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ASSESSING ADVERTISING EFFICIENCY: DOES THE INTERNET PLAY A ROLE?

ABSTRACT

This research focuses on a major concern for marketers addressing the claims of inefficiency of the spending on advertising. We examine whether the Internet can help increase overall advertising efficiency. Using a sample from the Spanish automobile industry, we combine a nonparametric method - Data Envelopment Analysis - with recent important insights from statistics and econometrics studies, and we find that online advertising improves the efficiency levels and this effect is more pronounced in the long-term temporal framework.

During the last few decades, expenditures in manufacturing and general management have been declining while marketing costs have risen (Sheth and Sisodia 1995). From a "budgetary" context perspective, the biggest part of marketing expenditures usually goes to advertising and promotion (Ambler 2000). Some empirical evidence suggests that, in the long-term, advertising has a positive effect on differentiation and brand equity, while this is not the case for promotion (Boulding et al. 1994; Jedidi et al. 1999). Although recent studies have found that promotion has a role in building brand knowledge (e.g., Palazón-Vidal and Delgado-Ballester 2005), the "traditional wisdom" of advertising enhancing brand equity has given rise to very high amounts of advertising budgets. However, researchers claim that advertising is "rife with productivity problems" (Sheth and Sisodia 1995, p. 19). Consequently, advertising is under increasingly severe scrutiny because of the growing emphasis on accountability of advertising results (Bhargava et al. 1994).

The pressure to justify advertising expenditures has led marketers to look for a new advertising mix, stressing Internet usage. Online advertising is believed to be highly cost-effective relative to other media, particularly when taking into account its ability for more precise targeting and two-way dialogue with customers (e.g., Briggs and Hollis 1997). At the beginning of 2006, marketing chief officers of Fortune 500 companies announced that they planned to increase online advertising spending up to 32% compared to the previous year. Could this be part of the way of making advertising more efficient?

Academic research in Internet advertising has grown exponentially in the last decade in search of the role of the Internet as a marketing tool. Researchers refer to Internet's capability of addressing individual customers (Deighton 1997), its interactivity and ability to store vast amounts of information (Peterson et al. 1997) and the fact that it

allows customers to seek unique solutions to their needs (Sheth et al. 2000). Moreover, Internet advertising attracts attention because of the current shift in advertising strategy in favor of deriving maximum response from selected target groups instead of maximum exposure to many unknown audience groups (Yoon and Kim 2001, p. 53). The accountability of online advertising along with its contribution to marketing efficiency and effectiveness are expected to lead to further growth in Web-based advertising efforts (Brackett and Carr 2001; Sharma and Sheth 2004; Hollis 2005).

In spite of the expanding attention to the role of the Internet in advertising, the contribution of online advertising to overall advertising efficiency still remains unclear because of a lack of studies that deal with this issue. This study, therefore, aims to address this gap in the literature and assess the advertising efficiency with a focus on the role of the Internet. We verify whether the use of the Internet as an advertising tool affects the overall advertising efficiency in the Spanish automobile industry over a period of seven years. The research approach used in this study encompasses two dimensions – competition and time - as crucial in the assessment of advertising efficiency. Data Envelopment Analysis (DEA) has been chosen as the appropriate technique for measuring advertising efficiency because it can deal with the concern in the marketing literature that advertising expenditure decisions are often made with competitors in mind (Rust et al. 2004a). Therefore, it is important to benchmark the results of advertising against the best performers in the industry. In this field, recent research (Simar and Wilson 1998, 2007) demonstrates that DEA efficiency coefficients are biased estimations of the true, unknown, efficiency levels, this bias being potentially amplified when the number of units included in the sample under analysis is relatively small. As this may well be the case in our sample, bootstrapping techniques to correct the observed bias in the DEA efficiency estimates are applied. Once the bias is adjusted

in the estimated efficiency scores, following Simar and Wilson (2007), we use the corrected efficiency scores as a dependent variable in a 7-year truncated regression. The results of this study suggest that the Internet has gained its place as a necessary part of the advertising mix since firms that had invested consistently in online advertising achieved long-term gains in efficiency.

CONCEPTUAL BACKGROUND

Advertising Efficiency

Early research in assessing advertising performance focused on advertising ROI (Dhalla 1978), efficiency of advertising spending measured by the advertising cost/sales ratio (Smith and Park 1992), and the effect of advertising on sales measured by econometric models (Assmus et al. 1984). However, scholars have been pointing out that environment and competition have to be taken into account when assessing the productivity of marketing actions (Sheth and Sisodia 2002; Vakratsas and Ambler 1999). Rust et al. (2004a: 86) argue that firm performance is fundamentally affected by competition and it changes over time, therefore it is necessary to capture both dimensions (competition and time) in marketing productivity measurement. We discuss, in turn, the theoretical rationale supporting this view.

