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WORKING PAPER NO. 177

Advertising and Cost Reduction

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May 2007

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Abstract

The empirical literature on internalization has found a positive relationship between advertising intensity and foreign direct investment. The model presented in this paper explains this evidence by a technological change in the communications environment and makes predictions for other cost-reducing investments. We consider a market in which a single producer launches a new product. At first potential buyers are unaware of the product and its price, and the producer decides the optimal advertising strategy. We find that both advertising spending and investment in per unit cost reduction are higher under targeting than under mass advertising when the advertising technology exhibits marginal economies of targeting.

Keywords: Informative advertising, Targeting, Foreign Direct Investment, Cost reduction

JEL Classification: F23; L12; M37

Acknowledgements: I thank Giacinta Cestone, Maria Grazia Romano and seminar participants at the University of Salerno for enlightening discussions and suggestions.

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1 Introduction

In "Boundaries of Multinational Enterprises and the Theory of International Trade" James Markusen (1995) offers a number of micro facts to evaluate the so-called "new trade theory". Among broadly agreed-upon findings, he notes that multinationals tend to be important in industries and firms characterized by a high level of marketing expenditure[1].

The internalization theory[2] posits that foreign direct investment (FDI) should occur when a firm can increase its value by internalizing markets for certain intangible assets, such as technological know-how, advertising, product differentiation, and consumer goodwill. Such intangible assets are said to share some of the characteristics of public goods, so that to realize the potential additional value of employing them abroad, a firm must internalize the market for them by engaging in international direct investment[3].

This paper argues that the observed positive relationship between marketing expenditure and FDI can be explained by a technological change in the communications environment. Moreover, FDI is only one of many cost-reducing investments (CRI) that can be triggered by this technological 'revolution'. Other ways to affect unit costs, for instance, are lobbying for labor market deregulation or investing in R&D to improve the production process.

Our story goes as follows. People are spending less time reading newspapers and magazines and watching broadcast TV but are going to the cinema more, listening to more radio, watching more cable and satellite TV and turning to a new medium, the Internet (The Economist, 2004). For a long time firms have used the mass media (newspapers, magazines, broadcast TV, etc.) to reach their potential customers. However, the improvements in information technology and the diffusion of new communication media (cable and satellite TV, outdoor advertising, specialized magazines, Internet, etc.) has led marketers to shift away from mass marketing, and to develop more and more highly focused marketing programs aimed at customers in more narrowly defined micromarkets. As a result advertisers are shifting larger portions of their budgets to media that target more effectively. Moreover, in choosing among media types, advertisers take into consideration the nature of the prod-

[1] Grubaugh 1987 has shown that advertising intensity, R&D expenditures and product diversity increase a firm's probability of being multinational. Merck and Yeung 1991 show that the market value of a firm is positively related to its multinational structure and that the relationship is explained by the presence of intangible assets. Finally, Merck and Yeung 1992 use an event study approach to show that advertising spending increases the probability of a positive stock price reaction to foreign direct investment among large firms.

[2] This view is developed in Hymer 1976, Caves 1971, Dunning 1973, Williamson 1975, Buckley and Casson 1976, Rugman 1981, and others.

[3] The internalization theory thus implies that when firms possessing significant intangible assets expand abroad, shareholders' wealth increases owing to the larger scale over which the intangible assets are applied.

uct (for instance, fashions are best advertised in color magazines; Kotler 2002, Kotler and Armstrong 1998). This last point makes one wonder whether the changing environment has had an asymmetric impact on different industries. Our conjecture is that industries and products better suited to the new media vehicles have benefited more from the 'revolution' and that the new advertising strategy has had an influence both on advertising spending and on the incentives to engage in cost-reducing investment. If this conjecture is valid, the data should show a positive relationship between advertising intensity and a firm's probability of being multinational for those industries and companies that are doing less broadcasting and more "narrowcasting".

This theory has the advantage of offering an explanation for the fact that some industries and firms have a higher level of advertising expenditure, while the internalization theory does not explain why intangible assets should differ by industry or over time. To study the interaction between alternative advertising strategies and cost-reducing investment, we examine a market in which a single producer launches a new product. Initially, potential buyers are unaware of the existence of the product and of its price, so the producer must decide the optimal advertising strategy.

