5. Equilibrium Outcomes under Non-exclusive Location and Direction Marketing Strategy

**Proposition 4:** Compared to the benchmark, under non-exclusive location and direction marketing strategy:

a) the average price paid by a consumer is lower,
b) the demand is equal to the benchmark demand for each seller,
c) the payoff is lower for each seller,
d) consumer’s surplus is higher, and
e) social welfare is higher.

Proposition 4 reveals that the non-exclusive location and direction marketing strategy benefits consumers and the society at the expense of seller profits, regardless of the propensity for instant gratification, compared to the benchmark case. Our findings demonstrate that offering the location and direction information to both competing sellers hurts the sellers on the average, compared to offering the information to only one seller. Clearly, non-exclusive contract results in a more severe competition between the sellers than exclusive contract. However, we note that it is only the seller that has the exclusive contract loses when the exclusivity is removed, but the loss suffered by this seller offsets the gain realized by the other seller. Consumers and the society are better off when there are no exclusive restrictions on the information sharing contract.

### 4.3 Comparison of Location-only and Location and Direction

Our findings reveal that sellers are hurt on the average when targeted mobile marketing accounts for consumers’ travel direction as well as location compared to location alone, under both exclusive and non-exclusive contracting arrangements. Targeting based on consumer direction (in addition to location) benefits only the seller that has the exclusive contract and only when the propensity for instant gratification is sufficiently high. Consumers benefit when sellers use the direction information also except when the propensity for instant gratification is high and the mobile operator deploys an exclusive contract. While the society benefits from a non-exclusive contract targeting consumers based on travel direction also, it does not always benefit under the exclusive contract.

### 5 Seller Incentives to Acquire Information

The results of Section 4 shows that targeting mobile consumers using location and travel direction affect the different players in the mobile eco system in different ways and the impacts depend on the type of information and whether one or both firms have the information. An important question faced by sellers is whether they should enter into a contract with the app. The answer to this question clearly depends on the price charged by the app for the information. In this section, we explore the sellers’ decisions to acquire mobile information assuming that the app offers the information for a fixed fee.

We derive the subgame perfect equilibrium for the following sequence of the events. In stage 1, the app offers to sell the information it has about the consumer to each firm for a fixed price of $c$. In stage 2, each firm simultaneously decides to either accept or reject the contract. In stage 3, consumers search for sellers and firms submit their price offers simultaneously. Finally, consumer evaluates the competing offers and chooses the one that provides a higher surplus and all players realize their payoffs in stage 4. We assume that $c$ is not too high that neither seller finds it profitable to acquire the information.
5.1 Location Information

**Proposition 5:** When the app offers only location information, only one seller acquires the information when the propensity for instant gratification is moderate (i.e., \(-8c + 8t + 2\sqrt{16c^2 - 44ct + 22t^2} \leq \frac{4(2c - 2t + \sqrt{4c^2 - 5ct + 7t^2})}{3t} < \frac{4}{5}(-1+\sqrt{21}) \geq 2.87\)) and both sellers acquire the information otherwise.

Recall from Proposition 2, a low propensity for instant gratification softens the competition and benefits both sellers, and therefore, both are induced to adopt mobile marketing if the cost of information is not too high. If the propensity for instant gratification is moderate or high, sellers are hurt if both acquire information. When only one seller acquires the information, while the seller that does not acquire the information is hurt and the other benefits, the loss to the former is not significant; however, the increased competition combined with the cost of acquiring the information results in only one seller acquiring the information. The benefit enjoyed by the seller that possesses the information exclusively and the hurt suffered by the seller that does not have the information increase with \(r\), which induce both firms to acquire the information when the propensity for instant gratification is high.

5.2 Location and Direction Information

**Proposition 6:** When the app offers location and direction information, only one seller acquires the information when the propensity for instant gratification is low (i.e., \(r \leq \frac{8t - 2t + 2\sqrt{16c^2 + 4ct - 2t^2}}{3t}\)), and both sellers acquire the information otherwise.