The competition dimension

According to the information processing theory, consumers process information independently for different brands and then compare the values across all relevant attributes (Fishbein and Ajzen 1975). Nevertheless, as Teng and Laroche (2007) claim, the information processing theory places a limit on the consumer behavior models to discover the real marketing phenomenon, since competition has been ignored. New developments in the field posit that the consumer decision-making process is a

competitive comparison and it is the result of competition at each stage of ad and brand information processing (Laroche et al. 1996; Teng and Laroche 2007). Since the consideration of competing brands is a central element of brand choice (Guadagni and Little 1983), and competition has an impact on each consumer's purchase decisions (Rust et al. 2004b), we contend that competition should be included in the measurement of the effect of advertising on sales.

The competition dimension has received relatively little attention in advertising research. Only recently have researchers started to examine the effect of advertising by taking the competition into consideration (e.g., Vakratsas and Ma 2005; Yoo and Mandhachitara 2003). Over the last decade, a few studies have applied DEA methods to evaluate advertising efficiency in competitive settings. Luo and Donthu (2001) assessed the best advertising practices among the top 100 U.S. advertisers and found that many leading advertisers have low advertising efficiency (below 20 percent). Färe et al. (2004) estimated the cost efficiency in advertising in the U.S. beer industry and found that the overall cost efficiency index was low and there was considerable variability in media-mix efficiency among firms and over time. Büschken (2007) revealed eight percent inefficiency of brand advertising spending in the German car market. Luo and Donthu (2005) compared two frontier methodologies – DEA and the Stochastic frontier model - to benchmark inefficiency, demonstrating about 20% inefficiency of media spending for the top 100 U.S. advertisers. Lohtia et al. (2007) used DEA to evaluate banner advertisements efficiency.

We follow the latter stream of research and address the competition dimension by evaluating advertising efficiency relative to competitors. Thus, the competition dimension in our study is introduced by the use of DEA, a technique that explicitly

considers the competitors in evaluating the efficiency of advertising by benchmarking the performance of each unit under analysis to the "best performers" in the industry.

The time dimension

Measuring the effect of advertising on sales, with attention to the duration of this effect, has been extensively studied. Among the techniques applied are the Koyck model (e.g., Leone 1995), the VAR model (e.g., Dekimpe and Hassens 1995), and the examination of cumulative effects of advertising on choice and quantity (Jedidi et al. 1999). Much of the literature used distributed lag models that capture the relation between advertising flows and sales flows. Clarke (1976) estimated that the duration interval of advertising varied widely, but the effect of advertising on sales lasts only months. Conversely, other authors claim that the advertising effect on sales carries over for multiple years (Dekimpe and Hassens 1995; Peles 1971) and that advertising affects long-run marketing productivity by creating knowledge and maintaining acceptance about brands (Cobb-Walgren et al. 1995; Berkowitz et al. 2001; Ehrenberg et al. 2002).

A critical part of how advertising influences consumer behavior is explained by memory since consumers usually do not make brand purchase choices at the time of advertising exposure, but rather on the basis of the memory of the advertising messages (Mehta and Purvis 2006). Braun-La Tour and La Tour (2004) explain that the conventional wisdom in advertising was that memory for an ad creates a separate memory trace that decays over time. Failure to remember the ad was considered a consequence of the inability to find the right cue to access its content (Keller 1987). However, a newer view in this respect (Edell 1993) is that the memory for the ad interacts with other information stored in the memory (other ads, personal experience, word-of-mouth about the brand, etc.). Therefore, the memory for advertising is dynamic in nature (Braun 1999).

In line with the latest developments in consumer behavior and memory research, advertising efficiency in our study is defined as the efficiency of the expenditures in advertising made by a company in generating sales relative to its competitors, and we estimate the efficiency over a period of seven years. The advertising efficiency measurement model is presented in Figure 1. We adopt the definition of technical efficiency, i.e., the ability to minimize input use in the production of a given output vector, or the ability to obtain maximum output from a given input vector (Kumbhakar and Lovell 2000).

Place Figure 1 about here

Internet Advertising

Since the early 1990s Internet advertising has grown exponentially and has occupied a place as a necessary part of the advertising mix. This is so because the Internet is believed to be more effective than traditional media in accomplishing certain advertising objectives (Li and Leckenby 2004). As stated by Briggs and Hollis (1997), the Web offers unique advantages over other media in terms of targeting and direct marketing. Deighton (1997) highlights two critical features of the Internet: addressability (the communication is directly addressable to individuals) and responsiveness (the communication is alert to the receiver's response). Thus, the Internet provides a targeted means for reaching consumers (Burke 1997).

