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Free samples, profits, and welfare: The effect of market structures and behavioral modes

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ABSTRACT

This paper addresses an important and underresearched issue in the economics and marketing literatures: what are the managerial and social consequences when firms use business models that are based on the dissemination of free samples? We develop an analytical model of free samples for *both* digital and physical goods that addresses three fundamental managerial and social questions. First, what is the effect of different market structures (i.e., monopoly and oligopoly) and cost structures on optimal marketing policy and prices? Second, what is the effect of different behavioral modes on prices and free samples? Third, how do different market structures and behavioral modes affect social welfare?

The main conclusion is that a number of standard results do not hold when firms have the option of selling products *and* of distributing free samples. For example, the optimal strategy for oligopolists who produce homogeneous goods and coordinate their marketing policies is to *increase* – not decrease – the quantity of sold output. Similarly, under well-defined cost and demand conditions, monopoly can lead to a socially inferior outcome to competition. From a policy viewpoint, the managerial and social welfare implications of free samples depend on the type of market structure (monopoly or oligopoly) *and* the behavioral modes chosen by the firms in an industry (e.g., whether to coordinate their free sample policies or to behave non-cooperatively).

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1. Introduction

Business models in a wide spectrum of industries are based on marketing strategies that rely heavily on the distribution of free samples of their products. These industries cover the gamut and range from those that produce physical products (e.g., shampoo and cold medications) to those that sell digital goods (e.g., software). Indeed, today this "two-sided market" model based on free samples has emerged as *the* revenue engine for all of the biggest Web companies, from Facebook and MySpace to Google. For a succinct discussion see "The Economics of Giving It Away," *The Wall Street Journal*, 1/31/2009.

Consider the following examples. The *Wall Street Journal* currently offers a free two-week subscription to its online version, after which subscribers need to pay. Reportedly, the *Wall Street Journal* is pursuing a strategy of blending free and paid content on its Web site. Tapoulos is a popular music game for the iPhone that is distributed free. The goal is to induce millions of people to try the free version and to encourage a significant fraction of them to upgrade to paid versions. More generally, many online firms base their entire business models on giving out the product for free and obtaining revenue solely from advertisements on their Web sites.

These examples bring up a number of critical managerial and social issues. From a managerial viewpoint, will the dissemination of free samples lead to higher or lower prices for paid products? Will the dissemination of free online products on a Web site lead to higher advertising revenues for those Web sites? What are the effects of the market structure (monopoly or oligopoly) and different behavioral modes (e.g., partial or full cooperation) on the quantity of free samples and prices? From a social viewpoint, is it true that, if firms are allowed to distribute free samples, monopoly will always lead to socially inferior results to competition? Are the managerial and social results different for digital goods (those with zero marginal costs) and physical goods (those with positive marginal costs)?

Despite the importance and growing use of business models that are based on distributing free samples, the analytical marketing and economic literatures in this area are sparse. In particular, this literature on sampling appears to have focused heavily on digital goods (i.e., products for which the marginal costs are zero and consumers purchase at most one unit) — not on physical goods (i.e., products whose marginal costs are positive). For example, Peitz and Waelbroeck (2006) developed a music download model that allows for a special type of product differentiation in which the profit-maximizing multiproduct monopolist charges the same price across all products (p. 909).

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Our focus is significantly different from Peitz and Waelbroeck (2006). In contrast to their model, our model focuses on homogeneous products. However, it considers both monopolistic and oligopolistic models in which firms can pursue different game strategies (e.g., partial or full cooperation). Our model considers both digital goods (whose marginal costs are zero) and physical goods (whose marginal costs are positive and vary across both trial and regular sizes). Our model focuses on how firms' marketing policies affect *both* profits (firm-level and industry-level) and welfare. Finally, our model allows competing firms to choose the intensity of free sampling. Peitz and Waelbroeck (2006) assume that the firm's sampling decision is binary (i.e., whether or not to offer free downloads to consumers).

The key managerial and welfare questions we examine are as follows. First, what is the effect of different market structures (i.e., monopoly and oligopoly) on optimal free sample policy and prices? Second, what is the effect of different behavioral modes (e.g., whether firms coordinate their free sample policies or not) on the firm's marketing policy, and how do the results vary across market structures? Third, what is the effect of different market structures and behavioral modes on social welfare when firms distribute free samples? As noted previously, for generality the model considers both digital goods and physical goods.

The main finding is that a number of standard results in the literature do not hold when firms have the option of selling products *and* of distributing free samples. For example, when oligopolists coordinate their free sample policies, both the total quantities of free samples *and* sold output increase. Interestingly, there are well-defined cost and demand conditions under which monopoly can be *socially superior* to a competitive market structure. Finally, the managerial and social welfare results depend on the type of market structure (i.e., monopoly or oligopoly) and the behavioral modes chosen by firms (e.g., whether to coordinate their free sample policies or to behave non-cooperatively).

