Estimating Advertising Effects on Sales in a Competitive Setting

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Over the last several decades, advertising effects on sales have been studied without appropriately taking into consideration competitors’ advertising activities. As a result, advertisers often instinctively match competitors’ spending proportionately when it is monitored. The weakness of such a competitive parity approach is that they implicitly assume zero-sum competition only. This study identifies a variety of competitive conditions under which better budgeting strategies can be formulated. Specifically, four types of competition are conceptualized based on how an advertiser and its competitors affect each other’s sales according to level of media advertising spending. In addition, appropriate strategies for setting advertising budgets to deals with each situation are discussed. A mathematical method is developed to measure advertising effectiveness for both the advertiser and competitors on sales of a focal brand. The method computes current and carryover effects, identifies in which type of competition the advertiser is operating, and, accordingly, determines which budgeting strategy best suits the situation. In an empirical illustration, the method was applied to data collected monthly over eight years. The analyzed product was Scotch whisky sold in Thailand.

The longitudinal analysis of the relationship between advertising spending and sales generated has a distinguished history facilitated in large part by a court case that brought the Lydia Pinkham Company’s annual medicine advertising-sales data for the years 1907-1960 into the public domain. Much valuable work on the advertising-sales relationship on the Pinkham data was done by Paldal (1964) who demonstrated for the first time the dynamic effect of advertising on sales through a Koyck (1954) distributed lag model. Since Paldal’s (1964) study, researchers have showed a tremendous amount of interest in the long-term, or carryover or lagged, effects of advertising using the Koyck model (Aaker, Carman, and Jacobson, 1982; Bass and Leone, 1983; Clarke, 1976; Dhillon, 1978; Jedidi, Melo, and Gupta, 1999; Lee, and Reuji, 1985; McCann, Morey, and Raturi, 1991; Mela, Gupta, and Lehmann, 1997; Rao, 1986; Srinivasan and Weir, 1988).

In this study we take the advertising-sales relationship one step further by examining the impact of a brand’s spending on its own sales and on those of the competing brand and vice versa. Marketing managers often carefully monitor competitive media spending in the belief that share of voice and share of market are directly related (Jones, 1990). Matching competitive advertising spending, also known as the competitive parity media strategy, assumes zero-sum rivalry (Shimp, 2000). However, the issue of the extent to which, for example, an advertiser’s advertising spending helps the advertising effect of competitors is a question that remains open (Kent and Allen,
ADVERTISING EFFECTS ON SALES

In a symbiotic market in which both brands help each other, the aggregate spending of each brand would expand the total market without much concern over market share gains and losses. But equally the likelihood exists that the advertiser’s spending increases will have little or no impact on the competitors’ sales. Such a situation would suggest a different media strategy than in the case of zero-sum market rivalry.

Magnitude, duration, and estimation of the carryover effects have received much attention from scholars. Nevertheless, previous research on carryover effects has principally focused on a single brand without including the competition into the model. Long-term advertising effects have been studied without appropriately addressing the role of competitors’ advertising (Chandy, Tellis, MacInnis, and Thaivanich, 2001; Vakratsas and Ambler, 1999; Wells, 2000; Weilbacher, 2001).

The purpose of this study is to estimate the effects of media advertising on a focal brand and its competing brands. When knowing the effects of its own and competitors’ advertising on the brand, the advertiser could develop a better understanding of how many sales its advertising has generated and how many sales competitors’ advertising has stolen or generated. Accordingly, equipped with this knowledge, the advertiser will be able to develop a better strategy to deal with competitive advertising activity and more optimally and strategically set an advertising budget.

In the following sections, we first discuss advertising budgeting strategy in different forms of competition, introduce a mathematical model to estimate carryover and current effects of the advertiser’s and competitors’ advertising, and illustrate the application of the model using actual market data.

ADVERTISING EFFECT AND BUDGETING IN A COMPETITIVE SETTING

Four competitive situations are possible when combining the effect of the competitor’s advertising on the sales of the advertiser’s target brand and the effect of the advertiser’s advertising on the sales of the competing brand. Each situation requires its own appropriate strategic approaches to advertising budgeting as discussed individually below. A typology that presents the managerial option of each situation serves to summarize the first part of this article and provide guidance for the focus of the empirical section.