The most frequently highlighted feature of Internet advertising is its interactivity (e.g., Rodgers and Thorson 2000). Interactivity is considered one of the main reasons that make the Internet a substantial advertising vehicle (Roberts and Ko 2001). Although different definitions of interactivity have been provided in the literature (e.g., Steuer 1992), there is a common view that in an interactive environment the marketing

communication is changed from a one-way to a two-way process (Stewart and Pavlou 2002) where, on the one hand, advertisers have the advantage of identifying customers, differentiating them, and customizing purchasing and post-purchase service (Roberts and Ko 2001) and, on the other hand, consumers have more influence on the process by selecting advertising, and choosing whether, when and how to interact (Pavlou and Stewart 2000). The described features of the Internet have led several authors (Brackett and Carr 2001; Sharma and Sheth 2004; Hollis 2005) to the expectation of further growth in Web-based advertising efforts, stressing the contribution of the Internet to marketing efficiency and effectiveness, in view of the shift in advertising strategy in favor of deriving maximum response from selected target groups instead of maximum exposure to many unknown audience groups (Yoon and Kim 2001).

Because of its ability to transmit information quickly and inexpensively, the Internet is expected to have a greater impact on marketing communications than on other marketing elements. Peterson et al. (1997) suggest that communication channel intermediaries will probably be the most affected by the Internet, since it has been designed to deliver information efficiently and is more flexible and superior in targeting buyers, enabling direct interaction. In a similar vein, Zeng and Reinartz (2003) argue that the Internet has a very differentiated impact along the three different stages of the consumer decision-making process: i) search, ii) evaluate and iii) transact. The Internet has been very successful, the authors state, in increasing the efficiency and effectiveness of the first stage – the information search. For different industries and products, the possible gains from the Internet at the three stages would vary greatly. Products like books, travel and computer equipment can provide customer values at all three stages, whereas, for new cars, the Internet currently has its highest potential in the first stage, thus increasing the communication benefits for consumers.

Indeed, Sheth et al. (2000) point out that in 1999 around 40 percent of automobile buyers perused the Internet before visiting a dealer, which is 25 percent more than in 1998. Yoon and Kim (2001) found that the Internet affected the purchase decision of customers that are highly involved with automobiles more than other media. Klein and Ford (2003) found that an increasingly greater proportion over time of searching for automobiles is conducted using Internet sources. Ratchford et al. (2003) study the effect of the Internet on information search for automobiles and report gains for consumers stemming from time savings but also from better buys (reductions in opportunity losses). They further state that the Internet reduces time spent with the car dealer/manufacturer and thus leads to efficiency gains both for the consumer and for the dealer.

Another line of research compares the effects and effectiveness of the Internet with those of other media, with substantial differences among the media not being found (Faber et al. 2004). Comparing online and print advertising, Gallagher et al. (2001) found that those two media are equally effective, given an equal opportunity for exposure to the target audience. The advantage of the Internet is, therefore, in its cost-effectiveness. Research has reported that the Internet can boost brand impact at a 60% less cost than offline ads (McCarthy 2003, cited in Kanso and Nelson 2004). Taking an efficiency perspective, if online advertising is equally effective, is better at targeting interested consumers and is less costly, we expect that:

H1*: Investing in Internet advertising will increase overall advertising efficiency.*

The latest developments in Internet advertising suggest that it maximizes its impact when combined with conventional advertising. Li and Leckenby (2004) suggest that the integration of traditional and new media is nowadays essential for many

advertising campaigns. Parker and Plank (2000) explain that people do not abandon traditional forms of media for the Internet in their search processes. Besides, people are usually exposed first to offline ads, and consumers can be biased towards the Web efforts of advertisers based on previous attitudes toward the brand formed during exposure on offline advertisements (Balabanis and Reynolds 2001).

Researchers have long suggested that multiple-source messages would be more easily processed by (and will motivate more) consumers than repetitive messages (e.g., Edell and Keller 1999; Chang and Thorson 2004; Harkins and Petty 1981a, 1981b, 1987). A greater number of sources affects message credibility and this, in turn, influences purchase intention. Chang and Thorson (2004) advocate that marketers should apply multiple-source strategy since presenting information in varied contexts leads to ad messages being encoded in a slightly different way, which enhances retrieval ability and therefore increases awareness. In their study of multiple-source strategies, the television-Web ad mix led to higher attention, higher perceived message credibility, and a greater number of total and positive thoughts, and this effect was superior to the repetitive ad condition. Likewise, Tsao and Sibley (2004) found that there were reinforcing effects between online ads and several offline ad channels, such as television, billboards and direct mail, which led them to conclude that the Internet served a complementary and not a displacement role in the advertising mix.

