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Advertising Response to New Entry

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Abstract

Empirical studies on advertising outlays report that incumbent firms change their advertising strategies in response to a new entry. While some incumbents reduce their advertising expenditures, others increase them in comparison to the pre-entry period. Existing literature on strategic advertising in entry games is mostly focused on entry deterrence, meanwhile no theoretical foundation is found in this literature to explain what determines a change in the advertising strategies in the case of entry accommodation. The present work considers four types of advertising and builds a model that examines how accommodating incumbents decide on advertising. The paper also provides results on how advertising is related to the size of the entry. Particularly, informative advertising and advertising enhancing product differentiation allow greater entry, while complementary and business-stealing advertising result in fewer entries since they reduce residual demand for potential entrants. Depending on whether post-entry competition variables are strategic substitutes or strategic complements, incumbent firms may increase or reduce their advertising outlays in response to new entries.

JEL codes: D43, L13

Keywords: Advertising, Entry Accommodation, Industrial Organization

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1 Introduction

Following a seminal paper by Bain (1956), advertising became an important and credible tool through which incumbent firms can limit, regulate or even deter entry. More recently, Sutton (1991) empirically supported this idea and added that advertising can also alter the market structure. Despite the obvious entry deterrence effect of advertising, little research has been done to explain the advertising behavior of incumbent firms when they do not block, but accommodate new entry. A set of papers devoted to entry accommodation mainly consists of empirical studies which measure advertising responses to new entry, or consider what market characteristics (e.g. concentration ratio) can explain a significant advertising response of incumbent to new entry (e.g. Cubbin and Domberger (1988), Thomas (1999)). However, no theoretical foundation is provided to explain this response.

The present paper is motivated by the research of Cubbin and Domberger (1988), where the authors examine advertising responses to new entries of incumbent firms using data on 42 companies in 17 consumer good industries. Their empirical research suggests significant¹ changes in advertising intensity of 16 companies: five companies reduced their advertising intensity after entries and eleven companies increased their advertising expenditures. Cubbin & Domberger further show that a positive reaction (increase in advertising) to the entry is highly expected when the incumbent is a dominant firm in the industry and its market is either static or declining. In other words, a dominant firm fights for its market share more aggressively if the market is not growing.

The empirical research of Cubbin and Domberger (1988) offers an evidence that incumbent firms indeed react to new entries². However, their paper does not provide a theoretical framework that could explain why different firms (even in the same indus-

¹The authors use a model of structural breaks to see how incumbent firms react to new entry. The breaks happen at the date of the new entry in a given industry. Corresponding dummy variables indicate a value of the reaction. Their estimates are statistically significant at 95% level in 16 cases.

²A summary and an interpretation of the empirical results of Cubbin&Domberger(1988) are presented in Appendix A.

tries) choose different advertising strategies: some of them reduce advertising and others increase their advertising intensities. Moreover, nothing is known about how the advertising response of an incumbent depends on the size of the entry: whether greater entry makes an incumbent firm more or less aggressive in advertising.

The present paper considers four different types of advertising: complementary advertising, informative advertising, persuasive advertising changing a distribution of consumer preferences (business-stealing) and persuasive advertising enhancing product differentiation. There are two research questions stated in the paper. The first one considers if different types of advertising lead to different reactions of an incumbent firm in the case of entry accommodation. In fact, as shown in Appendix A, incumbent firms react differently to new entries. The second question considers how advertising response is related to the size of the entry. Specifically, it is of great interest to know: if greater entry makes an incumbent firm more or less aggressive in advertising if entry is exogenous; and if more intensive advertising can limit new entry when the number of entering firms is endogenously determined.

The rest of the paper is organized as follows. Section 2 reviews related literature. Section 3 considers the models of duopoly and multiple entry. Sections 4 and 5 are results and conclusion respectively.

2 Literature Review

Economic analysis of advertising begins with Marshall (1890, 1919) and Chamberlin (1933). Prevailing at that time, the neoclassical school did not consider advertising as a way to influence the functioning of the markets, since neoclassical principles assumed complete information, full rationality and fixed preferences. Moreover, under the assumption of competition, only market price determines supply and demand decisions and thus there is no purpose in advertising. However, Marshall (1890, 1919) argued that adver-

tising has two economic roles: on the one hand, it can convey useful market information and thus it is constructive; on the other hand, it can really persuade consumers to switch between sellers and therefore it is combative. Later, Chamberlin (1933) integrated advertising in his model of product differentiation by arguing that advertising is a source and an attribute of product differentiation. Following his thought, advertising creates entry barriers, decreases demand elasticity and redistributes market shares, since it is able to change the tastes and preferences of consumers. These conclusions of Chamberlin (1933) and the development of the theory of imperfect competition motivated a more detailed study of the economics of advertising.

Modern economics points out three approaches to advertising: persuasive, informative and complementary. Persuasive advertising is the first view on advertising. It was introduced by Chamberlin (1933) and implies that advertising is a way that firms can change the tastes and preferences of consumers, create entry barriers and obtain market power. This theoretical approach was then empirically verified by Comanor and Wilson (1969, 1974). In their research, the authors show that market power measured as profit rates is strongly and significantly dependent on advertising intensity. Their conclusions imply that advertising may have a real entry-deterrence effect. This result is parallel to the one of Sutton (1974), who shows that advertising intensity reaches higher levels in oligopolies and moderately concentrated markets with differentiated products. The latter case is discussed in Fehr and Stevik (1998), where the authors considered three different ways that persuasive advertising is used in a duopoly. Their results suggest that when firms compete in persuasive advertising, changing consumers' tastes or reservation prices, they result in a wasteful advertising war and thus both would be better off if the firms could agree not to advertise. In contrast, persuasive advertising enhancing product differentiation benefits both, since it makes market demand less elastic and softens price competition. In Bloch & Manceau (1999), the authors show how business-stealing persuasive advertising can shift the distribution of consumers' preferences towards the advertised product and thus it can steal consumers from rivals. Persuasive advertising is

therefore socially overprovided and anticompetitive.

The second approach is related to the Chicago school and initiated by Stigler. In his study, Stigler (1961) considers an informative role of advertising. Particularly, he assumes that markets with full information are not real and therefore consumers lack necessary information on prices, product characteristics and the existence of sellers and products in general. Informative advertising can remedy information asymmetry and improve market performance. These ideas motivated research on informative advertising, for example, Butters (1977), Grossman and Shapiro (1984) and the interaction of advertising and search. In the latter case, when consumers face searching costs, advertising provides consumers with market information and stimulates search (e.g. Robert and Stahl, 1993). It also allows firms to retain positive profits with high searching costs (e.g. Anderson and Renault, 2006) and finally it can expand demand (e.g. Konishi and Sandfort, 2002).

A complementary view on advertising is the third approach. It is firstly introduced in Becker and Stigler (1977) and then developed in Becker and Murphy (1993). This approach implies that advertising is a good in itself and thus it directly enters the utility function of consumers. Consequently, firms can directly influence consumers' willingness to pay through advertising. For example, complementary advertising can take the form of an image or brand-building advertising, or advertising developing the social-economic attributes of the advertised good. Therefore, advertising firms are able to increase a consumer's valuation for the good and reservation price respectively. Sutton (1991, 2012) uses brand advertising (which is purely complementary advertising) to study how the sunk costs of advertising influence the entry. He finds that the harder (more expensive) it is to develop a brand, the greater the number of firms in the market. In contrast, the cheaper it is to advertise, the fewer firms will remain in the market. Sutton explains it with an endogenous sunk cost approach, a special type of sunk costs that limit the level of concentration in the industry. Recently, this approach was used by Etro (2014) and Senyuta and Zigic (2016) to investigate the entry effect of R&D outlays.

Different types of advertising (or view on advertising) predict different effects on mar-

ket functioning. Persuasive and complementary advertising increase market power and thus are anticompetitive. On the contrary, informative advertising remedies information problems and thus promotes competition, since better informed consumers become more sensitive to price changes. Welfare effects therefore also vary depending on the nature of advertising.

One of the most interesting questions related to the economics of advertising is how incumbent firms use advertising when they expect a new entry. Comanor and Wilson (1974) have empirically shown that firms use advertising to secure market power. Advertising creates reputation, product differentiation, and high penetration costs to entrants. Thus advertising is able to deter entry if incumbent firms are not willing to allow a new entry.

When incumbent firms do not consider entry deterrence profitable, they may accommodate a new entry. In this case, however, incumbent firms may also change their advertising strategies if new entry occurs. This phenomenon is empirically shown in Cubbin and Domberger (1988). The authors investigate the advertising behavior of incumbent firms in 17 consumer goods industries and conclude that pre-entry advertising intensity significantly differs from post-entry advertising. Particularly, they find that a positive response is highly expected among dominant firms in declining or stagnant markets. In other words, larger firms have more to lose and thus they aggressively fight for their market share by the means of advertising. The authors also find that different firms demonstrate different responses: some of them increase their advertising intensity and others reduce their advertising. This result is interesting but the authors do not suggest any explanation why firms demonstrate different reactions.

Using different approaches to advertising, the present paper answers what explains the different advertising responses of incumbent firms in the case of entry accommodation. In addition, the paper considers multiple entry and studies how advertising response depends on the number of new firms when entry is exogenous and how the size of the endogenous entry depends on the advertising strategy of the incumbent firm.

3 Model

The model considers four types of advertising and studies whether an incumbent firm overinvests or underinvests in advertising when it accommodates an entrant. One has to understand underinvestment and overinvestment as accommodation strategies coined in Fudenberg and Tirol (1984). Following their theory, when an incumbent firm accommodates an entrant, it overinvests if it strategically increases its advertising to maximize profit³. In contrast, an incumbent underinvests when it strategically reduces its advertising to maximize profit when it allows entry. Depending on the nature of post-entry competition Fudenberg and Tirol (1984) classify overinvestment into *Fat Cat* and *Top Dog* business strategies, and underinvestment into *Puppy Dog* and *Lean and Hungry Look*.

This paper identifies what business strategy is chosen when an incumbent significantly reacts with a change in advertising intensity to the entrant. Four types of advertising are analyzed: complementary advertising, persuasive advertising changing the distribution of tastes and preferences, persuasive advertising enhancing product differentiation, informative advertising expanding demand.