Our model is therefore also related to the economics literature on informative advertising that is directly informative, i.e., advertising that conveys 'hard' information[4]. More specifically, this paper contributes to the smaller body of literature on specialized advertising media that allow sellers to target ads to particular segments of the potential market[5]. The paper most closely related to the present study is Esteban, Hernández and Moraga-Gonzales (2006). They formulate a general advertising technology that encompasses others in the literature and allows for the study of distinct strategies. They find a property of the technology that they call *strong economies of targeting,* under which targeting is preferred to mass advertising[6]. There are strong economies of targeting when advertising costs decrease and the consumer audience increases when ads are shifted from less to more specialized media. We posit the same advertising technology to study a different question: how advertising expenditure and cost-reducing investment are influenced by different advertising strategies. We find that both spending and cost-reducing investment are greater with targeting than with mass advertising when the marginal cost of ads is non-increasing and the marginal probability of getting informed is non-decreasing when advertisers shift from less to more

[4] See among others Butters 1977, Shapiro 1980, Grossman and Shapiro 1984, Robert and Stahl 1993, Stahl 1994 and Stegeman, 1991.

[5] See for instance Grossman and Shapiro 1984, Bester and Petrakis 1996, Hernández-García 1997, Esteban, Gil and Hernández 2001, and Esteban, Hernández and Moraga-Gonzales 2006.

[6] Esteban, Hernández and Moraga-Gonzales 2006 also study the question of how advertising strategy bears on product design strategy.

specialized media. We call this property *marginal economies of targeting.*

The rest of the paper is organized as follows. Section 2 describes the model and characterizes the results. Section 3 concludes with a review of the empirical predictions. All proofs are in the Appendix.

2 Model and Analysis

Consider a firm that produces and markets a new product. Let $c(f)$ denote the marginal cost of producing one unit of the good. Marginal cost is decreasing in CRI, i.e., in the amount of money f invested to reduce unit production costs. A way to affect unit costs is to invest in wage-reducing practices, such as locating a production plant in a country that offers a location advantage in term of cheap factor prices, or lobbying legislators to lower the minimum wage. Another possibility is investing in R&D to improve the production process. Let $Q(p)$ be the (potential) demand function and $P(q)$ the inverse demand function. We assume that $P(q)$ is twice differentiable, downward sloping and concave.

Potential buyers do not know of the product's existence and price, so the potential demand will not be realized unless consumers are informed about the product. Esteban, Hernández and Moraga-Gonzales (EHMG 2006) present an advertising technology that allows the producer to choose the target of the advertisement. A unitary mass of potential consumers buy at most a single unit of the good. Consumers' valuations are ordered and decreasing in the unit interval $[0,1]$. In particular, EHMG consider that for any t in the unit interval $[0,1]$, there is at least one advertising medium able to reach potential buyers in $[0,t]$. They call the target of the advertising campaign t and talk of "*mass advertising*" when $t=1$, i.e. ads are sent to the entire population; and of "*customer directed advertising*" when $t=Q(p)$, i.e. ads are sent only to those consumers who are willing to buy the product at price p. An advertising technology is described as the combination of two elements: the cost of advertising $A(n,t)$ and the probability $r(n,t)$ with which a consumer in $[0,t]$ becomes informed. Both the cost and the probability are functions of the number of ads n and the target t. Assume that both cost and the probability are not decreasing in the number of ads, i.e., $A_n(n,t) \geqslant 0$ and $r_n(n,t) \geqslant 0$.

We now introduce two fundamental properties of the advertising technology with respect to the target t.

The first definition is the property first introduced in EHMG.

Definition 1 *An advertising technology* $\{A(n,t), r(n,t)\}$ *presents strong economies of targeting whenever, for any given number of ads* n, *(i)* $A_t(n,t) > 0$, *and (ii)* $r(n,t) + tr_t(n,t) < 0$.

In words, we have *strong economies of targeting* when, for a given number of ads, advertising costs decrease and consumer awareness increases as we move ads from less to more specialized advertising media.

We now introduce a new property.