Similarly, Saeed et al. (2003) found evidence about the complementary effect of Web site value and offline advertising. In their study, performance was influenced by advertising expenditures complemented by Web site features facilitating product search, product choice and the product-ownership experience. Ilfeld and Winer (2002) found that both online and offline advertising increase Web traffic and this, in turn, increases brand equity. Therefore we expect that:

***H2**: Companies that employ an advertising mix in which conventional media are complemented by Internet advertising will have greater advertising efficiency.*

A great deal of the research in online advertising has focused on brand-related response measures. This is not surprising since much of the marketing communications efforts of the companies are oriented towards building a favorable attitude, brand familiarity and brand preference in consumers' minds as a basis for purchase intention and decision. Ehrenberg et al. (2002) view advertising as having the function of brand maintenance or refreshing acceptance of the brand. They further explain that, since advertising works through people's memory, the gap between exposure and behavior will be different for different types of products; it could be seconds for an in-store display, months for an instant coffee, or years for car or insurance campaigns (p. 9). Berkowitz et al. (2001, p. 29) suggest that in the case of advertising for brand building, its effect on sales could be seen in the long-term, especially when buying products after evaluation and discussion with others (which is normally the case when buying automobiles).

Similarly, in the online environment, brand-building and brand-supporting activities are not usually expected to produce quick results. Ilfeld and Winer (2002) found that neither online nor offline advertising lead to immediate development of brand equity, therefore, brand equity for Web sites should be built over time. Drèze and Hussherr (2003) found that banner ads have a positive effect even beyond the traditional click-through measure, impacting recall, brand recognition and brand awareness; Goldsmith and Lafferty (2002) also supported the positive effect of online advertising on brand recall and consumers' view of the brand, and Briggs and Hollis (1997) provided evidence about the sizable effect of banner ads on brand loyalty and attitudes. Hence, desired outcomes such as brand awareness, positive attitude and purchase intention will

likely be observed after investing consistently in Internet advertising over time. Thus, we expect that:

> ***H3****: The more temporal-consistent the firm is investing in Internet advertising, the better its overall advertising efficiency.*

METHOD

To test the effect of Internet advertising on the efficiency of the advertising mix, we followed a two-stage research approach. In the first stage, efficiency coefficients per firm and year using the DEA technique were calculated. The second stage uses the DEA estimates as a dependent variable in a bootstrap truncated regression analysis. A detailed explanation of the method follows.

First Stage: Data Envelopment Analysis

Data Envelopment Analysis has become an important tool in efficiency measurement in the last two decades. It is based on the seminal work of Farrell (1957) and was originally developed by Charnes et al. (1978), with constant returns to scale, and later extended by Banker et al. (1984) to include variable returns to scale. DEA is a non-parametric, linear programming based technique designed to measure the relative performance of decision making units (DMUs) where the presence of multiple inputs and outputs poses difficulties for comparisons. DEA uses the ratio of weighted inputs and outputs to produce a single measure of productivity (relative efficiency). Efficient DMUs are those for which no other DMU generates as much or more of every output (with a given level of inputs) or uses as little or less of each input (with a given level of outputs). The efficiency of each unit, therefore, is measured in comparison to all other units. An important feature of DEA is that it builds an efficient frontier comprising all of the efficient units, thus allowing a comparison to the best performers (Charnes et al. 1978).

The efficient DMUs have an efficiency score of one (or 100%), while the inefficient ones have efficiency score more than one (or more than 100%) in the output-oriented DEA model, and less than one but greater than zero in an input-oriented model. An input-oriented model will look for efficiency by proportionately reducing inputs, while an output-oriented model will focus on increasing outputs given the observed inputs consumption. In the case of measuring advertising efficiency, the output-oriented model seems to be preferable since advertising budgets are usually preliminarily decided and the goal is maximization of outputs with the available budget (Low and Mohr 1999; Piercy 1987). The DEA models employed in our study are, therefore, output-oriented and with variable returns to scale in order to control for possible different economies of scale at which companies operate. The model is presented below.

$$
\begin{aligned}
&Max.\beta_t\ ,\\
&s.t.:\\
&\sum_{k=1}^{K}\lambda_k \cdot y_{ikt} \geq \beta_t \cdot y_{it}^{o}, \qquad i=1,...,I,\\
&\sum_{k=1}^{K}\lambda_k \cdot x_{jkt} \leq x_{jt}^{o}, \qquad j=1,...,J,\\
&\sum_{k=1}^{K}\lambda_k = 1,\\
&\lambda_k \geq 0.
\end{aligned}
\qquad [1]
$$

Where β_t is the efficiency coefficient for the unit under analysis in period t ($\beta_t = 1$ indicates that the DMU under analysis is efficient, and $\beta_t > 1$ that this DMU is inefficient. β_t*-1* determines the output growth rate required to reach the frontier), y_{it}^{o} is the observed outputs vector of the DMU under analysis in period t, x_{jt}^{o} is the observed inputs vector of the DMU under analysis in period t, y_{ikt} and x_{jkt} refer to outputs and inputs vectors for the k *(k=1, ..., K)* DMUs forming the total sample, and λ stands for the activity vector.