3.1 Duopoly

The model uses a framework of horizontal product differentiation *a la* Hotelling. It considers a post-entry duopoly market where an incumbent and entrant are located at the edges of a unit line. The location of given consumer i is shown by x_i uniformly distributed on $[0, 1]$. When an incumbent accommodates, the firms compete in prices, although the incumbent reacts to the entry with a change in advertising, so post-entry competition is conditional on the strategic choice of the incumbent's advertising. It is assumed that the

³Both underinvestment and overinvestment are compared to the pre-entry level of (advertising) investment (or to the level of non-strategic investment). When a new entry occurs, an incumbent firm overinvests if it exceeds the pre-entry (non-strategic) level. The reverse holds for underinvestment.

incumbent chooses advertising optimally and it is implemented effectively⁴. Advertising technique is explained by its corresponding effect on demand and is defined by a function of advertising expenditures $A(a)$, where a is an advertising intensity⁵ of incumbent. This function is increasing and convex in a : $A'(a) > 0$, $A''(a) > 0$, $A(0) = 0$. Marginal costs are constant and normalized to zero. At the first stage the incumbent decides on strategic advertising. At the second stage entry occurs and firms choose their outputs and prices simultaneously.

Case 1. Complementary advertising

Following the idea of Stigler and Becker (1977) and Murphy and Becker (1993), complementary advertising implies that advertising directly enters the utility function of consumers because it complements an advertised good. This type of advertising increases a consumer's reservation price since the consumer possesses preferences for complementary advertising. Examples of this kind of advertising are image advertising or any advertising delivering social status when the advertised good is consumed. Additionally, complementary advertising is used to build a brand name or image associated with an advertised product.

If an incumbent decides to invest in complementary advertising, the advertising should influence the reservation price. So when consumer i buys from the incumbent, her utility is $U^1(x_i) = R + R(a) - tx_i - p_1$ and if she buys from the entrant $U^2(x_i) = R - t(1 - x_i) - p_2$. The value of t is a measure of product differentiation. A function of $R(a)$ shows how complementary advertising influences the reservation price⁶, while R stands for an objective valuation of the good (it is similar to both incumbent and entrant). Figure 1 demonstrates that advertising shifts up a graph of willingness-to-pay by $R(a)$

⁴All advertising messages reach consumers and none are lost. Advertising is correctly understood by consumers.

⁵Advertising intensity is a common notation for the amount of advertising produced by firms. It can be measured in units of advertising, the target fraction of consumers or a share of advertising expenditures in total revenue.

⁶Since $R(a)$ shows the utility from complementary advertising, $R(a)$ has regular features of utility function: $R'(a) > 0$, $R''(a) < 0$.

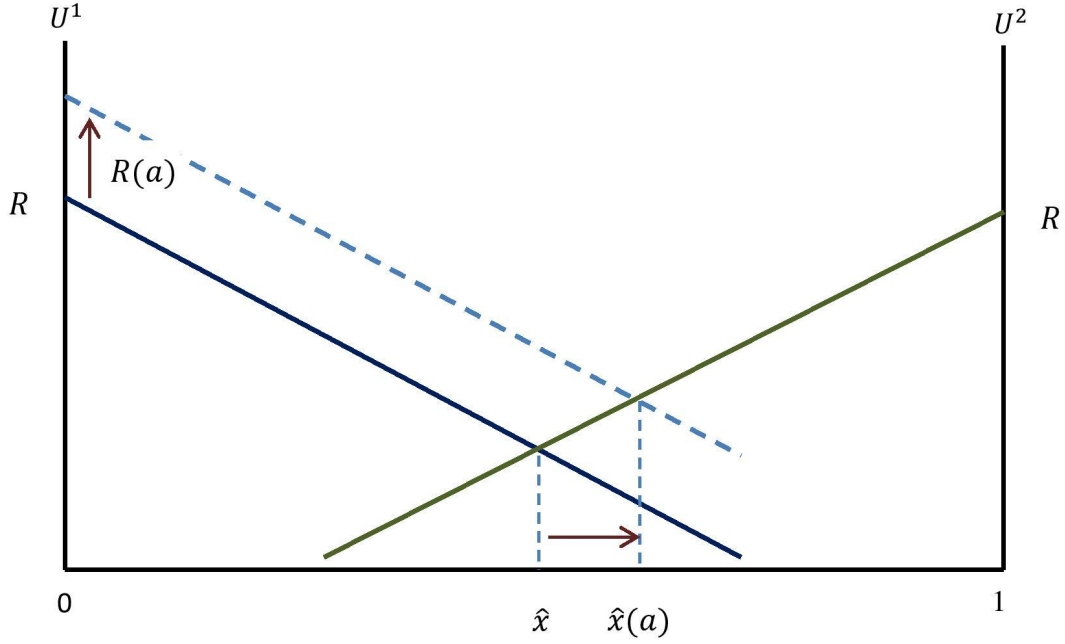


Figure 1: Complementary Advertising

if consumers buy from the incumbent. In turn, this changes the location of indifferent consumer \hat{x} to $\hat{x}(a)$.

As in any model *a la* Hotelling the location of the indifferent consumer is determined by condition $U^1(\hat{x}) = U^2(\hat{x})$ which is identical to the following equation:

$$R + R(a) - t\hat{x} - p_1 = R - t(1 - \hat{x}) - p_2 \quad \text{or}$$

$$\hat{x} = \frac{R(a) + p_2 - p_1 + t}{2t}$$

All consumers with x_i lower than \hat{x} buy from the incumbent and a share of $(1 - \hat{x})$ buy from the entrant⁷. Profit functions are formed in a regular manner:

⁷Since the paper is focused on accommodation only, interior solutions only are considered. Corner solutions are exactly the cases of the entry-deterrence and thus they are omitted. A condition on accommodation is in Appendix C.

$$\begin{aligned}\pi^1(p_1, p_2, a) &= p_1 \left[\frac{R(a) + p_2 - p_1 + t}{2t} \right] - A(a) \\ \pi^2(p_1, p_2, a) &= p_2 \left[1 - \frac{R(a) + p_2 - p_1 + t}{2t} \right]\end{aligned}$$

Joint first order conditions are determined by the partial derivatives of the profit functions with respect to corresponding prices:

$$\begin{aligned}\frac{\partial \pi^1}{\partial p_1} &= \frac{R(a) + p_2 - 2p_1 + t}{2t} = 0 \\ \frac{\partial \pi^2}{\partial p_2} &= \frac{-R(a) - 2p_2 + p_1 + t}{2t} = 0\end{aligned}$$

The best response functions are given by $p_1(p_2, a) = \frac{R(a) + p_2 + t}{2}$ and $p_2(p_1, a) = \frac{-R(a) + p_1 + t}{2}$. So post-entry competition results in equilibrium prices $p_1(a) = \frac{R(a) + 3t}{3}$ and $p_2(a) = \frac{-R(a) + 3t}{3}$. As one can see, complementary advertising of an incumbent reduces the markup of an entrant which in turn indicates its aggressiveness.

The total effect of complementary advertising on an incumbent's profit is shown by:

$$\frac{d\pi^1}{da} = \left[-\frac{p_1}{2t} \frac{R'(a)}{3} \right] + \left[\frac{R'(a)p_1}{2t} - A'(a) \right]$$

The term in the first brackets is the strategic effect of complementary advertising and the term in the second brackets is the direct effect. Following the approach of Tirol and Fudenberg (1984), the direct effect is the effect of the strategic investment that directly influences the profit function. Strategic effect, in turn, influences the profit function through the choice of the strategic variable of the rival. Since $R'(a) > 0$, strategic effect is negative, the incumbent underinvests in complementary advertising and the corresponding business strategy is *Puppy Dog*. Enhancing the value of the advertised good for consumers, the incumbent is able to capture a bigger share of the

market and increase its markup, while relatively lowering the valuation of the entrant's good⁸. A comparison of strategic and non-strategic⁹ complementary advertising is shown in Appendix B.

Case 2. *Persuasive advertising changing the distribution of tastes and preferences*

Persuasive advertising changes consumers' tastes and preferences but does not directly enter the utility function of consumers¹⁰. Fehr and Stevik (1998) explain the role of persuasive advertising and conclude that it either shifts consumers' preferences towards the advertised product or increases product differentiation. In the first case, persuasive advertising changes the distribution of tastes and preferences, i.e. in terms of the present model it shifts the location of the indifferent consumer and thus captures a part of consumers located near the entrant. Figure 2 demonstrates that the distribution of consumers is shifted with persuasive advertising. Since consumers are distributed uniformly, this change in distribution is a horizontal shift of the willingness-to-pay curves to the right. A function of $x(a)$ shows a shift in the location of an indifferent consumer so that the incumbent steals $x(a)$ part of consumers located next to the entrant¹¹.

$$\hat{x} = \frac{p_2 - p_1 + t}{2t} + x(a)$$

The incumbent sells to \hat{x} share of the market and the entrant obtains a residual share of $(1 - \hat{x})$. The resulting profit functions are as follows:

⁸In this sense, complementary advertising is similar to vertical differentiation when an incumbent invests in higher quality.

⁹When incumbent firm does not take into account the strategic effect of advertising that it has on post-entry action of the entrant, the incumbent firm acts non-strategically. In other words, the incumbent chooses advertising intensity based on the direct effect of advertising only. While when it considers both strategic and direct effects of advertising together, it acts strategically. If non-strategic advertising is smaller (greater) than strategic, the incumbent overinvests (underinvests).

¹⁰Persuasive advertising does not enter the utility function directly as goods or complementary advertising do. Instead, it enters the utility function indirectly, changing the relation between the goods. In other words, it affects the mathematical form of the utility function.

¹¹More intensive advertising shifts demand more and thus $x'(a) > 0$, although the marginal effectiveness of advertising decreases $x''(a) < 0$.