Zero-sum competition

This is a competitive situation that most advertisers assume to be the case and on which they base their budgets. In this type of rivalry, the advertiser’s gain is the competitor’s loss because the size of market remains fixed. The rivalry becomes severe when the available resources, such as potential buyers, are not sufficient for advertisers to achieve their growth targets (Schmidt and Kochan, 1972). Zero-sum competition is more likely to occur in mature product categories in which the market is static, and the outcome of one advertiser can increase only if the outcome of others decreases (Pfeffer and Salancik, 1978). At this stage in the product category life cycle, it may become overpopulated with head-to-head competitors and substitute products (Kotler, 2000). Hence, products without distinctive features and competitive advantages can become vulnerable to a competitor’s marketing activities. In a zero-sum competition, the advertiser may consider increasing advertising to defend its current market share position when competitors increase their media spending (Jones, 1990).

Advertiser’s advantage

In this situation, the competitor’s advertising increases the advertiser’s sales whereas the advertiser’s advertising reduces the competitor’s sales. This favorable phenomenon is likely to occur when the advertiser’s brand is highly recognized and preferred and the competitor’s brand is not. The market power is asymmetric between the advertiser and the competitor (Pfeffer and Salancik, 1978). For example, Energizer bunny commercials were given many advertising awards for their theme, “It keeps going and going and going.” But consumers often did not associate the commercials with the Energizer battery but with the Duracell battery because consumers mistakenly thought the best commercial must have been for the best brand. Despite its excellent advertising, Energizer failed to solely increase its own sales; much of its benefit went to the stronger competitor.

When the competitor has a weak brand, its advertising often stops at reminding consumers of a need for the product category, failing to influence the purchase of its brand (Ephron, 1997). Consumers do not learn much about brands they are not familiar with. However fascinated with advertisements, consumers are likely to select the best brand available that they perceive has the best quality and that they are highly loyal to and well aware of (Aaker, 1991; Yoo, Donthu, and Lee, 2000). High product value with heavy advertising investments may interest consumers, so consumers may try the weak brand but they would hesitate to adopt it when it is unfamiliar and they perceive it to be of poor quality. In this manner, the competitor’s advertising fails to boost the sales of its weak brand and merely fortifies the strength of the advertiser’s stronger brand. Meanwhile, the advertiser’s advertising successfully contributes to the sales of its brand by at-
tracting more consumers, which damages the competitor’s sales.

The advertiser in this situation should attack the competitor, fully capitalizing on its advantage from its strong brand. The size of the budget should be determined based on the competitor’s threat—how much damage needs to be done. However, eliminating the competitor permanently may not be a good idea because its advertising helps the advertiser’s sales. A more desirable strategy would be to keep the competitor weak but in the market.

**Competitor’s advantage**

This is another asymmetric rivalry but the opposite of the advertiser’s advantage situation. The advertiser’s advertising increases the competitor’s sales while the competitor’s advertising decreases the advertiser’s sales. The advertiser’s brand is surely weaker in consumer perceptions and actual product quality than the competing brand, and advertising expenditures will be wasted because much of it benefits the competitor. To maintain sales, the advertiser should focus its budget on lessening the destructive impact of competitors’ advertising on its sales. At the same time, the advertiser should first improve product quality and establish stronger brand equity by seeking other more credible methods of consumer promotions such as product demonstration, free sampling, educational materials, and publicity (Keller, 1998; Laforet and Saunders, 1999).

**Symbiotic competition**

In this positive-sum situation, both parties benefit from each other’s advertising activity. This symbiotic competition is mutually advantageous, rewarding, and reinforcing as the input of one party becomes input for the other simultaneously (Pfeffer and Salancik, 1978). Symbiotic competition is likely to occur when products involve emerging technologies in new markets or when the market is not fully matured and has much room for expansion. There is no need to fear an increase in the competitor’s advertising because it positively contributes to the advertiser’s sales. Therefore, the total effects of advertising on the brand must take into account not only the advertiser’s own advertising but also the competitor’s advertising. Hence, it is possible for the advertiser to increase sales by maintaining a modest amount of advertising.