Propositions 5 and 6 reveal that system-wide adoption of mobile marketing (non-exclusive scenario) depends critically on the information used for targeting consumers. If the propensity for instant gratification is high, a system-wide adoption of mobile marketing is obtained regardless of information type. On the other hand, if the propensity for instant gratification is low, while system-wide adoption of mobile marketing is obtained when only location information is offered, only a partial adoption is obtained when both location and direction information are offered.

6 Implications and Conclusion

Factors related to mobility such as consumer’s location and travel direction play an important role in a mobile consumer’s evaluation of competing products. This paper focuses on consumer targeting using such mobile data. We analyze how competition between sellers is affected when one or both sellers acquire mobile information and what sellers’ incentives are to acquire the information. We do the analysis for the two scenarios: one in which the information includes only consumer’s location and one in which the information includes both location and travel direction.

Our findings show that the type of information offered by the app and the ratio of unit time cost to unit transportation cost, which we refer to as the propensity for instant gratification, shape the competition between sellers and their incentives to acquire the information. We find that under mobile marketing, the price competition is lower and seller profits are higher when the propensity for instant gratification is sufficiently small (although the threshold value of \(r\) varies) under both exclusive and non-exclusive location-only scenarios. Both sellers benefit from mobile marketing in a larger range of \(r\) in the non-exclusive scenario compared to the exclusive scenario. Moreover, offering location and direction information further intensifies price competition compared to offering only location information. While the seller that has mobile information is never hurt in the exclusive scenario, both sellers are hurt in the non-exclusive scenario. While consumers and society benefit from location and direction information under non-exclusive contract, consumers and society are worse off under location-only non-exclusive contract. Consumers and society may benefit from each type of mobile information under the exclusive
contract. Consumers benefit only when $r$ is sufficiently high and the society benefits only when $r$ is sufficiently low.

When consumers have a high propensity for instant gratification, both sellers acquire the mobile information offered by the app, but both sellers are worse off compared to the benchmark where neither seller has the information, leading to a prisoners’ dilemma situation, regardless of the information type. On the other hand, when consumers have a low propensity for instant gratification, if only location information is offered, both sellers acquire the information and both sellers benefit compared to the benchmark case, and if both location and direction information are offered, only one seller acquires the information in the equilibrium, and the one that acquires the information benefits and the other loses compared to the benchmark. When the propensity for instant gratification is moderate, if only the location information is offered, one seller acquires the information in the equilibrium and the one that acquires the information benefits and the other loses compared to the benchmark, and when location and direction are offered, both acquire the information and both are hurt.

The type of information offered by the app affects the thresholds that separate the high, moderate, and low propensity for instant gratification regions. The thresholds are smaller when both location and direction are offered than when only location information is offered.

The increasing growth in mobile marketing suggests that it is here to stay. Consequently, a comparison of the location-only marketing and the location and direction marketing strategies is valuable to marketers. The results provide insights into a mobile app platform’s issues related to product design – the mobile information type to be offered –, the type of contract – exclusive or non-exclusive, and pricing. On the other hand, the implications for a consumer involve issues related to disclosure and use of the mobile information. From a social planner’s perspective, our results show that, regardless of the propensity for instant gratification, the non-exclusive location and direction marketing strategy benefits consumers and the society at the expense of seller profits.

We made a number of simplifying assumptions. First, we assumed that there is a single platform provider or app. Existence of multiple apps complicates the analysis in several ways. The apps may provide different mobile information, and the two sellers may use different apps. The analysis of the case when apps offer different mobile information, and the sellers use different apps is challenging and requires further research. Second, we assume that platform provider uses fixed pricing for different contracts. Future research should address platform providers’ pricing decision and the type of the contract it offers to maximize its payoff. Third, we assumed that platform provider knows the consumer’s travel direction with certainty. However, platform provider may infer travel direction with some uncertainty. Future research should address the uncertainty about travel direction.
References
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