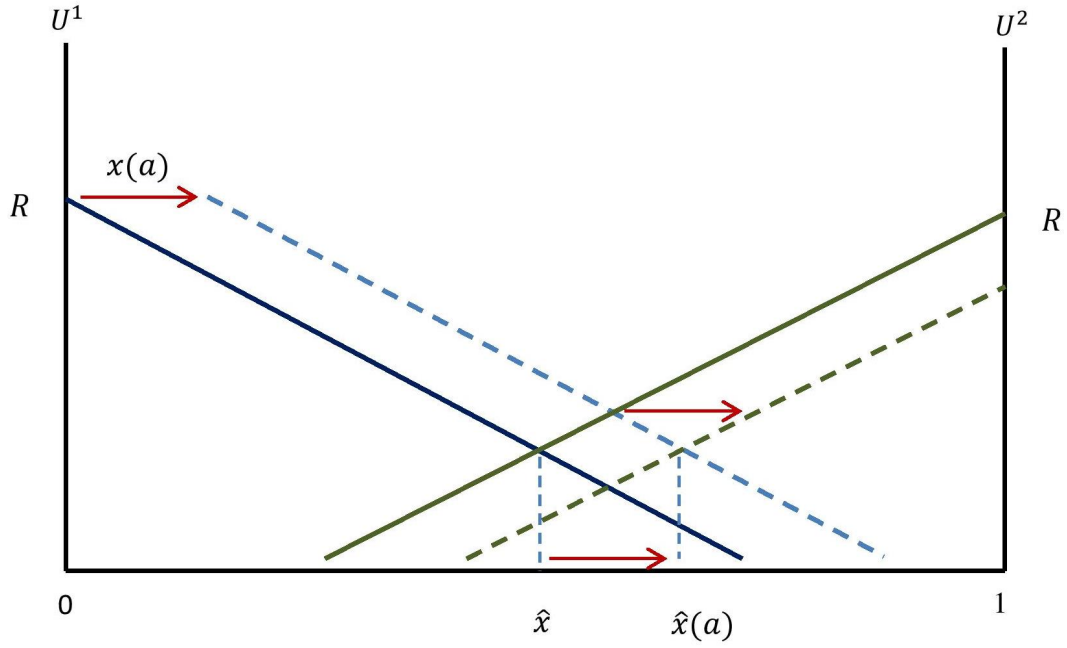


Figure 2: Persuasive Advertising Changing Distribution of Tastes and Preferences

$$\begin{aligned}\pi^1(p_1, p_2, a) &= p_1 \left[\frac{p_2 - p_1 + t}{2t} + x(a) \right] - A(a) \\ \pi^2(p_1, p_2, a) &= p_2 \left[1 - \frac{p_2 - p_1 + t}{2t} - x(a) \right]\end{aligned}$$

Joint first order conditions are determined by the partial derivatives of the profit functions with respect to corresponding prices:

$$\begin{aligned}\frac{\partial \pi^1}{\partial p_1} &= \frac{p_2 - 2p_1 + t}{2t} + x(a) = 0 \\ \frac{\partial \pi^2}{\partial p_2} &= \frac{-2p_2 + p_1 + t}{2t} - x(a) = 0\end{aligned}$$

Reaction functions are defined by $p_1(p_2, a) = \frac{2tx(a)+p_2+t}{2}$, $p_2(p_1, a) = \frac{-2tx(a)+p_1+t}{2}$ and the corresponding prices are $p_1(a) = \frac{2tx(a)+3t}{3}$, $p_2(a) = \frac{-2tx(a)+3t}{3}$. Persuasive advertising reduces the entrant's markup and thus lowers the entrant's profitability. In turn, it shows that the incumbent is a tough competitor.

The total effect of persuasive advertising is defined by:

$$\frac{d\pi^1}{da} = \left[-p_1 \frac{x'(a)}{3} \right] + [p_1 x'(a) - A'(a)]$$

The term in the first brackets is a the strategic effect of persuasive advertising and the term in the second brackets is the direct effect. Since $x'(a) > 0$ strategic effect is negative, the incumbent underinvests in persuasive advertising that changes the distribution of tastes and preferences, thus the corresponding business strategy is *Puppy Dog*. A comparison of strategic and non-strategic persuasive advertising is in Appendix B.

Case 3. *Persuasive advertising enhancing product differentiation*

The second type of persuasive advertising enhances product differentiation or brand loyalty. In both cases persuasive advertising makes demand less elastic and thus increases market power. In the framework of the given model, advertising influences the value of t and hence changes the slope of the willingness-to-pay curves¹². Figure 3 demonstrates that these graphs become steeper. To see how advertising affects post-entry competition, one has to look at the location of the indifferent consumer, profit functions and response functions. A point of the indifferent consumer is the same as in a traditional model of Hotelling. However, the degree of product differentiation is the function of advertising in the present setting: $\hat{x} = \frac{p_2 - p_1 + t(a)}{2t(a)}$.

$$\begin{aligned} \pi^1(p_1, p_2, a) &= p_1 \left[\frac{p_2 - p_1 + t(a)}{2t(a)} \right] - A(a) \\ \pi^2(p_1, p_2, a) &= p_2 \left[1 - \frac{p_2 - p_1 + t(a)}{2t(a)} \right] \end{aligned}$$

Joint first order conditions are determined by the partial derivatives of the profit

¹²The function of $t(a)$ shows how persuasive advertising changes the degree of product differentiation. Higher advertising intensity results in greater perceived differences between products, $t'(a) > 0$.

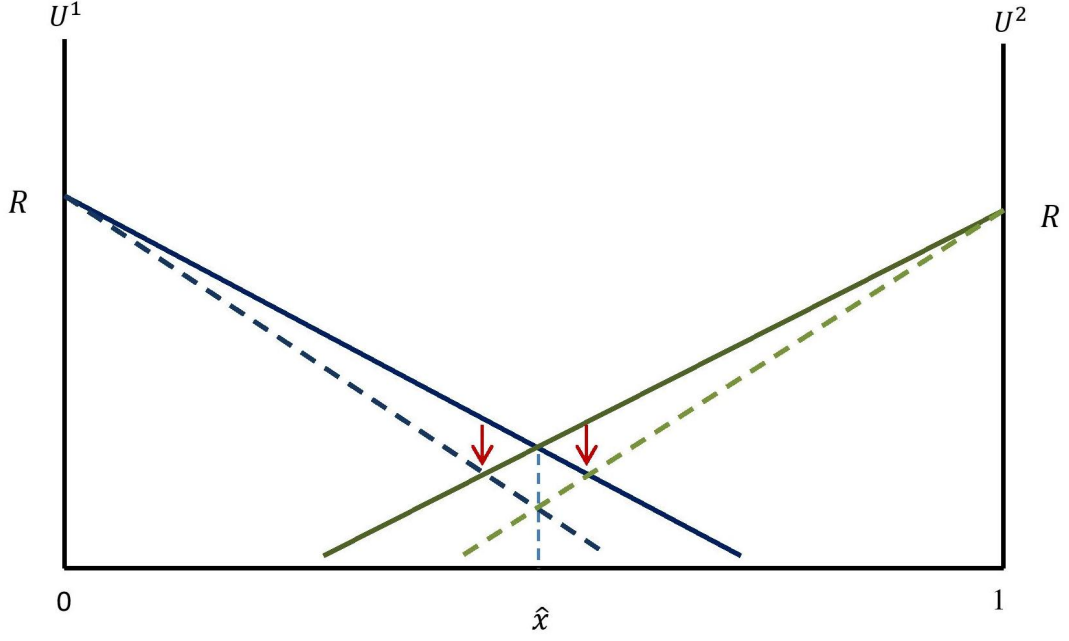


Figure 3: Persuasive Advertising Enhancing Product Differentiation

functions with respect to corresponding prices:

$$\begin{aligned}\frac{\partial \pi^1}{\partial p_1} &= \frac{p_2 - 2p_1 + t(a)}{2t(a)} = 0 \\ \frac{\partial \pi^2}{\partial p_2} &= \frac{-2p_2 + p_1 + t(a)}{2t(a)} = 0\end{aligned}$$

The best response functions are given by $p_1(p_2, a) = \frac{p_2 + t(a)}{2}$, $p_2(p_1, a) = \frac{p_1 + t(a)}{2}$ and thus prices are $p_1(a) = t(a)$, $p_2(a) = t(a)$. Persuasive advertising enhancing product differentiation benefits both incumbent and entrant, since it decreases demand elasticity and consequently brings market power to both. In fact, the entrant enjoys a positive externality from the incumbent's advertising because it softens price competition.

The total effect of persuasive advertising is determined by:

$$\frac{d\pi^1}{da} = \left[p_1 \frac{t'(a)}{2t(a)} \right] + \left[\frac{p_1(p_1 - p_2)t'(a)}{2t^2(a)} - A'(a) \right]$$

The term in the first brackets is the strategic effect of persuasive advertising and

the term in the second brackets is the direct effect. Since $t'(a) > 0$ strategic effect is positive, the incumbent overinvests in advertising and hence the corresponding business strategy is *Fat Cat*. A comparison of strategic and non-strategic persuasive advertising is in Appendix B.

Case 4. Informative advertising

Informative advertising provides consumers with market information like prices, product characteristics, usage instructions, availability, and existence of the advertised product. It thus increases demand elasticity. Literature on informative advertising usually considers advertising as a way to bring new customers to the market either by informing them about the existence of the advertised product or by reducing searching costs¹³. In the latter case consumers with high searching costs are motivated to participate in the market. In either case informative advertising expands the demand for the advertising firm. In the framework of the given model, informative advertising brings additional customers to the incumbent, which is shown by $\varphi(a)$ ¹⁴. Profit functions are as follows:

$$\begin{aligned}\pi^1(p_1, p_2, a) &= p_1 \left[\frac{p_2 - p_1 + t}{2t} + \varphi(a) \right] - A(a) \\ \pi^2(p_1, p_2, a) &= p_2 \left[1 - \frac{p_2 - p_1 + t}{2t} \right]\end{aligned}$$

Joint first order conditions are determined by the partial derivatives of the profit functions with respect to corresponding prices:

$$\begin{aligned}\frac{\partial \pi^1}{\partial p_1} &= \frac{p_2 - 2p_1 + t}{2t} + \varphi(a) = 0 \\ \frac{\partial \pi^2}{\partial p_2} &= \frac{-2p_2 + p_1 + t}{2t} = 0\end{aligned}$$

¹³See for example Stigler (1961), Butters (1977), Grossman&Shapiro (1984), Konishi&Sandfort (2002).

¹⁴If the incumbent's advertising intensity is a , informative advertising attracts $\varphi(a)$ new customers: $\varphi'(a) > 0$, $\varphi''(a) < 0$.

The best response functions are $p_1(p_2, a) = \frac{2t\varphi(a)+p_2+t}{2}$, $p_2(p_1, a) = \frac{p_1+t}{2}$ and thus prices are $p_1(a) = \frac{4t\varphi(a)+3t}{3}$, $p_2(a) = \frac{4t\varphi(a)+3t}{3}$. Informative advertising benefits both firms because the incumbent firm has shifted out its demand curve while not stealing customers from the entrant.

The total effect of informative advertising is defined by:

$$\frac{d\pi^1}{da} = \left[p_1 \frac{2\varphi'(a)}{3} \right] + [p_1\varphi'(a) - A'(a)]$$

The term in the first brackets is the strategic effect of informative advertising and the term in the second brackets is the direct effect. Since $\varphi'(a) > 0$ strategic effect is positive, the incumbent overinvests in advertising and hence the corresponding business strategy is *Fat Cat*. A comparison of strategic and non-strategic informative advertising is in Appendix B.