Figure 1 summarizes the four types of advertising competition and the recommended budgeting strategies.

**CARRYOVER EFFECTS MODEL IN COMPETITION**

We applied Berkowitz, Allaway, and D’Souza’s (2001a, 2001b) approach in estimating the carryover and current effects of an advertiser’s and competitors’ advertising on the sales of the focal brand. The approach was an integrative extension of previous developments (Koyck, 1954; Palda, 1964; Srinivasan and Weir, 1988; Tellis and Weiss, 1995; Zellner and Geisel, 1970) and was used to estimate the advertising effects of multiple media across multiple stores. The following equation would be estimated for a market where the amount of advertising of two competing brands, brand A and brand B, affects the sales of brand A:

\[
S_A(t) = \beta_0 + \beta_A A_B^a(t) + \beta_B A_B^b(t) + u(t)
\]

(1)

where

- \(S_A(t)\) = sales of brand A in time \(t\)
- \(\beta_0\) = intercept
- \(\beta_i\) = current effect of brand \(i\)’s advertising on sales
- \(A_i^a(t)\) = goodwill or advertising stock for brand \(i\) in time \(t\)
- \(u(t)\) = random disturbance in time \(t\).

![Figure 1: Advertising Effect and Spending in a Competitive Environment](image)
\[ A_i(t) \] is built up recursively as

\[ A_i(t) = A_i(1) \]
\[ A_i(t) = (1 - \lambda_i) A_i(t-1) + \lambda_i A_i(t-1) \]

where \( \lambda_i \) is the carryover or lag effect of advertising of brand \( i \) (0 \( \leq \lambda_i \leq 1 \)).

For a detailed explanation of how the original version of Equation (1) was derived, please see Berkowitz, Allaway, and D’Souza (2001a, 2001b).

Equation (1) is an additive time series model and assumes that the sales of a brand are an additive function of advertising expenditures invested for the brand and the competitor’s brand. The equation can be easily extended to a more complex market situation in which more brands are competing against each other. Its generalized form is as follows:

\[ S_i(t) = \beta_0 + \sum_{i=1}^m \beta_i A_i(t) + u_i(t) \]  \hspace{1cm} (2)

where \( i \) is a brand (\( i = 1, 2, 3, \ldots, m \)) and one brand is an advertiser’s focal brand while the others are competitors’ brands.

In the following section, using actual sales and advertising data, we illustrate the above method of estimating advertising effects on sales in a competitive setting.

**DATA**

For an illustration of our method, longitudinal data on Scotch whisky brands in Thailand were chosen. In Thailand, the Scotch whisky market is larger than any other beverage alcohol, commanding 87 percent market share by volume over all other spirits such as rum, vodka, brandy, bourbon, and liqueurs. The annual consumption of Scotch whisky is about 15 million bottles, all packaged in Scotland and indeed representing the U.K.’s most valuable export to Thailand. The size of the market permitted us to refer to it as high-priced fast-moving goods. Thailand licensing laws are so permissive that virtually all entertainment outlets and restaurants can sell Scotch, which is consumed along with ice and soda. There are very few restrictions on all media advertising for beverage alcohol, and both trade and consumer promotions are permitted in department stores and supermarkets. Scotch whisky is the drink of choice for entry-level drinkers to senior citizens. Thailand’s religion Theravada Buddhism is quite liberal on the issue of alcohol consumption.

The data of 90 monthly observations were collected over 7 years and 6 months, and the data collection was terminated in June 1997 right before Thailand’s economy collapsed from the financial crisis that hit Asia. The high quality sales data were obtained from the Excise Department of Thailand based on liquor taxes, and the monthly advertising spending data in print and broadcast media came from the AC Nielsen Media Monitoring Service and the Media Data Resources Inc. Sales were measured in standard 9-liter cases containing twelve 75-centiliter bottles each. Advertising spending was originally measured in baht, Thai currency, but we converted it to U.S. dollars for convenient comparison.