The 'true' production frontier and the efficiency measure are all unknown. Estimates of the efficiency can be calculated using observed, or actual, input-output combinations. These estimates will yield information on the input-output pairs that are considered efficient given the observed data. Although this information may appear to be deterministic, past studies have examined the statistical properties of the DEA estimators. Banker (1993) proved weak consistency of the DEA estimator for the single-input, single-output case. Gijbels et al. (1999) derived the asymptotic sampling distribution for the single-input, single-output model along with the asymptotic bias and variance. However, in the multi-input, multi-output case which typifies our study, the bootstrap seems to be the only way to investigate the sampling distribution of the DEA estimators (Simar and Wilson 2000a).

The "smoothed" bootstrap approach of Simar and Wilson (1998) is used here, and the theoretical underpinnings can be found in the extensive work by Simar and Wilson (1998, 1999, 2000a,b). The key assumption behind this approach is that the known bootstrap distribution will mimic the original unknown distribution if the known data generating process (DGP) is a consistent estimator of the unknown DGP. The bootstrap process will, therefore, generate values that mimic the distributions which would be generated from the unobserved and unknown DGP (Simar and Wilson 1998, 2000a,b). Because DEA estimates a production frontier boundary, generating bootstrap samples is not straightforward. The "smoothed" bootstrap is based on the DEA estimators themselves by drawing with replacement from the original estimates of beta, and then it applies the reflection method proposed by Silverman (1986).

The seven steps in this procedure are quite simple to implement:

1. Solve program (1) and obtain the original efficiency scores $\beta_1 \ldots \beta_k$.
2. Define a sample $\beta_{B1} \ldots \beta_{Bk}$ generated from $\beta_1 \ldots \beta_K$.
3. Smooth the sample.

4. Obtain the final value $\beta_1^* ... \beta_K^*$ by adjusting the smoothed sample so that the variance of the final bootstrap sequence is asymptotically correct.
5. Adjust the original outputs using the ratios $\beta_1 / \beta_1^* ... \beta_K / \beta_K^*$.
6. Resolve model (1) using the adjusted outputs to obtain $\hat{\beta}_{b1}^* ... \hat{\beta}_{bK}^*$.
7. Repeat Steps 2 to 6 B times to obtain B sets of estimates (usually 2000).

Once the desired number of samples is obtained, the bias of the original estimates $\beta_1 ... \beta_K$ is calculated as follows:

$$bias\ \hat{\beta}_k = \frac{\sum_{b=1}^{B} \left(\hat{\beta}_{bk}^* - \beta_k \right)}{B} \qquad [2]$$

which, finally provides the bias-corrected estimator of the true value of $\beta_1 ... \beta_K$:

$$\hat{\beta}_k^* = \beta_k - bias\ \hat{\beta}_k \qquad [3]$$

Second Stage: Truncated Regression Analysis

To assess the effect of Internet advertising on efficiency we used the bias-corrected efficiency coefficient resulting from the DEA-based bootstrap as a dependent variable in an explanatory truncated regression model. We pulled the data for all the years and controlled for year and firm effect including dummy variables. This allows us to control for time effect and for unobservable firm-specific effect.

Since DEA efficiency coefficients are censored (in our case the output-oriented DEA model results in coefficients which are censored with a lower bound of 100), the traditional ordinary least squares model is not appropriate. While other studies have used Tobit models when the dependent variable is censored (e.g., Datar et al. 1997; Luo and Homburg 2007), recent research in econometrics has demonstrated that with DEA efficiency scores, truncated regression models are much more suitable and produce more robust results (Simar and Wilson 2007). In particular, Simar and Wilson (2007) found

that the best-performing model is the truncated regression with bootstrap estimates. We follow their recommendation and use this technique for our model estimates. Thus, we apply a double bootstrap[1] model (once in the first stage with the DEA measurement, and second, in the truncated regression analysis).

DATA, ANALYSES AND RESULTS

Input and Output Variables for the Efficiency Analysis

In this research we focus on car advertising. Eighteen car dealers operating in Spain have been considered as being suitable for the study because of the availability of all necessary data for input and output variables. The car dealers included represent 74% of the new cars sold in the Spanish market in 2007. Data for input variables have been obtained from the *INFOADEX* (*Information for Advertising Expenditures*) database. *INFOADEX* provides detailed information on advertising expenditures made in Spanish media (Television, newspapers, magazines, Sunday supplements, radio, cinema, Internet and outdoor). *INFOADEX* computes advertising expenditure by monitoring daily communication markets and their prices. We consider as output variables: (1) sales revenue, available from the *SABI (Sistema de Análisis de Balances Ibéricos)* database, and (2) sales as measured by number of cars sold, made available to us by the Spanish Association of Manufacturers of Cars and Trucks. Data have been obtained for seven years - from 2001 to 2007.