3.2 Multiple Entry

Let us now consider a multiple entry case where one incumbent accommodates several entrants. The incumbent anticipates this entry and invests in advertising which can be of four types, as in the previous chapter. Two different frameworks are going to be studied: exogenous entry (the number of entrants is fixed) and endogenous entry (free-entry condition). The first approach demonstrates how the advertising reaction of the incumbent depends on the competitive pressure (number of entries). The second one shows how the advertising response to entry influences the equilibrium number of entries.

Post-entry market is characterized by the following inverse demand functions¹⁵ of incumbent i and N identical entrants e :

¹⁵These inverse demand functions are derived from quadratic utility function as done in Dixit (1979).

$$\begin{aligned}
p_i &= d - b \left(x_i + \theta \sum_{e=1}^N x_e \right) \\
p_e &= d - b \left(x_e + \sum_{-e \neq e}^{N-1} x_{-e} + \theta x_i \right)
\end{aligned}$$

where x_i and x_e are sales of the incumbent and one representative entrant; d , b , θ are demand parameters.

The incumbent can influence the parameters of the indirect demand functions by choosing what type of advertising is going to be used:

Complementary advertising increases the value of the incumbent's product for a consumer and thus changes the value of d in the inverse demand function of the incumbent. Therefore $d(a)$ is a function of advertising a , such that $d'(a) > 0$, $d''(a) < 0$.

Persuasive advertising enhancing product differentiation decreases the degree of product substitutability. Parameter θ indicates how close products of entrants are related to the incumbent's, if $\theta = 0$ products are not related in consumption, if $\theta = 1$ these goods are perfect substitutes. The incumbent can decrease the value of θ by means of advertising, such that $\theta'(a) < 0$.

Persuasive advertising changing the distribution of tastes and preferences steals consumers from potential entrants. It is also known as business-stealing advertising.

Informative advertising attracts new consumers and expands the market. It makes market demand more elastic since consumers become more sensitive to the change in prices. This can be captured by the reduction in parameter b , $b'(a) < 0$, that is responsible for the market capacity and demand function slope.

Advertising technology is described by an advertising expenditure function $A(a)$, $A'(a) > 0$, $A''(a) > 0$. Variable production costs are normalized to zero, fixed cost is equal to F .

As in the previous chapter, the incumbent anticipates and accommodates entries. At the first stage of the game the incumbent invests in advertising and then at the second

stage competes with entrants in quantities, so x_i and x_e are strategic substitutes. Post-entry competition is simultaneous and non-cooperative.

Case 1. Complementary Advertising

In the second stage of the game, profit functions of the incumbent and of a representative entrant look as follows:

$$\begin{aligned}\pi_i &= x_i \left(d(a) - bx_i - b\theta \sum_{e=1}^N x_e \right) - A(a) - F \\ \pi_e &= x_e \left(d - bx_e - b\theta x_i - b \sum_{-e \neq e}^{N-1} x_{-e} \right) - F\end{aligned}$$

First order conditions of the profit optimization problems are as follows:

$$\begin{aligned}\frac{\partial \pi_i}{\partial x_i} &= d(a) - 2bx_i - b\theta \sum_{e=1}^N x_e = 0 \\ \frac{\partial \pi_e}{\partial x_e} &= d - 2bx_e - b \sum_{-e \neq e}^{N-1} x_{-e} - b\theta x_i = 0\end{aligned}$$

This brings the reaction function of the incumbent $x_i = \frac{d(a) - b\theta \sum_{e=1}^N x_e}{2b}$ and a reaction function of one representative entrant $x_e = \frac{d - b \sum_{-e \neq e}^{N-1} x_{-e} - b\theta x_i}{2b}$. There are N identical entrants so $\sum_{e=1}^N x_e = Nx_e$, that in turn results in usual best response functions:

$$\begin{aligned}x_i &= \frac{d(a) - b\theta Nx_e}{2b} \\ x_e &= \frac{d - b\theta x_i}{b(N+1)}\end{aligned}$$

Equilibrium is described by $x_i^* = \frac{(N+1)d(a) - N\theta d}{b(N(2-\theta^2)+2)}$, $x_e^* = \frac{2d - \theta d(a)}{b(N(2-\theta^2)+2)}$, $p_i^* = \frac{(N+1)d(a) - N\theta d}{(N(2-\theta^2)+2)}$, $p_e^* = \frac{2d - \theta d(a)}{(N(2-\theta^2)+2)}$.

Exogenous entry. The total effect of complementary advertising on the incumbent's

profit is equal to $\frac{d\pi_i}{da} = \sum_{e=1}^N \frac{\partial \pi_i}{\partial x_e} \frac{dx_e}{da} + \frac{\partial \pi_i}{\partial a}$. The first part of the total effect is the strategic effect of advertising and the second part is the direct effect. In the case of complementary advertising, strategic effect is equal to $\frac{N\theta^2 x_i d'(a)}{(N(2-\theta^2)+2)} > 0$, meaning that the incumbent overinvests in complementary advertising. The corresponding strategy is *Top Dog*.

The advertising rule is described by the FOC with respect to a : $\frac{d\pi_i(a)}{da} = 0$. This can be computed as the following condition:

$$d'(a) \left[\frac{2(N+1)^2 d(a) - 2N(N+1)\theta d}{b(N(2-\theta^2)+2)^2} \right] = A'(a)$$

To see how advertising changes with N , one has to check the sign of $\frac{da}{dN}$. This value can be found using the implicit function theorem $\frac{da}{dN} = -\frac{\pi_{aN}}{\pi_{aa}}$. By definition, the profit function is concave in advertising and thus $\pi_{aa} < 0$, which in turn means that $sign \left[\frac{da}{dN} \right] = sign [\pi_{aN}] = sign \left[\frac{d\pi_a}{dN} \right]$.

$$\frac{d\pi_a}{dN} = \frac{2\theta}{b} \left[\frac{2(N+1)(\theta d(a) - d) - \theta^2 dN}{(N(2-\theta^2)+2)^3} \right] d'(a) < 0$$

Since $\frac{d\pi_a}{dN} < 0$, the advertising response to the entry decreases with the number of entrants: $\frac{da}{dN} < 0$. It means that if the incumbent firm responds to the entry with complementary advertising, its advertising decreases with the number of entrants.

Vives (2008) proposes the decomposition of the total effect of demand parameter on strategic investment. In particular, the author computes how competitive pressure parameters (like the number of firms and market capacity) affect R&D through their effect on the firm's demand and market price. This approach of Vives (2008) is also applicable in the case of strategic advertising. By backward induction, at the first stage of the game the incumbent chooses how much to invest in complementary advertising. His profit function is thus $\pi_i(a, N) = x_i(a) p_i(x_i(a, N), x_e(a, N), N) - A(a) - F$ which is maximized at some $a = a^*$. Since $sign \left[\frac{da}{dN} \right] = sign \left[\frac{d\pi_a}{dN} \right]$, one can get more intuition about $\frac{da}{dN}$ by decomposing $\frac{d\pi_a}{dN}$.

$$\begin{aligned}
\frac{d\pi_i(a, N)}{da} &= \left[\frac{\partial p_i}{\partial x_i} \frac{\partial x_i}{\partial a} + \sum_{e=1}^N \frac{\partial p_i}{\partial x_e} \frac{\partial x_e}{\partial a} + \frac{\partial p_i}{\partial a} \right] x_i(a, N) + \frac{\partial x_i}{\partial a} p_i(x_i(a, N), x_e(a, N), N) - \\
-A'(a) &= \frac{\partial x_i}{\partial a} \left[\frac{\partial p_i}{\partial x_i} x_i(a, N) + p_i(x_i(a, N), x_e(a, N), N) \right] + x_i(a, N) \left[\sum_{e=1}^N \frac{\partial p_i}{\partial x_e} \frac{\partial x_e}{\partial a} + \frac{\partial p_i}{\partial a} \right] - \\
-A'(a) &= x_i(a, N) \left[\sum_{e=1}^N \frac{\partial p_i}{\partial x_e} \frac{\partial x_e}{\partial a} + \frac{\partial p_i}{\partial a} \right] - A'(a)
\end{aligned}$$

A term $\left[\frac{\partial p_i}{\partial x_i} x_i(a, N) + p_i(x_i(a, N), x_e(a, N), N) \right]$ is equal to zero because of the FOC with respect to x_i .

If $D(a, N) = x_i(a, N)$ and $P(a, N) = \sum_{e=1}^N \frac{\partial p_i}{\partial x_e} \frac{\partial x_e}{\partial a} + \frac{\partial p_i}{\partial a}$, then $d\pi_a = \frac{d\pi_i(a, N)}{da} = D(a, N)P(a, N) - A'(a)$ and $\frac{d\pi_a}{dN}$ can be computed as the following:

$$\frac{d\pi_a}{dN} = \frac{\partial D(a, N)}{\partial N} P(a, N) + \frac{\partial P(a, N)}{\partial N} D(a, N)$$

The first term $\frac{\partial D(a, N)}{\partial N} P(a, N)$ is the demand effect of N on advertising and the second term $\frac{\partial P(a, N)}{\partial N} D(a, N)$ is the price effect of N . This decomposition makes it possible to separate the two effects of N . The demand effect of the competitive pressure (number of firms N) shows how the size of the entry influences the advertising decision of the incumbent firm through the change in residual demand for the incumbent. Particularly, it indicates a change in marginal sales due to one additional entry. The price effect of competitive pressure shows how the size of entry affects advertising through its influence on the incumbent's price. Intuitively, it defines how the incumbent's marginal profitability of advertising changes with a new entry.

Since $P(a, N) = d'(a) \left[\frac{N\theta^2}{N(2-\theta^2)+2} + 1 \right] > 0$ and $\frac{\partial D(a, N)}{\partial N} = \frac{-\theta(2d-\theta d(a))}{b(N(2-\theta^2)+2)^2} < 0$, demand effect of N is negative. It means that each additional entrant reduces marginal revenue of advertising, which in turn gives an incentive to reduce advertising. In contrast, price effect is positive, since $D(a, N) > 0$ and $\frac{\partial P(a, N)}{\partial N} = \frac{2d'(a)\theta^2}{b(N(2-\theta^2)+2)^2} > 0$. Complementary advertising is price-increasing by its nature, because it enhances the value of the product.