From the data, we chose two leading brands, namely, the Market Leader brand and the Challenger brand, to examine the dynamic advertising effects on each other’s sales. The Market Leader takes the greatest market share within its category market whereas the Challenger holds a major market share and competes vigorously with the Market Leader for the market leadership (Kotler, 2000). As reported in Table 1, the Market Leader and the Challenger dominated the market with 48.5 percent and 14.9 percent market shares and 41.9 percent and 14.8 percent voice shares, respectively, during the surveyed


<table>
<thead>
<tr>
<th>Variable (per month)</th>
<th>Mean</th>
<th>Standard Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry sales in 9-liter 12-bottle cases</td>
<td>86,752</td>
<td>5,404</td>
</tr>
<tr>
<td>The Market Leader's sales (market share)</td>
<td>41,649</td>
<td>2,681</td>
</tr>
<tr>
<td>The Challenger's sales (market share)</td>
<td>13,089</td>
<td>1,061</td>
</tr>
<tr>
<td>Industry advertising spending</td>
<td>U.S.$693,731</td>
<td>U.S.$52,484</td>
</tr>
<tr>
<td>The Market Leader's advertising spending (voice share)</td>
<td>U.S.$270,581</td>
<td>U.S.$22,220</td>
</tr>
<tr>
<td>The Challenger's advertising spending (voice share)</td>
<td>U.S.$110,708</td>
<td>U.S.$13,104</td>
</tr>
</tbody>
</table>

Note: Thai currency (baht) was converted to the U.S. dollar.
periods. The rest of the market was divided among about 20 other weak brands whose market and voice shares ranged from 1 percent to 6 percent. In 1996, the retail price per 75-centiliter bottle was U.S.$27 for the Market Leader and U.S.$18 for the Challenger.

An independent commercial advertising tracking study showed that both brands enjoyed similar advertising effectiveness ratings throughout the period under investigation, and another background study confirmed that neither brand displayed greater ability to buy media at better rates than the other. Thus, the purpose of advertising execution and cost of media of the brands were close to constant.

**ANALYSIS AND RESULTS**

After several versions of Equation (1) were tested, the following model was finally adopted:

\[
(1 - L)S_i(t) = \beta_0 + \beta_\lambda A_i^\lambda(t) + \beta_A B_i^A(t) \\
+ \beta_1 D_1 + \beta_2 D_2 + u(t) \]  

(3)

where the terms were as defined previously, except that

\[ S_i(t) = \text{sales of brand } i \ (i = \text{brands A and B)} \text{ in time } t \ (t = 1, 2, \ldots, 90 \text{ months)} \]

\[ D_1 = \text{dummy variable (1 if November; 0 otherwise)} \]

\[ D_2 = \text{dummy variable (1 if December; 0 otherwise)} \]

\[ \rho = \text{parameter reflecting the carryover effects of other marketing investments and activities.} \]

To estimate the carryover effect terms of advertising for the Market Leader (denoted as brand A) and the Challenger (denoted as brand B), ranging from 0.00 to 1.00, we formed a two-dimensional ma-

 trance inflation factor ranged from 1.02 to 1.61 and the condition index ranged from 3.66 to 4.65. As a variance inflation factor of 10 or less or a condition index of 30 or less is considered the threshold for lack of multicollinearity (Hair, Anderson, Tatham, and Black, 1998), we concluded that the regression coefficients of our regression model were not significantly affected by other predictor variables, which indicates that the regression coefficients are stable.

Table 2 summarizes several models selected from 441 regression analyses as ranked by RMSE, and Table 3 reports the best models in which the RMSE was minimized and the sales were best predicted. The RMSE was a minimum when \( \lambda_A = 0.25 \) and \( \lambda_B = 0.75 \) for the sales of the Market Leader, and \( \lambda_A = 0.35 \) and \( \lambda_B = 0.75 \) for the sales of the Challenger.