Definition 2 *An advertising technology* $\{A(n,t),\, r(n,t)\}$ *presents marginal economies of targeting whenever, (iii)* $A_{nt}(n,t) \geqslant 0$*, and (iv)* $r(n,t) + tr_{nt}(n,t) \leqslant 0$.

That is, we have *marginal economies of targeting* when the marginal cost of ads is non-increasing and the marginal probability of getting informed is non-decreasing with the shift of ads from less to more specialized media.

As we are mainly interested in studying the behaviour of f and n, we start by taking t as an exogenous characteristic of the technology. Then the monopolist's problem consists in solving the following program[7]:

$$\underset{q,f,n}{Max}\,[P(q) - c\,(f)]\,qr(n;t) - A(n;t) - f. \tag{1}$$

Our purpose is to study how f and n vary as we move from *mass advertising* ($t = 1$) to (a technology that permits) more targeted advertising ($t < 1$). To make this comparison using Topkis' Monotonicity Theorem (Topkis 1978, but see also Milgrom and Shannon 1994) we can 'aggregate' the variables that we are not interested in. In our case we can rewrite (1) as

$$\underset{f,n}{Max}\; l\,(f,n;t) = [P(q\,(f)) - c\,(f)]\,q\,(f)\,r(n;t) - A(n;t) - f. \tag{2}$$

Intuitively, this is a dynamic programming approach: first, for any given values of f and n we write the maximum value of (1) and then choose f and n to maximize the value function (2)[8]. If $l\,(f,n;t)$ is supermodular and has increasing differences, we can apply Topkis' Monotonicity Theorem[9]. For smooth functions in $\mathbb{R}^N$ we can use the following result, always following Topkis (1978).

Lemma 1 *Let* $l : \mathbb{R}^2 \times \mathbb{R} \longrightarrow \mathbb{R}$ *be twice continuously differentiable. Then* l *has increasing differences in* $(x;t)$ *if and only if* $\frac{\partial^2}{\partial x \partial t} l\,() \geqslant 0$ *for* $x = f, n$ *and* l *is supermodular in* x *if and only if* $\frac{\partial^2}{\partial f \partial n} l\,() \geqslant 0$.

[7] While the monopolist's problem should be written $[P(q) - c\,(f)] \min\{q,t\}\, r(n,t) - A(n,t) - f$, it is straightforward to show by contradiction that $q \leqslant t$. Assume $q > t$; then the monopolist's profits decrease with quantity ($P^{'}(q) < 0$). Therefore, the equilibrium quantity will be zero, but $q = 0 \leqslant t$.

[8] $q\,(f)$ is the implicit solution to $P^{'}(q)q + P(q) - c\,(f) = 0$.

[9] The version of Topkis' Monotonicity Theorem needded for our purposes is the following: Let $l : \mathbb{R}^2 \times \mathbb{R} \longrightarrow \mathbb{R}$. If l is supermodular in $x = (f,n)$ and has increasing differences in $(x;t)$, then $\arg\max l\,(x;t)$ is monotone non-decreasing in t.

We are now able to prove the following Proposition.

Proposition 1 *If the advertising technology exhibits (ii$'$) $r_t(n,t) \leqslant 0$, (iii) $A_{nt}(n,t) \geqslant 0$, and (iv$'$) $r_{nt}(n,t) \leqslant 0$, then unit cost reducing investment, f, and advertising intensity, n, are non-increasing in t.*

When consumer awareness increases, as we move to (a technology that permits) more targeted advertising ($r_t(n,t) \leqslant 0$), the expected sales of the firm given f and n increase. This creates an incentive to increase revenue by investing in unit cost reduction f. At the same time, reasons of cost and of effectiveness ($A_{nt}(n,t) \geqslant 0$ and $r_{nt}(n,t) \leqslant 0$) favour increased advertising intensity, reinforcing the positive effect on expected sales[10].