As a result, it increases markup, which gives an incentive to stimulate advertising activity. The total effect $\frac{d\pi_a}{dN}$ is negative meaning that demand effect exceeds the price effect and incumbent firm reduces its advertising as entry becomes greater.

Endogenous entry. Free entry implies that the equilibrium number of entrants is determined by the zero-profit condition: $\pi_e = x_e^* p_e^* - F = \frac{1}{b} \left[\frac{2d - \theta d(a)}{N(2 - \theta^2) + 2} \right]^2 - F = 0$.

To see how the size of entry depends on the advertising of the incumbent firm, one has to apply the implicit function theorem:

$$\frac{dN}{da} = - \frac{(\pi_e)'_a}{(\pi_e)'_N} = - \frac{\theta d'(a)(2 + N(2 - \theta^2))}{(2 - \theta^2)(2d - \theta d(a))} < 0$$

This shows that when entry is endogenous, the equilibrium number of entrants is decreasing in complementary advertising. This result is explained by the fact that complementary advertising increases the value of the incumbent's good to consumers and thus captures greater market share and reduces the residual demand for potential entrants, because all consumers are willing to purchase from the incumbent. Free entry condition therefore results in fewer entries in the industry.

This result supports the conclusion of Sutton (1991, 2012) where the author studies complementary advertising as an endogenous sunk cost to build a brand (or increased perceived quality). Sutton concludes that the easier (cheaper) it is to advertise, the fewer firms remain in the market and vice versa. In the framework of the present model, cheaper advertising technology results in a decrease in $A(a)$ which leads to higher advertising outlays. And since for complementary advertising $\frac{dN}{da} < 0$, one can see that an increase in advertising leaves a smaller number of firms in the industry. In turn, it implies that cheaper advertising leads to fewer firms as it is in Sutton (1991, 2012)

Case 2. *Persuasive advertising enhancing product differentiation*

This kind of advertising lowers the value of θ , which reflects the degree of substitutability of competing products. At the second stage of the game, profit functions of the incumbent and of one representative entrant look as follows:

$$\begin{aligned}\pi_i &= x_i \left(d - bx_i - b\theta(a) \sum_{e=1}^N x_e \right) - A(a) - F \\ \pi_e &= x_e \left(d - bx_e - b\theta(a) x_i - b \sum_{-e \neq e}^{N-1} x_{-e} \right) - F\end{aligned}$$

First order conditions of the profit optimization problems are as follows:

$$\begin{aligned}\frac{\partial \pi_i}{\partial x_i} &= d - 2bx_i - b\theta(a) \sum_{e=1}^N x_e = 0 \\ \frac{\partial \pi_e}{\partial x_e} &= d - 2bx_e - b \sum_{-e \neq e}^{N-1} x_{-e} - b\theta(a)x_i = 0\end{aligned}$$

This gives a reaction function of the incumbent $x_i = \frac{d - b\theta(a) \sum_{e=1}^N x_e}{2b}$ and a reaction function of one representative entrant $x_e = \frac{d - b\theta(a) \sum_{-e \neq e}^{N-1} x_{-e} - b\theta(a)x_i}{2b}$. There are N identical entrants so $\sum_{e=1}^N x_e = Nx_e$, that in turn results in:

$$\begin{aligned}x_i &= \frac{d - b\theta(a)Nx_e}{2b} \\ x_e &= \frac{d - b\theta(a)x_i}{b(N+1)}\end{aligned}$$

Equilibrium is described by $x_i^* = \frac{d(1+N-N\theta(a))}{b(N(2-\theta^2(a))+2)}$, $x_e^* = \frac{d(2-\theta(a))}{b(N(2-\theta^2(a))+2)}$, $p_i^* = \frac{d(1+N-N\theta(a))}{(N(2-\theta^2(a))+2)}$, $p_e^* = \frac{d(2-\theta(a))}{(N(2-\theta^2(a))+2)}$.

Exogenous entry. Total effect of this kind of advertising on the incumbent's profit is equal to $\frac{d\pi_i}{da} = \sum_{e=1}^N \frac{\partial \pi_i}{\partial x_e} \frac{dx_e}{da} + \frac{\partial \pi_i}{\partial a}$. The first part of the total effect is the strategic effect of advertising and the second part is the direct effect. Strategic effect is equal to $\frac{d}{da} \frac{N \theta(a) x_i^* (2+N(2-4\theta(a)+\theta^2(a)))}{(N(2-\theta^2(a))+2)^2} \theta'(a)$. The sign of the strategic effect depends on the sign of $(2 + N(\theta^2(a) - 4\theta(a) + 2))$. It is negative for $N \leq 2$ or $\theta(a) < 2 - \sqrt{2(1 - \frac{1}{n})}$. In this case the incumbent underinvests and the corresponding business strategy is *Lean and*

Hungry Look. When $N > 2$ and $\theta(a) > 2 - \sqrt{2(1 - \frac{1}{n})}$, the incumbent overinvests and the corresponding business strategy is *Top Dog*. These results show that a more competitive environment (larger N and lower product differentiation) makes the incumbent firm advertise more aggressively. The firm tries to differentiate itself from its rivals as much as possible if the initial θ is rather high. In contrast, if initial product differentiation is rather low, the incumbent underinvests. It is worth noting that as N approaches infinity, the threshold $\theta_1 = 2 - \sqrt{2(1 - \frac{1}{n})}$ tends to 0.59. In turn, it means that for any N and any equilibrium $\theta^* \leq 0.59$, the incumbent firm underinvests. Since advertising enhancing product differentiation reduces the equilibrium value of $\theta^*(a)$, the situation with underinvestment becomes more probable.

By backward induction, at the first stage of the game the incumbent chooses how much to invest in advertising. Its profit function is thus $\pi_i(a) = x_i(a) p_i(a) - A(a) - F$ which is going to be maximized with respect to a :

$$\frac{2d^2N}{b} \left[\frac{(2\theta(a)(1 + N - N\theta(a)) - (2 + N(2 - \theta^2(a))))(1 + N - N\theta(a))}{(2 + N(2 - \theta^2(a)))^3} \right] \theta'(a) = A'(a)$$

To see how advertising changes with N , one has to check the sign of $\frac{d\pi_a}{dN}$. This value is positive for $N \leq 4$ or $\theta < \theta_2$ and negative for $\theta > \theta_2$ and $N > 4$ ¹⁶. Therefore the advertising response to the entry is decreasing in the number of entrants if competitive pressure is rather high (larger N and lower product differentiation). In contrast, if the environment is not much competitive, the incumbent firm increases its advertising, since advertising becomes more profitable and effective. As N approaches infinity, the threshold θ_2 tends to 0.71. It implies that for any N and any equilibrium $\theta^* < 0.71$ the incumbent firm increases its advertising in response to a larger entry. Since advertising enhancing product differentiation reduces the equilibrium value of $\theta^*(a)$, a situation with $\frac{d\pi_a}{dN} > 0$ becomes more probable.

¹⁶ θ_2 is a relevant solution to the equation $(2\theta_2(1 + N - N\theta_2) - (2 + N(2 - \theta_2^2)))(1 + N - N\theta_2) = 0$.

Decomposition of the total effect into the demand effect and price effect is $\frac{d\pi_a}{dN} = \frac{\partial D(a,N)}{\partial N}P(a,N) + \frac{\partial P(a,N)}{\partial N}D(a,N)$. The first term $\frac{\partial D(a,N)}{\partial N}P(a,N)$ is the demand effect of N on advertising and the second term $\frac{\partial P(a,N)}{\partial N}D(a,N)$ is the price effect of N .

Since $P(a,N) = -d\theta'(a)N \left[\frac{2(1+N)+2\theta(a)(N-2)+N\theta^2(a)(3-N\theta(a))}{N(2-\theta^2(a))+2} \right] > 0$ and derivative $\frac{\partial D(a,N)}{\partial N} = \frac{-d\theta(a)(2-\theta(a))}{b(N(2-\theta^2(a))+2)^2} < 0$, the demand effect of entry is negative. It means that each additional entrant reduces the marginal revenue of advertising, which in turn gives an incentive to reduce advertising. In contrast, the price effect is positive, since $D(a,N) > 0$ and $\frac{\partial P(a,N)}{\partial N} = \frac{-2d\theta'(a)(2-2\theta(a)+N(2+6\theta(a)-5\theta^2(a)+\theta^3(a)))}{(N(2-\theta^2(a))+2)^3} > 0$. Product differentiation advertising is price-increasing by its nature since it reduces price elasticity. It thus increases markup, which gives an incentive to stimulate advertising activity. If the total effect $\frac{d\pi_a}{dN}$ is positive, then the price effect exceeds the demand one and the incumbent firm advertises more as entry becomes greater. The reverse holds for $\frac{d\pi_a}{dN} < 0$.

Endogenous entry. Free entry implies that the equilibrium number of entrants is determined by zero-profit condition: $\pi_e = x_e^* p_e^* - F = \frac{1}{b} \left[\frac{d(2-\theta(a))}{(N(2-\theta^2(a))+2)} \right]^2 - F = 0$.

To see how the size of entry depends on the advertising of the incumbent firm, one has to apply the implicit function theorem:

$$\frac{dN}{da} = -\frac{(\pi_e)'_a}{(\pi_e)'_N} = -\theta'(a) \frac{2 + N(2 - 4\theta(a) + \theta^2(a))}{(2 - \theta(a))(2 - \theta^2(a))}$$

As in the case with the sign of the strategic effect, the sign of $\frac{dN}{da}$ depends on the sign of $2 + N(2 - 4\theta(a) + \theta^2(a))$. It is positive equilibrium $N^* \leq 2$ or $\theta^* < \theta_1$. In contrast, it is negative for $N^* > 2$ and $\theta^* > \theta_1$. A limit of θ_1 equals 0.59 meaning that for any N and any equilibrium $\theta^* < 0.59$, a sign of $\frac{dN}{da}$ is always positive. Since advertising enhancing product differentiation reduces equilibrium θ^* , the situation with $\frac{dN}{da} > 0$ becomes more probable.

If $\frac{dN}{da}$ is positive then the incumbent's advertising increases the equilibrium number of entries. The incumbent increases the equilibrium degree of product differentiation (lowers θ^*). This result is logically expected since a higher degree of product differentiation

expands residual demand for entrants and thus allows more entries. For example, these results are similar to Zigic (2012), where it is shown that when competing products are less alike, competition becomes softer and more firms enter in equilibrium.