**TABLE 2**

RMSE for Different Carryover Effects (from 441 Regressions)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Carryover Effect for the Market Leader</th>
<th>Carryover Effect for the Challenger</th>
<th>RMSE</th>
<th>Carryover Effect for the Market Leader</th>
<th>Carryover Effect for the Challenger</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>0.25</td>
<td>0.75</td>
<td>17.535</td>
<td>0.35</td>
<td>0.75</td>
<td>6.167</td>
</tr>
<tr>
<td>50th</td>
<td>0.35</td>
<td>0.55</td>
<td>17.535</td>
<td>0.15</td>
<td>0.70</td>
<td>6.197</td>
</tr>
<tr>
<td>100th</td>
<td>0.40</td>
<td>0.45</td>
<td>17.570</td>
<td>0.30</td>
<td>0.30</td>
<td>6.225</td>
</tr>
<tr>
<td>150th</td>
<td>0.20</td>
<td>0.05</td>
<td>17.588</td>
<td>0.50</td>
<td>0.25</td>
<td>6.247</td>
</tr>
<tr>
<td>200th</td>
<td>0.45</td>
<td>0.10</td>
<td>17.610</td>
<td>0.25</td>
<td>0.10</td>
<td>6.268</td>
</tr>
<tr>
<td>250th</td>
<td>0.60</td>
<td>0.35</td>
<td>17.654</td>
<td>0.95</td>
<td>0.00</td>
<td>6.283</td>
</tr>
<tr>
<td>300th</td>
<td>0.70</td>
<td>0.90</td>
<td>17.704</td>
<td>0.70</td>
<td>0.90</td>
<td>6.303</td>
</tr>
<tr>
<td>350th</td>
<td>0.90</td>
<td>0.60</td>
<td>17.722</td>
<td>0.50</td>
<td>1.00</td>
<td>6.287</td>
</tr>
<tr>
<td>400th</td>
<td>0.85</td>
<td>0.15</td>
<td>17.748</td>
<td>0.65</td>
<td>1.00</td>
<td>6.318</td>
</tr>
<tr>
<td>441st</td>
<td>1.00</td>
<td>1.00</td>
<td>18.516</td>
<td>1.00</td>
<td>1.00</td>
<td>7.258</td>
</tr>
</tbody>
</table>

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TABLE 3
Estimated Parameters with Carryover Effects

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Intercept (β₀)</th>
<th>Advertising (βₐ)</th>
<th>The Leader's Advertising</th>
<th>November (D₁)</th>
<th>December (D₂)</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Carryover Effects (λₐ = 0.25 and λᵦ = 0.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Market</td>
<td>25,661</td>
<td>0.02</td>
<td>0.03</td>
<td>25,027</td>
<td>58,808</td>
<td>0.55</td>
</tr>
<tr>
<td>Leader's Sales</td>
<td>(3.303) (0.01)</td>
<td>(0.02)</td>
<td>(7,086)</td>
<td>(7,010)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales p &lt; 0.0001</td>
<td></td>
<td>p = 0.03</td>
<td>p = 0.09</td>
<td>p = 0.00</td>
<td>p &lt; 0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Carryover Effects (λₐ = 0.35 and λᵦ = 0.75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Challenger's</td>
<td>4,507</td>
<td>0.01</td>
<td>0.01</td>
<td>17,241</td>
<td>17,954</td>
<td>0.64</td>
</tr>
<tr>
<td>Sales p = 0.00</td>
<td>(1.185) (0.00)</td>
<td>(0.008)</td>
<td>(2,483)</td>
<td>(2,467)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales p = 0.00</td>
<td></td>
<td>p = 0.00</td>
<td>p = 0.01</td>
<td>p &lt; 0.00</td>
<td>p &lt; 0.00</td>
<td></td>
</tr>
</tbody>
</table>

*Standard errors are in parentheses.*

The best models provided some important facts. First, they showed that the Market Leader and the Challenger were in symbiotic competition. Their advertising benefited each other’s sales probably because the product was a fast-moving consumer good whose market was expanding. The beta values of advertising of both brands, which represents actual current impact of advertising on sales, were positive for both brand’s sales, which suggests a symbiotic relationship.

Second, the carryover effects remained consistent across models but the beta values (i.e., current effects) were different. The carryover effects of the Market Leader’s advertising remained as low as 0.25 and 0.35 and those of the Challenger were 0.75. But the beta values were lower in the model predicting the sales of the Challenger than in the model of the Market Leader. Specifically, one dollar of the Market Leader’s advertising increased its own and the Challenger’s sales by 0.0231 and 0.015 whisky case of 12 bottles, respectively, while one dollar of the Challenger’s advertising increased the Market Leader’s and its own sales by 0.0325 and 0.019 whisky case, respectively.