There is a requirement in applying DEA that input and output variables should be positively correlated (Luo and Donthu 2005). A correlation analysis has been run in order to see the relationship between the variables. Descriptive statistics and correlations between the variables are presented in Table 1.

Place Table 1 about here

Efficiency coefficients were estimated per firm per year following the bootstrap bias-corrected DEA technique. We also estimated optimal weights for each input giving the relative value of the inputs for the resulting efficiency scores. The DMU-specific optimal weights are reported in Table 2. Importantly, although the Internet can be considered a new input and its importance in terms of the percentage of the total advertising budget is small, the optimal weights for Internet advertising are positive and different from zero in more instances than the rest of the inputs, which gives us confidence that this is a relevant input in the efficiency measurement model[2].

Place Table 2 about here

Testing the Effect of Internet Advertising on Efficiency

In H1, we suggest that the investment in Internet advertising will contribute to improve efficiency. As noted, the Internet is a new and small input, and there are considerable differences between the units in our dataset in terms of investment in Internet advertising. We generated a binary variable, where 1 corresponds to firms that have started to invest in Internet advertising since the first year under analysis (2001) and have invested in the Internet during all years under analysis[3]. As Model 1 in Table 3 reveals, firms that have invested in online advertising along the years have lower efficiency score levels ($b = -657.1539$, $p = .000$). Note that our DEA model is output-oriented, which means that the greater the score, the greater the inefficiency. Thus, a negative sign here means that the Internet has helped decrease the inefficiency, or in other words, increase the efficiency.

Place Table 3 about here

In H2, we suggest that firms combining online and offline advertising will be more efficient. To discover whether there was a particular advertising mix corresponding to firms with higher efficiency, a cluster analysis was run. Two groups of firms were formed: Cluster 1 was characterized by greater share of print and outdoor advertising, while Cluster 2 relied more on broadcast and Internet advertising. The clusters were largely stable in all the years, and the four variables (print, broadcast, outdoor and Internet) were significantly discriminating between the clusters throughout the years, with some small exceptions (Appendix 1 outlines the description of the media mix of the two clusters). Table 4 presents the average efficiency scores for the two clusters, as well as the evolution of the efficiency scores of each company in the sample throughout the years. The average efficiency scores are always lower for Cluster 2, thus revealing that Cluster 2 has performed better in achieving lower inefficiency in all years under analysis[4]. While there are some "good performers" in Cluster 1 that have persisted at relatively low inefficiency levels during the whole period under analysis, in general Cluster 2 has performed better.

Place Table 4 about here

The difference between the efficiency scores of the two clusters increases as time passes, starting from 19.83% inefficiency in 2001, i.e., firms in Cluster 1 were, on average, 19.83% more inefficient, and reaching 62.52% in 2007. However, during the first years (2001-2004) the difference is not statistically significant. It is in 2005 that the difference between the efficiency levels of the two clusters becomes significant. Thus, our results suggest that there is a synergistic effect between Internet and offline (in this case, broadcast) advertising; however, the effect is not immediate. The companies in cluster 2 have persisted in their online-offline advertising mix along the years and have

achieved significantly better efficiency levels in the second part of the period under analysis (2005-2007). Figure 2 illustrates how the advertising mix of the companies in Cluster 2 has contributed over the years to the overall advertising efficiency of these companies.

Place Figure 2 about here

We ran a truncated regression model using the cluster result as an explanatory variable (we generated a binary variable "Online-offline advertising mix", where 1 corresponds to Cluster 2, and 0 corresponds to Cluster 1). As expected, the effect on the efficiency score was negative and statistically significant (b = -442.9168, p = .002), suggesting that the advertising mix adopted by Cluster 2 decreases inefficiency (Model 2 in Table 3). We also ran an equation that simultaneously analyzes H1 and H2 in order to observe the consistency of the coefficients. As expected, the same signs of the coefficients of the variables "Internet advertising" (-96.69, p=.042) and "Online-offline advertising mix" (-311.68, p=.003) were obtained.

In H3, we suggest that the contribution of the Internet to overall advertising efficiency will be seen in the long-term, taking into account the consistent investment in Internet advertising over time. The ANOVA results (Table 4) already suggest that the contribution of the Internet to efficiency is more pronounced for companies that have persisted in their Internet advertising along the years. DEA efficiency scores, however, do not usually follow a normal distribution. That is why, to further test H3 and assure robustness of the results, we generated a new variable for the temporal consistency of a firm in its online advertising investment, and we ran a truncated regression. The variable reflects the accumulated number of years a firm has invested in Internet advertising divided by the total number of years[5]. Model 4 in Table 3 reveals that the temporal

consistency in Internet advertising has a significant negative effect on the efficiency score, thus reducing inefficiency (b = -81. 58799, p= .013).