Case 3. *Business-stealing advertising*

When an incumbent firm uses business-stealing advertising, it persuades consumers to buy its products by shifting their preferences towards the incumbent's product. In other words, the incumbent captures some portion of $s(a)$ consumers with advertising, $s'(a) > 0$. There are N identical entrants and thus every entrant loses $\frac{s(a)}{N}$ potential market share from the business-stealing advertising of the incumbent. Therefore profit functions for the incumbent and N identical entrants look as follows:

$$\begin{aligned}\pi_i &= (x_i + s(a)) \left(d - bx_i - b\theta \sum_{e=1}^N x_e \right) - A(a) - F \\ \pi_e &= \left(x_e - \frac{s(a)}{N} \right) \left(d - bx_e - b\theta x_i - b \sum_{-e \neq e}^{N-1} x_{-e} \right) - F\end{aligned}$$

First order conditions of the profit optimization problems are a system of two equations:

$$\begin{aligned}\frac{\partial \pi_i}{\partial x_i} &= d - bx_i - b\theta \sum_{e=1}^N x_e - b(x_i + s(a)) = 0 \\ \frac{\partial \pi_e}{\partial x_e} &= d - bx_e - b \sum_{-e \neq e}^{N-1} x_{-e} - b\theta x_i - b \left(x_e - \frac{s(a)}{N} \right) = 0\end{aligned}$$

Second stage competition results in the following reaction functions: $x_i = \frac{d - bs(a) - b\theta N x_e}{2b}$,

$$x_e = \frac{dN + bs(a) - b\theta N x_i}{bN(N+1)}.$$

Equilibrium is described by outputs $x_i^* = \frac{d - bs(a) - bNs(a) + dN - b\theta s(a) - dN\theta}{b(2(N+1) - \theta^2 N)}$,

$$\begin{aligned}x_e^* &= \frac{2bs(a) + 2dN + b\theta Ns(a) - d\theta N}{bN(2(N+1) - \theta^2 N)} \text{ and prices } p_i^* = \frac{(d + Nd + bs(a) - Nd\theta - bs(a)\theta + Nbs(a) - Nbs(a)\theta^2)}{(2(N+1) - \theta^2 N)}, \\ p_e^* &= \frac{(2d - d\theta - 2bs(a) + bs(a)\theta + bs(a)\theta^2)}{(2(N+1) - \theta^2 N)}.\end{aligned}$$

Exogenous entry. Total effect of this kind of advertising on the incumbent's profit is equal to $\frac{d\pi_i}{da} = \sum_{e=1}^N \frac{\partial \pi_i}{\partial x_e} \frac{dx_e}{da} + \frac{\partial \pi_i}{\partial a}$. The first part of the total effect is the strategic effect of advertising and the second part is the direct effect. Strategic effect is equal to $\frac{-(x_i+s(a))b\theta(2+\theta N)s'(a)}{(2(N+1)-\theta^2 N)} < 0$ and implies that the incumbent firm underinvests in advertising if it wants to use business-stealing advertising. The corresponding business strategy is *Lean and Hungry Look*.

To see how advertising depends on the entry, one has to check the sign of $\frac{d\pi_a}{dN} = \frac{-4(1-\theta)\theta(d(N-1)\theta+bs(a)(1+N+N\theta)(\theta^2+\theta-2))}{(2(N+1)-\theta^2 N)^3} s'(a)$. It is positive, meaning that the incumbent firm advertises more intensively if entry is large and less intensively if entry is small.

Decomposition of the total effect into demand effect and price effect is $\frac{d\pi_a}{dN} = \frac{\partial D(a,N)}{\partial N} P(a, N) + \frac{\partial P(a,N)}{\partial N} D(a, N)$. The first term $\frac{\partial D(a,N)}{\partial N} P(a, N)$ is the demand effect of N on advertising and the second term $\frac{\partial P(a,N)}{\partial N} D(a, N)$ is the price effect of N .

Since $P(a, N) = -\theta bs'(a) \left[\frac{2+\theta}{N(2-\theta^2(a))+2} \right] < 0$ and $\frac{\partial D(a,N)}{\partial N} = \frac{\theta(d(\theta-2)-bs(a)(\theta^2+\theta-2))}{b(N(2-\theta^2(a))+2)^2} < 0$, the demand effect of N is positive. Because of the fact that larger entry reduces residual demand of the incumbent, the only way to compensate this loss is to steal consumers from the rivals with advertising. This stimulates advertising activity. The price effect is also positive, because $D(a, N) > 0$ and $\frac{\partial P(a,N)}{\partial N} = \frac{2\theta bs'(a)(2-\theta^2-\theta)}{b(N(2-\theta^2(a))+2)^2} > 0$. Every new entry makes competition tougher and reduces prices, the only way to compensate a loss in the markup is to capture more consumers with advertising. The total effect $\frac{d\pi_a}{dN}$ is positive and the incumbent firm advertises more as entry becomes greater.

Endogenous entry. Free entry implies that the equilibrium number of entrants is determined by the zero-profit condition $\pi_e = x_e^* p_e^* - F$ or:

$$\left[\frac{2bs(a) + 2dN + b\theta Ns(a) - d\theta N}{bN(2(N+1) - \theta^2 N)} - \frac{s(a)}{N} \right] \left[\frac{(2d - d\theta - 2bs(a) + bs(a)\theta + bs(a)\theta^2)}{(2(N+1) - \theta^2 N)} \right] - F = 0.$$

To see how the size of entry depends on the advertising of incumbent firm, one has

to apply the implicit function theorem:

$$\frac{dN}{da} = -\frac{(\pi_e)'_a}{(\pi_e)'_N} = s'(a) \frac{b(\theta^2 + \theta - 2)(2 + (2 - \theta^2))}{(2 - \theta^2)(d(2 - \theta) + bs(a)(\theta^2 + \theta - 2))} < 0$$

The sign of $\frac{dN}{da}$ is negative, it means that as the incumbent invests more in advertising, entry becomes harder and fewer firms enter the market. As more consumers are persuaded to like the incumbent's product, a smaller market share is left to newcomers and thus fewer firms can enter. Indeed, if the incumbent firm can effectively shift the preferences of consumers towards its product, it would be hard for any entrant to profitably operate on shortened residual demand. And since business-stealing advertising reduces the available market share for all newcomers, entry is limited.

Case 4. Informative advertising

Informative advertising makes market demand more sensitive to the change in prices and attracts more consumers. These effects can be reflected by the decrease in $b(a)$, $b'(a) < 0$. Profit functions look as follows:

$$\begin{aligned}\pi_i &= x_i \left(d - b(a)x_i - b(a)\theta \sum_{e=1}^N x_e \right) - A(a) - F \\ \pi_e &= x_e \left(d - b(a)x_e - b(a)\theta x_i - b(a) \sum_{-e \neq e}^{N-1} x_{-e} \right) - F\end{aligned}$$

First order conditions of the profit optimization problems are a system of two equations:

$$\begin{aligned}\frac{\partial \pi_i}{\partial x_i} &= d - 2b(a)x_i - b(a)\theta \sum_{e=1}^N x_e = 0 \\ \frac{\partial \pi_e}{\partial x_e} &= d - 2b(a)x_e - b(a) \sum_{-e \neq e}^{N-1} x_{-e} - b(a)\theta x_i = 0\end{aligned}$$

This gives a reaction function of the incumbent $x_i = \frac{d-b(a)\theta \sum_{e=1}^N x_e}{2b(a)}$ and a reaction function of one representative entrant $x_e = \frac{d-b(a)\theta \sum_{-e \neq e}^{N-1} x_{-e} - b(a)\theta x_i}{2b(a)}$. There are N identical entrants so $\sum_{e=1}^N x_e = Nx_e$, that in turn bring usual best response functions:

$$\begin{aligned} x_i &= \frac{d - b(a)\theta Nx_e}{2b(a)} \\ x_e &= \frac{d - b(a)\theta x_i}{(N + 1)b(a)} \end{aligned}$$

Equilibrium is described by $x_i^* = \frac{(N+1-N\theta)d}{(N(2-\theta^2)+2)b(a)}$, $x_e^* = \frac{(2-\theta)d}{(N(2-\theta^2)+2)b(a)}$, $p_i^* = \frac{(N+1-N\theta)d}{(N(2-\theta^2)+2)}$, $p_e^* = \frac{(2-\theta)d}{(N(2-\theta^2)+2)}$.

Exogenous entry. The total effect of the advertising on incumbents profit is equal to $\frac{d\pi_i}{da} = \sum_{e=1}^N \frac{\partial \pi_i}{\partial x_e} \frac{dx_e}{da} + \frac{\partial \pi_i}{\partial a}$. The first part of the total effect is the strategic effect of advertising and the second part is the direct effect. In the case of informative advertising the strategic effect is equal to $\frac{N\theta x_i d(2-\theta)}{(N(2-\theta^2)+2)b(a)} b'(a) < 0$, meaning that the incumbent underinvests in informative advertising. The corresponding strategy is *Lean and Hungry Look*.

Advertising rule is defined by FOC $\frac{d\pi_i(a)}{da} = 0$:

$$-b'(a) \left[\frac{d(1 + N - N\theta)}{2(N + 1) - n\theta^2} \right]^2 = A'(a)$$

To see how advertising changes with N , one has to check the sign of $\frac{da}{dN}$. Using the implicit function theorem $\frac{da}{dN} = -\frac{\pi_{aN}}{\pi_{aa}}$ and $\pi_{aa} < 0$, we have that $sign \left[\frac{da}{dN} \right] = sign \left[\frac{d\pi_a}{dN} \right]$:

$$\frac{d\pi_a}{dN} = \frac{2d^2\theta}{b^2} \left[\frac{(2 - \theta)(1 + N - N\theta)}{2(N + 1) - n\theta^2} \right] b'(a) < 0$$

Since $\frac{d\pi_a}{dN} < 0$ the advertising response to the entry is decreasing in the number of entrants: $\frac{da}{dN} < 0$. It means that if the incumbent firm responds to the entry with informative advertising, its advertising decreases in the number of entrants. As more new firms enter the market, the less benefits the incumbent gets from informative advertis-

ing. Informative advertising may increase demand but it reduces prices because of the elasticity effect.

Decomposition of the total effect into demand and price effect is $\frac{d\pi_a}{dN} = \frac{\partial D(a,N)}{\partial N}P(a,N) + \frac{\partial P(a,N)}{\partial N}D(a,N)$. The first term $\frac{\partial D(a,N)}{\partial N}P(a,N)$ is the demand effect of N on advertising and the second term $\frac{\partial P(a,N)}{\partial N}D(a,N)$ is the price effect of N .