Third, this symbiotic competition was more beneficial to the Market Leader than to the Challenger. The Challenger’s advertising was slightly more efficient in boosting sales than the Market Leader’s advertising as shown in the beta values. In both models, the Challenger’s advertising increased sales more effectively than the Market Leader’s advertising did. On the other hand, the Market Leader’s advertising did not help the Challenger’s sales as much as the Challenger’s advertising increased the Market Leader’s sales. Note that the Market Leader was the leading brand in sales and advertising spending and the Challenger was the second leading brand. The Market Leader as the number one product in the market is most likely to benefit from the Challenger’s advertising.

Models with and without carryover effects

Equation (3) was also estimated under the assumption of no carryover effects, in which λₐ = 0.00 and λᵦ = 0.00. In the models without carryover effects, the current effect of advertising was underestimated, which suggests more spending on advertising; however, the sales in the month of December were overestimated. If the advertiser considers only the model without carryover effects, it would be misguided, thus relying more on seasonal demand peaks than on advertising.

As Berkowitz, Allaway, and D’Souza (2001a, 2001b) demonstrated through simulations, an approach that considers both carryover and current effects is superior to one that considers current effects only in setting advertising budgets. An advertiser, when ignoring carryover effects, can make two mistakes. First, a model that accounts for both carryover and current effects is more accurate at predicting sales than one that takes into account only current effects.

Second, when relying on a model incorporating carryover effects, the advertiser can achieve higher sales. To prove this argument, we predicted each month’s sales of the Market Leader and the Challenger. We inserted the average monthly advertising expenditures of the two brands, that is, $270,580 for the Market Leader and $110,708 for the Challenger (see Table 1). The predicted sales are summarized in Table 4. Overall, models with carryover effects produced higher sales than those without. When the budget is determined based on carryover effects, the annual sales of the Market Leader will rise by 4,597 cases and sales of the Challenger will rise by 1,974 cases. These results suggest an important implication in advertising budgeting. For an equal number of advertising dollars, a budgeting approach based on a model considering carryover effects will produce higher sales than one based on a model not considering carryover effects. In other words, to achieve the same amount of sales, a
TABLE 4
Predicting Sales with and without Carryover Effects Considered

<table>
<thead>
<tr>
<th>Month</th>
<th>The Market Leader’s Sales</th>
<th></th>
<th>The Challenger’s Sales</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January through October</td>
<td>355,090</td>
<td>351,560</td>
<td>3,540</td>
<td>106,690</td>
</tr>
<tr>
<td>November</td>
<td>60,536</td>
<td>59,462</td>
<td>1,075</td>
<td>27,910</td>
</tr>
<tr>
<td>December</td>
<td>94,317</td>
<td>94,332</td>
<td>-14</td>
<td>28,623</td>
</tr>
<tr>
<td>Total</td>
<td>509,948</td>
<td>505,352</td>
<td>4,597</td>
<td>163,225</td>
</tr>
</tbody>
</table>

The impact of creative advertising and heavy advertising dollars will survive for a while, still influencing consumers’ attitudes and behaviors, and wear out at the rate of carryover effects. Figure 2 illustrates how the effects of advertising wear out over time. The figure particularly shows how advertising of $100,000 wears out under each of 0.25 and 0.75 monthly carryover effects. After the first month, the goodwill of advertising in time $t$, $A(t)$, was computed as $(1 - \lambda)A(t) + \lambda A(t-1)$, where $\lambda$ is the carryover effect.

The advertising duration interval is computed using a formula of $\log(1 - p)/\log(\lambda)$, where $p$ is the percentage of advertising effects that have worn out from the total amount of advertising effects and $\lambda$ is the carryover effect term (Clarke, 1976). Table 5 reports the duration of advertising effects in two interval situations. For example, it took 1.66 months, that is, $\log(1 - 0.90)/\log(0.25)$, to consume 90 percent of the total advertising effects of the Market Leader whose $\lambda$ was 0.25. But the Challenger, with a 0.75 carryover effect budgeting approach based on a model considering carryover effects will require less advertising spending than one based on a model not considering carryover effects.