As in EHMG now consider t a choice variable. We check whether we can still find sufficient conditions such that expenditure for CRI, f, and advertising intensity, n, are higher when ads are directed only to those consumers who are willing to buy the product at price p, i.e., *customer directed advertising* than when they are directed to the entire population, i.e., *mass advertising.* Differentiating (1) with respect to t gives

$$[P(q) - c(f)]\, q r_t(n,t) - A_t(n,t). \tag{3}$$

Thus if the sign of (3) is positive $t = 1$ and mass advertising arises in equilibrium. If the sign of (3) is negative, recalling that $q \leqslant t$ (see footnote 7), the choice of the firm will be $t = q$. We can summarize the foregoing with the following Proposition.

Proposition 2 *The firm employs mass advertising (M) if and only if $[P(q) - c(f)]\, q r_t(n,t) - A_t(n,t) > 0$, in which case $t^M = 1$, and customer directed advertising (D) if and only if $[P(q) - c(f)]\, q r_t(n,t) - A_t(n,t) < 0$, in which case $t^D = Q(p)$.*

The optimal targeting strategy thus depends both upon the effectiveness of the alternative media and on their costs. Whether the advertising technology has the properties that determine *customer directed advertising* (D) or *mass advertising* (M) is, after all, a matter of empirical verification. While we can be confident that consumer awareness increases as we move to more specialized media (point (ii) in Definition 1)[11], it is less clear that advertising costs decrease (point (i) in Definition 1). Marketing scholars experts maintain that more specialized advertising media have higher *audience-attention probability* (Kotler 2002). For

[10] Note that the for the moment we are using weaker assumptions than in Definitions 1 and 2; their empirical validity is discussed later.

[11] Note that point (ii) in Definition 1 implies assumption (ii$'$) in Proposition 1.

instance, the probability that a targeted consumer will pay attention to at least one ad for a diet product transmitted by cable TV programming formats on nutrition or published in a magazine for young women is greater than the probability of reaching a consumer using a general readership magazine. As to advertising costs, EHMG find some evidence based on Dutch and Spanish press that $A_t(n,t) > 0$. But Stone (1996) claims that in many cases it is more expensive to reach a partial readership in a target region or audience. Moreover, in choosing media type, advertisers consider the nature of the product (for instance, fashions are best advertised in color magazines (Kotler 2002, Kotler and Armstrong 1998), so some industries and products that are well suited to be advertised through the new media vehicles may have benefited more from the changing communication environment. In other words, the cost of the advertising technology with respect to the target t and the choice of the advertising strategy could vary with the industry[12].

Let us now write the two problems for *mass advertising* (M) and for *customer directed advertising* (D).

$$(M): \underset{q,f,n}{Max}\,[P(q)-c(f)]\,qr(n,1)-A(n,1)-f. \tag{4}$$

$$(D): \underset{q,f,n}{Max}\,[P(q)-c(f)]\,qr(n,q)-A(n,q)-f. \tag{5}$$

Before conducting the same comparative statics exercise as for the exogenous case, we need two intermediate results.

Lemma 2 *a)* $q^D(f,n) < q^M(f)$ *for a given* f *and for any* n. *b)* The sign of $dq^D(f,n)/df$ is the same as that of $r(n,t)+tr_t(n,t)$.

For any given value of f and n we now write the maximum value of (4 and 5).

$$(M): \underset{f,n}{Max}\; g(f,n) = \left[P(q^M(f)) - c(f)\right] q^M(f)\, r(n,1) - A(n,1) - f. \tag{6}$$

$$(D): \underset{f,n}{Max}\; h(f,n) = \left[P(q^D(f,n)) - c(f)\right] q^D(f,n)\, r(n,q^D(f,n)) - A(n,q^D(f,n)) - f. \tag{7}$$

Now let us compare the solutions to these two maximization problems. To use Topkis' Monotonicity Theorem, we first parametrize the two problems (see Milgrom and Shannon 1994), by defining the function

$$l(f,n;\alpha) = \begin{cases} g(f,n) \text{ when } \alpha = 0, \\ h(f,n) \text{ when } \alpha = 1. \end{cases}$$

[12] Note that assuming part (ii) of Definition 1 still allows for both advertising regimes to arise in equilibrium. In that case, $A_t(n,t) > 0$ is sufficient but not necessary for (D). While, $A_t(n,t) < 0$ is necessary for (M) but not sufficient.