Since $P(a,N) = -b'(a)x_i > 0$ and $\frac{\partial D(a,N)}{\partial N} = \frac{-d\theta(2-\theta)}{b(a)(N(2-\theta^2(a))+2)^2} < 0$ the demand effect of N is negative. It means that each additional entrant reduces the marginal revenue of advertising which in turn gives an incentive to reduce advertising. The price effect is also negative, since $D(a,N) > 0$ and $\frac{\partial P(a,N)}{\partial N} = \frac{b'(a)d\theta(2-\theta)}{b(a)(N(2-\theta^2(a))+2)^3} < 0$. Informative advertising is procompetitive by its nature since it tends to reduce prices. Each additional entry reduces the markup of the incumbent firm and thus the incumbent decreases its advertising outlays. The total effect $\frac{d\pi_a}{dN}$ is negative, meaning that the incumbent firm advertises less as entry becomes greater.

Endogenous entry. Free entry implies that the equilibrium number of entrants is determined by the zero-profit condition: $\pi_e = x_e^* p_e^* - F = \frac{1}{b} \left[\frac{(2-\theta)d}{(N(2-\theta^2)+2)} \right]^2 - F = 0$.

To see how the size of entry depends on the advertising of incumbent firm, one has to apply the implicit function theorem:

$$\frac{dN}{da} = -\frac{(\pi_e)'_a}{(\pi_e)'_N} = -\frac{2 + 2N - N\theta^2}{2(2 - \theta^2)b(a)}b'(a) > 0$$

This shows that when entry is endogenous, the equilibrium number of entrants is increasing in informative advertising. This result is very intuitive, because informative advertising is always procompetitive, it expands market capacity. The informative advertising of the incumbent delivers a positive externality to entrants by giving them greater residual demand. Free entry condition therefore results in greater entry in the industry.

4 Results

In the previous section, four types of advertising were considered. In the duopoly case, if the incumbent firm reacts to the entry with complementary advertising or persuasive advertising changing the distribution of consumer preferences, it underinvests. Or else, if the incumbent firm reacts with informative advertising or persuasive advertising enhancing product differentiation, it overinvests.

So now it is possible to match these conclusions with observations from the findings of Cubbin and Domberger (1988). To start with, it is important to identify which type of advertising suits a particular market the most. First of all, if a market is growing (especially the market of a new product), there is no need for combative behavior (stealing consumers from the rival with persuasive advertising) or demand shrinking (with an enhanced product differentiation). Therefore, a growing market mainly implies either informative or complementary advertising. Informative advertising attracts more consumers and expands demand by means of informing perspective consumers about the existence of the product, its useful characteristics, prices and so on. Complementary advertising is usually used to build the brand name associated with a product and it is necessary when a product is newly introduced into the market. So, if a market is growing and the incumbent firm overinvests, it is more likely to use informative advertising; if the incumbent underinvests in the growing market, it is likely to use complementary advertising. However, the incumbent may also use some persuasive advertising if the good is not new.

If a market is stagnant or declining, the product is well known to consumers and is in the mature stage of its life-cycle. In this situation, informative advertising cannot attract more consumers to the market, and complementary advertising cannot be used on the mature stages of the product since brand image is already established for mature products. Therefore, the only suitable types of advertising are those which imply either stealing consumers from the rival or increasing the loyalty of the clientele. Persuasive

advertising changing the distribution of tastes and preferences steals customers from the rival and thus is suitable for stagnant and declining markets. Persuasive advertising enhancing product differentiation is used to increase the loyalty of the clientele and make the perceived difference between differentiated products stronger. It increases market power and consequently markups of the incumbent. Summing up, when a market is stagnant or declining, the incumbent firm overinvests if it uses persuasive advertising, enhancing product differentiation, and the incumbent firm underinvests if it uses persuasive advertising, changing the distribution of tastes and preferences.

When the incumbent firm faces multiple entry, it reacts aggressively with advertising and the corresponding business strategies are either *Top Dog* or *Lean and Hungry Look*. However, only complementary and business-stealing advertising are anticompetitive, while informative advertising and advertising increasing product differentiation ease the entry of new firms. These results are explained by the fact that complementary and business-stealing advertising increase the market share of the incumbent firm by means of a reduction in residual demand of potential entrants, that in turn leaves a smaller market share to the rivals and thus fewer firms can enter the market. On the contrary, informative advertising of the incumbent expands the borders of the market and delivers a positive externality to the potential entrants. This increases the market shares of both the incumbent and entrants, and in turn allows more entries. As for advertising enhancing product differentiation, it reduces the substitutability of competing products and thus softens competition, making new entries profitable.

When entry is exogenous, business-stealing and product differentiation advertising increases in the amount of entering firms. In the first case, greater entry reduces market share for the incumbent firm and thus it uses more aggressive advertising to compensate this potential loss. In the second case, greater potential entry motivates the incumbent to differentiate its product more in order to soften potential competition. The other types of advertising decrease in the amount of potential entrants, since with exogenous entry the demand effect is negative and each additional entrant reduces the marginal revenue

Type of ads	Business Strategy	Effect of entry on Ads, $\frac{da}{dN}$ Exogenous entry	Effect of Ads on the entry, $\frac{dN}{da}$ Endogenous entry
Complementary	Top Dog	$\frac{da}{dN} < 0$	$\frac{dN}{da} < 0$
Business stealing	Lean and Hungry Look	$\frac{da}{dN} > 0$	$\frac{dN}{da} < 0$
Product differentiation	Lean and Hungry Look if $N \leq 2$ or $\theta^* < \theta_1$	$\frac{da}{dN} > 0$ if $N \leq 4$ or $\theta^* < \theta_2$	$\frac{dN}{da} > 0$ if $N^* \leq 2$ or $\theta^* < \theta_1$
	Top Dog if $N > 2$ and $\theta^* > \theta_1$	$\frac{da}{dN} < 0$ if $N > 4$ and $\theta^* > \theta_2$	$\frac{dN}{da} < 0$ if $N^* > 2$ and $\theta^* > \theta_1$
Informative	Lean and Hungry Look	$\frac{da}{dN} < 0$	$\frac{dN}{da} > 0$

Figure 4: Multiple Entry

of advertising, which in turn leads to smaller advertising outlays.

It is important to note that advertising enhancing product differentiation may have different outcomes depending on the value of the equilibrium product differentiation. Firstly, a more competitive environment (larger entry and higher substitutability of goods) reduces advertising due to the lower benefits of advertising. However, if the equilibrium degree of product differentiation does not exceed its threshold and therefore stays rather high, entry and advertising are positively correlated. Secondly, advertising enhancing product differentiation reduces product substitutability and thus equilibrium θ decreases, which implies that the incumbent's advertising and entry are more likely to be positively related.

All results are summarized in Fig.4.

5 Conclusion

Advertising is used by firms not only to create entry barriers and deter entry, but it can also be used as a response to new entry in the case of accommodation. Empirical evidence suggests significant changes in advertising patterns of incumbent firms when they face new firms on the market. Some of them reduce their advertising expenditures, others increase their advertising. Existing economic literature investigating this phenomenon does not provide any theoretical foundation why firms react differently to new entry and does not explain how advertising response is related to the size of the entry.

The present paper considers four types of advertising and studies how the particular type of advertising chosen by the incumbent firm is related to the entry accommodation. Specifically, it investigates whether the incumbent firm overinvests or underinvests in a particular type of advertising and how the size of the entry is related to the advertising response.

In the case of a duopoly, when the post-entry market is organized *a la* Hotelling, the incumbent tends to overinvest (increase post-entry advertising levels) in informative advertising and persuasive advertising enhancing product differentiation. On the contrary, the incumbent underinvests (decreases post-entry advertising outlays) in complementary and business-stealing advertising.

In the case of multiple entry, when the demand structure is of Dixit (1979), the incumbent overinvests in complementary advertising and underinvests otherwise. If entry is exogenous, advertising that decreases substitutability of the competing products and business-stealing advertising is positively related to the size of entry, since, in the first case, greater potential competition motivates the incumbent firm to increase perceived differences between products and thus soften post-entry competition; and, in the second case, with larger entry, business-stealing advertising is the only way to secure a market share. When entry is endogenous, complementary and business-stealing advertising allow fewer firms to enter the market, since both reduce residual demand to potential entrants.

On the contrary, informative advertising and advertising increasing product differentiation are procompetitive and allow greater entry. Both of them are a positive externality that benefits potential entrants since both increase market shares of all firms operating in the market.

The theoretical model considered in the present paper serves to explain observations found in the empirical research of economists which investigate the advertising responses of incumbent firms to new entries. The model can be further extended to incorporate dynamics and to know how incumbents react to new entries treating advertising as an intangible asset.

Appendix A

The empirical results of Cubbin and Domberger (1988) are summarized in Table 1. There are nine categories: company name; industry where the given company operates; year when new entry took place; market type; estimates of coefficients in the regression equations¹⁷ (intercept, trend and dummy); dummy type; response ("over" means an increase in advertising above the pre-entry levels and "under" means a reduction in advertising under the pre-entry levels).

Some of the regressions are sketched in Fig. 5. There are six examples of advertising responses based on the results from Table 1: Phillips, P&G (washing-up liquids) and Gillette demonstrate a significant increase in their advertising expenditures after entries; Colgate-Palmolive, P&G (shampoo) and Ellida-Gibbs show a reduction.

¹⁷The estimated equations with structural breaks are specified as follows: $A_{it} = \alpha_i + \beta_i t + \gamma_i^I \delta_i + e_i$ if there is a jump in intercept and $A_{it} = \alpha_i + \beta_i t + \gamma_i^S \delta_i t + e_i$ if there is a change in slope. A_{it} is advertising expenditure of the firm i in period t . δ_i is a dummy variable taking the value of 0 before entry and 1 afterwards. $t = 1, 2, \dots, n$ are quarterly time-periods.