Additional Data Analyses

We specified several additional estimates in order to validate our results. To validate our efficiency estimates, a traditional output-oriented DEA model was ran and the results were compared with the bias-corrected bootstrap DEA estimates. There was a high correlation between the traditional and the bias-corrected bootstrap DEA models (Pearson correlation coefficient 0.9, p=.000). However, the Wilcoxon test detected significant differences between the median levels of efficiency (Z= -9.740, p=.000). Thus, in our analyses, we used the more robust, bias-corrected bootstrap estimates of efficiency (descriptive statistics are presented in Appendix 2).

An interesting feature of DEA is that it provides additional possibilities by estimating slacks for each input and output, which gives the amount of input (output) to be reduced (increased) in order for the DMU to become efficient by taking its closest peer on the efficiency frontier as a reference. Although the purpose of this paper is to look at the contribution of the Internet to overall advertising efficiency and not to give specific recommendations about how to reduce overspending, it is useful (especially from a managerial point of view) to estimate slacks and see which inputs should be reduced more in order for the firm to reach the efficiency frontier. We present the mean slacks per input and year in Table 5, where it can be observed that the Internet has the lowest overall slack. However, managers interested in slack analysis should focus on the individual firm slacks per input, which provide information about the overspending of each input by a particular DMU.

DISCUSSION

With the objective to discover the role of Internet advertising in the efficiency of the advertising mix, this study followed a sequence of techniques. First, contemporaneous efficiency frontiers were constructed for the seven years of analysis (2001-2007) using a bootstrapping DEA technique to reveal the inefficiency levels for each firm and year. We then ran a cluster analysis to discover possible different types of advertising mixes, based on four advertising media: print, broadcast, Internet and outdoor. Finally, we ran truncated regression models with bootstrap error estimation to uncover the effect of the Internet on the efficiency levels.

The results of this study shed light on a number of important issues in contemporary research in advertising. First, online advertising seems to be a promising way to increase overall advertising efficiency. In our sample, firms that had invested consistently in Internet advertising during the whole period of analysis had a lower average efficiency score, meaning lower inefficiency levels. Second, evidence was found about a particular advertising mix complementing offline (broadcast) with online advertising, which proved to be an efficiency-gaining mix. Third, our results support the claim of the marketers that the performance of marketing expenditures should be measured in long-term, taking into account the accumulated effect.

Our results support studies (Brackett and Carr 2001; Sharma and Sheth 2004; Hollis 2005) suggesting that the Internet will have a positive effect on the efficiency of marketing expenditures. Furthermore, this study complements the results of Yoon and Kim (2001), Klein and Ford (2003), and Ratchford et al. (2003), demonstrating that the gains of the Internet are not only on the consumer side; the firms can also obtain efficiency gains through online advertising. This is important since the Internet is still a

young advertising medium and how Internet expenditures affect performance is an issue of great relevance for managers.

However, we should bear in mind that our results come from a sample from a high-involvement product market. Consumer involvement with the product category has been considered an important factor in consumer research and it can affect the motivation to process information, the amount of effort put into the search and buying process and, thus, the way consumers respond to a specific type of advertising (Balabanis and Reynolds 2001). Therefore, we encourage similar studies with different product categories in order to better understand the role of the Internet for achieving advertising efficiency.

An important issue for advertisers is how to integrate different media and messages in order to produce a desired effect (brand image, sales, etc.). Extant research has examined the integration of print and online advertising. Kanso and Nelson (2004) claim that the partnership between magazine and Internet advertising needs to be enhanced since advertisers do not fully exploit the potential benefits of this possible synergy. Similarly, Sheehan and Doherty (2001) found that advertisers are not taking advantage of the possibilities of the Internet and that stronger integration between print and Internet ads is required. Tsao and Sibley (2004) suggest that there are reinforcement effects between Internet advertising and different offline communication channels, while the study of Chang and Thorson (2004) found evidence about the television-Web synergy. In our sample, firms that invested more in Internet advertising had a greater relative share of broadcast advertising in their mix and achieved higher efficiency. However, further exploration is needed to understand what kinds of media integration bring efficiency gains in different market settings.

Our results suggest that investments in Internet advertising have an accumulated long-term effect on efficiency gains. This resonates with the organizational learning literature (e.g., Dickson et al. 2001; Morgan and Turnell 2003), as well as with the notion of path dependence (Teece et al. 1997). Since learning is often a process of trial, feedback, and evaluation, it follows that a firm's previous investments will constrain its future behavior (Teece et al. 1997). Thus, we can speculate that firms which started to invest in Internet ads earlier have learned, on the basis of market response, how and how much to employ online advertising. Dickson et al. (2001: 217) suggest that "the cumulative, … evolutionary path a firm takes is created by the interaction between the firm's asset positioning and learning feedback effects and the business environment's positioning and learning feedback effects". The organizational learning literature provides potential fruitful direction for further theoretical exploration of the long-term effect of Internet advertising.