When the function $l(f, n; \alpha)$ is supermodular we have, by Topkis, $f(1) \geqslant f(0)$ and $n(1) \geqslant n(0)$,i.e., the solution of the second problem is greater than that of the first.

We can now prove the following Proposition.

Proposition 3 *Assume the advertising technology exhibits (ii$''$) $r(n,t) + tr_t(n,t) \leqslant 0$ and marginal economies of targeting, i.e., (iii) $A_{nt}(n,t) \geqslant 0$, and (iv) $r(n,t) + tr_{nt}(n,t) \leqslant 0$. Then the firm will spend more on cost-reducing practices and will choose greater advertising intensity under customer directed advertising (D) than under mass advertising (M), i.e., $f^D \geqslant f^M$ and $n^D \geqslant n^M$.*

To get the result, we now need somewhat stronger assumptions than in the exogenous case treated in Proposition 1. The reasoning following Proposition 1 is still valid: as we move from (M) to (D), greater consumer awareness $(r_t(n,t) < 0)$ increases expected sales, fostering incentives to increase unit revenue by investing in cost reducing practices, f. At the same time, reasons of cost and effectiveness ($A_{nt}(n,t) \geqslant 0$ and $r_{nt}(n,t) < 0$) favour increased advertising intensity, reinforcing the positive effect on expected sales[13]. However, under (D) the monopolist brings fewer units to the market, so stronger assumptions (*(ii$''$)*and *(iv)* instead of *(ii$'$)* and *(iv$'$)*) are needed to ensure that the increase in the probability of selling the product more than compensates for the decrease in quantity. The result is more actual sales for *customer directed advertising.*

3 Conclusion

The empirical literature on internalization has found a positive relationship between advertising intensity and the probability that the producer is a multinational. This evidence is also compatible with the model presented. However, the argument here is that the joint increase in marketing expenditure and in foreign direct investment can be explained by a change in the communications environment. More conclusive empirical evidence could be drawn both from cross section studies and from panel analysis. A cross section study could investigate whether in the industries where a positive relationship between advertising intensity and FDI has been found, firms have adopted the targeted advertising strategy, while panel analysis could confirm whether there is a temporal relation between the corporate decision to go multinational and advertising strategy. One conjecture is that industries and products better suited to the new media may have benefited more or earlier from the 'revolution'. If this is valid, the data should show a positive relationship between advertising intensity and the probability of being multinational specifically for the industries and

[13] Note that $r_t(n,t) < 0$ is implied by assumption *(ii$''$)* and $r_{nt}(n,t) < 0$ by assumption *(iv).*

companies that do less broadcasting and more narrowcasting. Finally, the empirical predictions concerning FDI should also extend to other cost-reducing investments such as R&D or lobbying for labor market deregulation.

Appendix

Proof of Proposition 1. First, replace the parameter t with $\widetilde{t} = -t$ and write the problem as $\underset{f,n}{Max}\; l\left(f,n;-\widetilde{t}\right)$. Given Lemma 1 we only check the sign of the three following derivatives:

1. $l_{fn}\left(f,n;-\widetilde{t}\right) = -r_n(n;-\widetilde{t})c^{'}(f)\,q(f) + r_n(n;-\widetilde{t})q^{'}(f)\left[P^{'}(q)q + P(q) - c(f)\right] \geqslant 0$. The result follows by recalling that $r_n(n,t) \geqslant 0$, $c^{'}(f) < 0$ and that the term in square brackets is zero;

2. $l_{f\widetilde{t}}\left(f,n;-\widetilde{t}\right) = r_t(n;-\widetilde{t})c^{'}(f)\,q(f) - r_t(n;-\widetilde{t})q^{'}(f)\left[P^{'}(q)q + P(q) - c(f)\right] \geqslant 0$. The result follows by assumption *(ii′)* $r_t(n,t) \leqslant 0$, and again by recalling that $c^{'}(f) < 0$ and that the term in square brackets is zero;

3. $l_{n\widetilde{t}}\left(f,n;-\widetilde{t}\right) = -\left[P(q) - c(f)\right]qr_{nt}(n;-\widetilde{t}) + A_{nt}(n;-\widetilde{t}) \geqslant 0$. The result is a consequence of assumption *(iii)* $A_{nt}(n,t) \geqslant 0$, *and (iv′)* $r_{nt}(n,t) \leqslant 0$. ■