Company	Industry	Year of Entry	Market Type	Intercept	Trend	Dummy	Dummy Type	Response
Philips	<i>Electric Shavers</i>	1976	<i>Growing</i>	656523	-19915	393779	intercept	Over
Colgate-Palmolive	<i>Toothpaste</i>	1975	<i>Growing</i>	300762	5534	-163986	intercept	Under
Huntley-Palmers	<i>Processed Nuts</i>	1976	<i>Stagnant</i>	5115	-583	24417	intercept	Over
Gillette	<i>Wet Shaving</i>	1976	<i>Declining</i>	356283	-9475	6598	slope	Over
Proctor & Gamble	<i>Washing-up Liquids</i>	1979	<i>Static</i>	372765	-7275	8533	slope	Over
Colgate-Palmolive	<i>Washing-up Liquids</i>	1979	<i>Static</i>	285911	-8275	2929	slope	Over
Nestles	<i>Instant Coffee</i>	1973	<i>Growing</i>	321797	17335	-15295	slope	Under
Proctor & Gamble	<i>Washing Powder</i>	1977	<i>Static</i>	1707782	-48490	24294	slope	Over
Lever Bros.	<i>Washing Powder</i>	1977	<i>Static</i>	1883686	-58631	24185	slope	Over
Swan	<i>Electric Kettles</i>	1980	<i>Static</i>	6820	1895	-1552	slope	Under
Colgate-Palmolive	<i>Disposable Nappies</i>	1981	<i>Growing</i>	75163	-3163	96394	intercept	Over
Robbinsons	<i>Disposable Nappies</i>	1980-1981	<i>Growing</i>	43686	-1755	124426	intercept	Over
Elida-Gibbs	<i>Shampoo</i>	1973-1977	<i>Static</i>	156762	2067	-2236	slope	Under
Proctor & Gamble	<i>Shampoo</i>	1973-1977	<i>Static</i>	6126	4850	-1629	slope	Under
Beechams	<i>Deodorants</i>	1970-1975	<i>Static</i>	128163	-5159	118323	intercept	Over
Rothmans	<i>Cigarettes</i>	1978	<i>Declining</i>	2547195	-26646	3235967	intercept	Over

Table 1. Summary of results based on Cubbin&Domberger (1988)

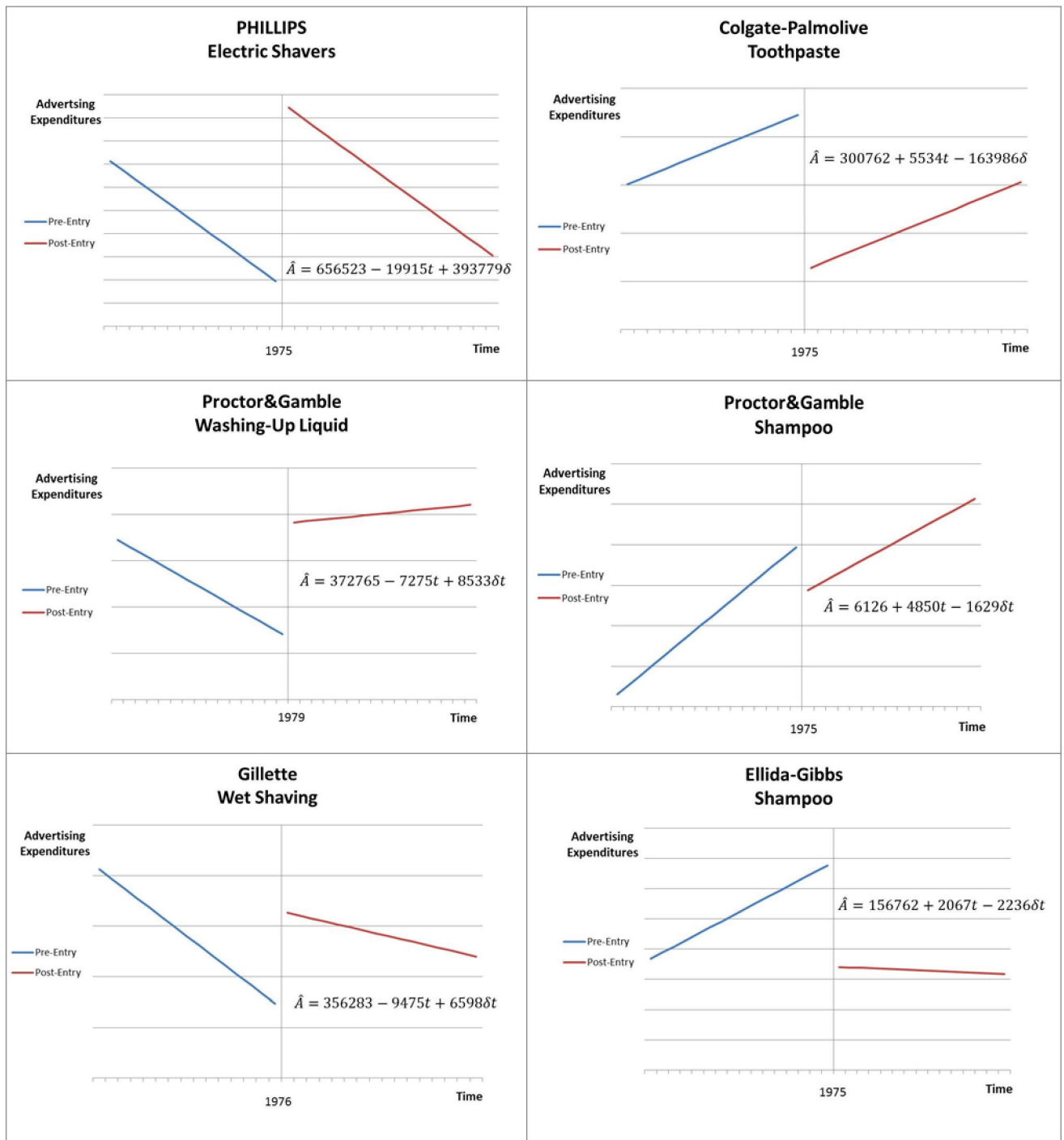


Figure 5: Examples of regression graphs from Table 1

Appendix B

Complementary advertising

When an incumbent firm decides on advertising non-strategically, it does not take into account the strategic effect it has on the entrant's post-entry action. In this case the incumbent's advertising rule is $\frac{p_1}{2t}R'(a) = A'(a)$ or $\frac{R(a)+3t}{6t}R'(a) = A'(a)$.

When an incumbent firm chooses advertising intensity strategically, it considers the total effect of advertising and thus the incumbent's advertising rule is $\left[-\frac{p_1}{2t}\frac{R'(a)}{3}\right] + \left[\frac{R'(a)p_1}{2t} - A'(a)\right] = 0$ or $\frac{R(a)+3t}{9t}R'(a) = A'(a)$. Since $\frac{R(a)+3t}{6t}R'(a) > \frac{R(a)+3t}{9t}R'(a)$, non-strategic advertising is greater than strategic, which means that the incumbent underinvests in complementary advertising when it accommodates an entrant.

Persuasive advertising changing the distribution of tastes and preferences

The non-strategic advertising rule is $p_1x'(a) = A'(a)$ or $\frac{(3t+2tx(a))}{3}x'(a) = A'(a)$.

The strategic advertising rule is $\left[-p_1\frac{x'(a)}{3}\right] + [p_1x'(a) - A'(a)] = 0$ or $\frac{2}{3}\frac{(3t+2tx(a))}{3}x'(a) = A'(a)$.

Since the non-strategic rule suggests higher levels of advertising, an incumbent underinvests in this kind of persuasive advertising.

Persuasive advertising enhancing product differentiation

The non-strategic advertising rule is $\left[\frac{p_1(p_1-p_2)t'(a)}{2t^2(a)} - A'(a)\right] = 0$ or $0 = A'(a)$ in a symmetric case. So a non-strategic incumbent would not advertise at all.

The strategic advertising rule is $\left[p_1\frac{t'(a)}{2t(a)}\right] + \left[\frac{p_1(p_1-p_2)t'(a)}{2t^2(a)} - A'(a)\right] = 0$ or $t'(a) = A'(a)$.

Since the strategic rule implies positive levels of advertising, an incumbent overinvests in persuasive advertising increasing t .

Informative advertising

The non-strategic advertising rule is $[p_1\varphi'(a) - A'(a)] = 0$ or $\frac{3t+4t\varphi(a)}{3}\varphi'(a) = A'(a)$.

The strategic advertising rule is $\left[p_1\frac{2\varphi'(a)}{3}\right] + [p_1\varphi'(a) - A'(a)] = 0$ or $\frac{5t+8t\varphi(a)}{3}\varphi'(a) = A'(a)$.

Since the strategic rule suggests higher levels of advertising, an incumbent overinvests in informative advertising.

Appendix C

Condition on accommodation. There is a certain set of parameters θ , d , b , N , F when an incumbent prefers to accommodate instead of deter entry. In many models with product differentiation, entry deterrence is more profitable when competing products are close substitutes and accommodation is preferred when product differentiation is rather high (as discussed in Zigic, 2012). Since the present paper only considers cases when incumbent accommodates entries, there should be a condition that $\pi_i(block) < \pi_i(accom)$ or if F is normalized to 1 and $x_i(block) = \frac{d - \sqrt{b(N+1)}}{b\theta} > 0$:

$$\frac{\left[d - \sqrt{b(N+1)} \right] \left[\sqrt{b(N+1)} - d(1 - \theta) \right]}{b\theta^2} < \frac{d^2(1 + N - N\theta)^2}{b(2 + N(2 - \theta^2))^2}$$

In our model this condition always holds as a strict inequality.

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Abstrakt

Empirické studie zabývající se výdaji na reklamu ukazují, že firmy mění své reklamní strategie v závislosti na vstupu nové firmy do odvětví. Zatímco někteří incumbenti zmenšují své reklamní výdaje, jiní je naopak oproti situaci před vstupem nové firmy zvýší. Stávající literatura zabývající se strategickou inzercí a reklamou v souvislosti s vstupem nové firmy do odvětví se většinou zaměřuje na znemožnění nového vstupu. Ve stávajícím výzkumu ovšem doposud chybějí teoretické základy, které by pomohly vysvětlit, co ovlivňuje změnu reklamních strategií v situaci, kdy dojde k akomodaci nového vstupu. Ve své práci stavíme model, který zkoumá, jak se akomodující incumbenti rozhodují o reklamní strategii. Za tímto účelem uvažujeme čtyři typy reklamy. Ve svém článku také uvádíme, jak je reklamní strategie spojena s velikostí nově příchozích. Konkrétně říkáme, že informativní reklama a reklama zvýrazňující diferenciaci produktu umožňují větší počet vstupujících. Naproti tomu komplementární a business-stealing typy reklamy zmenšují zbylou poptávku pro potenciální nově vstupující, a tím vedou k menšímu počtu vstupů do odvětví. Incumbenti zvyšují, respektive snižují, reklamní výdaje v závislosti na tom, zda proměnné popisující konkurenci po vstupu jsou spíše strategické substituty nebo komplementy.

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