2. The conceptual framework

Consider a set of firms operating in an industry that sells homogeneous products. Assume that each firm seeks to maximize its stock price under uncertainty. Let the firms be indexed by $i = \{1, 2, \ldots, n\}$. Each firm i, $i \in n$ determines the total quantity of output to produce (z_i), how many units of its final output to distribute as free samples (y_i), and how many units to sell (x_i) at the market price p. Each firm distributes free samples to consumers to develop consumer awareness of the product and to increase consumers' demand (willingness-to-pay) for the product the firm plans to sell. Thus, the market inverse demand function $p = f(x,y) + u$ depends on the total quantity of output sold by all firms $x = \sum_{i \in n} x_i$, the total quantity of free samples distributed by all firms $y = \sum_{i \in n} y_i$, and a stochastic disturbance term u. We assume the standard regularity condition $\frac{\partial p}{\partial x} < 0$. In addition, $\frac{\partial p}{\partial y} > 0$ and $\frac{\partial^2 p}{\partial y^2} < 0$. That is, consumers' reservation prices (willingness-to-pay) increase when more free samples are distributed; in particular, there are diminishing returns to distributing free samples. Note that, in a monopolistic market, the firm obtains the full benefit from expanding primary demand for the product category. Hence, there is no spillover effect. In contrast, in an oligopolistic market, the benefits also accrue to the other firms in the industry. This represents the full spillover case.

Assume that firms share the same production processes and face the same set of input prices. Thus, they share the same cost function given by $TC_i = C(x_i, y_i)$, $i \in n$, where i indexes firms, x_i represents the units of output sold, and y_i the number of units of output distributed as free samples. For any firm i, the marginal cost of production for sold output is $\frac{\partial TC_i}{\partial x_i} > 0$ and the marginal cost of free samples is $\frac{\partial TC_i}{\partial y_i} \geq 0$. Note that, in general, these marginal costs need not be the same. For example, in industries where products are divisible (e.g., cereal), the firm has the option of making two sizes: a small trial size and a regular size. Hence the optimal policy for the cereal manufacturer may be to distribute small trial sizes of free samples (whose marginal costs are low) to minimize the cannibalization of sold output of regular-sized units (whose marginal costs are high).

Each firm chooses its marketing strategy to maximize its stock price under uncertainty (defined later). Note that the firm's production decisions are endogenous; in particular, each firm must decide how many free samples (y_i) to distribute and how many units to sell (x_i). Furthermore, in general, for any firm, both the optimal amount of free samples distributed and the optimal quantity of sold output depend on the market structure (i.e., whether the industry is a monopoly or an oligopoly) and the behavioral mode (e.g., whether firms compete or cooperate).

In general, oligopolists can choose a variety of behavioral modes, ranging from full to partial cooperation (Wilkinson and Young, 2002). For example, oligopolists can compete in output but cooperate in their sampling policies. Consequently, it is necessary to examine different behavioral modes. We analyze four different combinations of market structure and behavioral mode:

Model 1: *Non-cooperative game* where firms compete fully in choosing their optimal free sample and output policies.
Model 2: *Semi-cooperative game* where firms cooperate in their free sample policies but act non-cooperatively when choosing their sold output.
Model 3: *Monopoly* where firms cooperate fully in choosing both their free sample and sold output policies.
Model 4: *Social welfare maximization* where free sample and output policies are chosen to maximize social welfare.

Note that one can examine other combinations of market structure using our framework. For example, firms can cooperate in output but compete in free samples. Detailed results are available from the first author.

3. The model

To analyze the managerial and welfare implications of different models, it is necessary to solve for the equilibrium values of the decision variables: the quantities of free samples distributed and of sold output.

Let the inverse market demand function for the product under uncertainty be:

$$p = d + 2\alpha\sqrt{\sum_{i \in n} y_i} - b \sum_{i \in n} x_i + u \tag{1}$$

where d, α, and b are positive constants and u is a stochastic disturbance term with mean $E(u)$. Note that α is a parameter that captures the effectiveness of free samples. For example, suppose consumers are highly uncertain about the benefits from using a new product. Then the demand-enhancing effect of free samples will be high (i.e., α will be large). In general, we expect the value of α to decrease over the product life cycle as consumers become better informed; furthermore, α will be higher for experience goods than for search goods. Similarly, b measures price sensitivity with respect to the quantity sold. Thus, the higher b is, the more price sensitive the market demand is for the product in question. Alternatively, the lower b is, the less differentiated the product.

Let the total cost function for each firm be given by the linear function:

$$C(x_i, y_i) = cx_i + (c + \delta)y_i \quad i = 1, \ldots, n \tag{2}$$

where $c \geq 0$ represents the marginal cost of producing a unit of output and $\delta \geq 0$ represents the differential cost per unit resulting from the distribution of free samples. Note that $\delta < 0$ for industries where the firm can make and distribute smaller trial sizes as free samples (e.g., soap and toothpaste); in addition, $c = 0$ for digital products (e.g., software). Hence, in terms of model structure, it is not necessary to distinguish between physical and digital products.

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