Proof of Lemma 2. a) Assume that the firm employs a D strategy. Differentiating (5) with respect to q we get

$$\left[P^{'}(q)q + P(q) - c(f)\right]r(n,q) + \left[P(q) - c(f)\right]qr_q(n,q) - A_q(n,q) = 0. \qquad \text{(A1)}$$

The choice of D implies that $\left[P(q) - c(f)\right]qr_q(n,q) - A_q(n,q) < 0$ and that $P^{'}(q)q + P(q) - c(f) > 0$. Since $P^{'}(q)q + P(q) - c(f)$ is a decreasing function of q ($P^{'}(q) < 0$ and $P^{''}(q) \leqslant 0$), it follows that $q^D(f,n) < q^M(f)$ for a given f.

b) To obtain $dq^D(f,n)/df$, we differentiate equation (A1) totally. Then, isolating $dq^D(f,n)/df$ we get

$$dq^D(f,n)/df = c'(f)\left[r(n,q) + qr_q(n,q)\right]/soc_q$$

The denominator is negative (assuming that the second order condition holds). Thus the result follows recalling that $c'(f)$ is negative. ■

Proof of Proposition 3. Given Lemma 1 we only have to check the sign of the following three derivatives:

1. $l_{f\alpha}(f,n;\alpha) = -c'\left[q^D r(n,q^D) - q^M r(n,1)\right] + \frac{dq^D}{df}\frac{\partial h(f,n)}{\partial q^D} - \frac{dq^M}{df}\frac{\partial g(f,n)}{\partial q^M} > 0$. First note that the second and third terms are both zero. Thus $c' < 0$ together with the following inequalities $q^M r(n,1) < q^M r(n,q^M) \leqslant q^D r(n,q^D)$ yield the result. Both inequalities

are a consequence of *(ii$''$)*. The first derives from $r_t(n,t) < 0$ (which is implied by *(ii$''$))*, and the second comes from $\frac{\partial tr(n,t)}{t} \leqslant 0$ (which is equivalent to *(ii$''$)*) and part a) of Lemma 2;

2. $l_{n\alpha}(f,n;\alpha) = \left[A_n(n,1) - A_n(n,q^D)\right] + \left[P(q^D) - c\right] q^D r_n(n,q^D) - \left[P(q^M) - c\right] q^M r_n(n,1) + \frac{dq^D}{dn}\frac{\partial h(f,n)}{\partial q^D} > 0$. First note that the last term is zero. Second, $P(q^D) > P(q^M)$ due to the decreasing demand function and to $q^D < q^M$ (Lemma 2). Third, $q^M r_n(n,1) < q^M r_n(n,q^M) \leqslant q^D r_n(n,q^D)$ where, following the same logic as in point 1, all inequalities can be shown to be a consequence of *(iv)* and $q^D < q^M$. Last, assumption *(iii)* implies $A_n(n,1) \geqslant A_n(n,t^D)$. The sign of the derivative follows by the four preceding steps;

3. $l_{fn}(f,n;\alpha) = -(1-\alpha)\, c' q^M r_n(n,1) - \alpha c' q^D r_n(n,q^D) + (1-\alpha)\frac{dq^M}{df}\left[\left(P^{'}q + P - c\right) r_n(n,1)\right]$

$+\alpha\frac{dq^D}{df}\left[(P-c)\left(r(n,q^D) + tr_{nq}(n,q^D)\right) + P^{'}qr_n(n,q^D) - A_{nq}(n,q^D)\right] \geqslant 0$. The first two terms are non-negative because $c' < 0$ and $r_n(n,t) \geqslant 0$. The third term is zero because $\left(P^{'}q + P - c\right) = 0$. The last term is non-negative because it is the product of two parts that are both non-positive. $\frac{dq^D}{df} \leqslant 0$ from part b) of Lemma 2 and assumption *(ii$''$)*. In the square bracket, all terms are non-positive: the first because of assumption *(iv)*; the second because of the decreasing demand function and $r_n(n,t) \geqslant 0$; the last because of assumption *(iii)*. ■

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