Finally, we would like to caution that, although the slack estimates for the Internet were smaller than the slacks for the rest of the inputs, there was still an overspending in online advertising by some firms. Thus, achieving efficiency gains is not a matter of blindly redirecting advertising resources from one medium to another, but rather it is a strategic issue requiring long-term commitment and a balanced advertising mix. DEA estimates can help firms identify their overspending per medium and points to a "best performing" peer that firms can use as a benchmark.

CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH LINES

In this study we provide a conceptual model to measure advertising efficiency that includes competition and time as relevant dimensions, and we model the effect of Internet advertising on the level of advertising efficiency. The results confirm that the Internet has gained its place as a necessary part of the advertising mix. In our sample,

firms that had invested consistently in online advertising achieved greater efficiency and this effect was more pronounced in the long-term. These results have important implications for managers. Efficient use of resources brings more working capital that can be invested in projects, thus increasing sales. Investment in Internet advertising can help employ the available resources in a more efficient manner. Further research is needed, however, to assess specific levels of Internet advertising spending that contribute to improvements of the efficiency across different industries, product categories and consumer targets.

For researchers, we outline a way of combining non-parametric methods and recent important insights from econometrics studies (Simar and Wilson 2007), in the search for a better understanding of the effect of the Internet on advertising efficiency. We suggest that our research approach can be employed to examine other related issues since it has the advantage of accounting for the effect of competitive efforts on a firm's long-term performance and has been found to provide robust results.

Nevertheless, this study is not free of some limitations. The selection of variables is very important in DEA, therefore, other output variables such as brand equity or profit can be included in the analysis to obtain a better view of advertising efficiency and the effects on different performance variables. This could be a way in which companies benchmark their marketing spending by considering the goals set to be achieved (market share, profit, etc.). On the other hand, input variables in our study group several broadcast and print media. Future research can use breakdowns of media advertising spending to give more depth to the analysis. In addition, case studies might complement the analysis by attaining more insights about the strategies employed as regards the advertising mix and, consequently, comparing and linking them to the DEA results.

Such a qualitative approach would help address the questions how and why online advertising helps in increasing the efficiency levels more in-depth.

A limitation of our data is that it comprises the period 2001-2007 and thus cannot account for the effect of the Internet on advertising efficiency during the years previous to 2001. Future research should address the Internet advertising expenditures before 2001 as well. Moreover, the results of our study could be country-specific and, therefore, it is desirable to do comparative studies across countries. Additionally, the focus of this study was solely on advertising. Future research could examine the relative efficiency including direct marketing, PR, promotions and sponsorship as inputs. From a methodological perspective, a potentially fruitful area for research is the application of the Malmquist index to track efficiency changes over time.

This research reports results based on accumulated advertising expenditures without differentiating among the diverse Internet advertising formats. Further research should explore the relative efficiency of the various online advertising formats. Special attention requires keyword search, the Internet advertising format that has experienced the biggest growth in the last five years in terms of revenues, but little is known about its effectiveness and efficiency. Finally, only paid Internet advertising to external parties is considered in this research, i.e., the investments in advertising in Web sites other than the Webs of the companies themselves. Future research should include the companies' own Web pages as well, since they are considered a powerful marketing tool.

Footnotes

[1]For technical details, please see Simar and Wilson (2007).
[2]The optimal weights are estimated from the dual of program [1]. We appreciate the comment of an anonymous reviewer that any newly introduced input increases efficiency under the DEA model. That is why we included the Optimal Input Weights analysis to assess the suitability of the Internet as an input variable. Correlation and regression analyses further assured that the Internet is a relevant variable that should be included in the efficiency measurement.
[3]It is relevant to note that the time frame firms in our sample have invested in Internet advertising ranges between 4 and 7 years. Thus, we are comparing firms that have invested 7 years (1 in the binary variable) with firms that have invested 4-6 years (0 in the binary variable).
[4]Recall that our DEA model is output-oriented; therefore, a lower efficiency score means lower inefficiency levels, or in other words, better performance in terms of efficiency.
[5]As a means of example, if a firm has been consistent and has invested in Internet during the whole period of analysis, it will have an initial value of 1 in 2001, 2 in 2002, and so on, reaching 7 in 2007; thus, the value of this variable for the firm will be 4, calculated by the formula: $\frac{\sum absolute\_frequency}{No.\_years}$. The formula gives greater value for firms that have been consistently investing in Internet consecutively all of the years.

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