**Carryover effects duration**
How long does the effect of advertising last? The answer to this question has important implications to advertising budgeting. If the advertiser believes there is no carryover effect at all, it must distribute the advertising budget uniformly throughout the advertising campaign period because the effect of advertising will disappear as soon as the commercial is exposed (Shimp, 2000). However, carryover effects exist. The impact of creative advertising and heavy advertising dollars will survive for a while, still influencing consumers’ attitudes and behaviors, and wear out at the rate of carryover effects. Figure 2 illustrates how the effects of advertising wear out over time. The figure particularly shows how advertising of $100,000 wears out under each of 0.25 and 0.75 monthly carryover effects. After the first month, the goodwill of advertising in time $t$, $A(t)$, was computed as $(1 - \lambda)A(t) + \lambda A(t-1)$, where $\lambda$ is the carryover effect.

The advertising duration interval is computed using a formula of $\log(1 - p)/\log(\lambda)$, where $p$ is the percentage of advertising effects that have worn out from the total amount of advertising effects and $\lambda$ is the carryover effect term (Clarke, 1976). Table 5 reports the duration of advertising effects in two interval situations. For example, it took 1.66 months, that is, $\log(1 - 0.90)/\log(0.25)$, to consume 90 percent of the total advertising effects of the Market Leader whose $\lambda$ was 0.25. But the Challenger, with a 0.75 carryover effect budgeting approach based on a model considering carryover effects will require less advertising spending than one based on a model not considering carryover effects.

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## TABLE 5
Carryover Effects Duration

<table>
<thead>
<tr>
<th></th>
<th>Advertising Expenditures of the Market Leader</th>
<th>Advertising Expenditures of the Challenger</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At 50% interval</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration on the Market Leader’s sales</td>
<td>0.50 months</td>
<td>2.41 months</td>
</tr>
<tr>
<td>Duration on the Challenger’s sales</td>
<td>0.66 months</td>
<td>2.41 months</td>
</tr>
<tr>
<td><strong>At 90% interval</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration on the Market Leader’s sales</td>
<td>1.66 months</td>
<td>8.00 months</td>
</tr>
<tr>
<td>Duration on the Challenger’s sales</td>
<td>2.19 months</td>
<td>8.00 months</td>
</tr>
</tbody>
</table>

General budget rules in a competitive setting: Relating carryover and current effects to competitive budgeting

Then, how are carryover and current effects related to advertising budgeting in a competitive setting? When all factors are considered, a better budgeting approach is possible to deal with competitors’ advertising activity. Various contingencies based on different advertising effects dynamically determine the advertising budget for an advertiser to maintain its sales. The advertising budget change for brand A can be computed by the equation of \((-1) \times (\text{brand B’s current effects/brand A’s current effects}) \times (\text{brand B’s carryover effects/brand A’s carryover effects})\), where brands A and B are any two competing brands. Table 6 reports the results of some selected situations.

The table makes two assumptions. First, the brand B’s current advertising effect varies from -2 to 2 as a relative value for the unity current effect of brand A. The effect of 2 means effectiveness two times greater than brand A’s effect to increase sales. Second, a brand’s advertising, once spent, decays at the carryover effect rate depending on \(\lambda_a\) and \(\lambda_b\), respectively, which were carryover effects. The advertising budget, \(A_a(1)\), that needs to be spent to avoid a decrease in sales due to the competitor’s advertising was then derived backward from \(\Sigma A_a(1)\). The table reports a selection of the 18,081 simulations that analyzed combined situations of 21 \((\lambda_a\) ranging from 0 to 1 by increments of 0.01) \(\times 21 (\lambda_b\) ranging from 0 to 1 by increments of 0.01) \(\times 41 (\text{brand B’s current effect ranging from -2 to 2 by increments of 0.1})\).

Let us explain how to read the table. For example, look at the first cell of \((0.75, 0.25)\) and \((1:2)\). In the cell, the carryover effects of brand A and brand B are 0.75 and 0.25, respectively, and the ratio of the current effects between brand A and brand B is 1 to -2. The current effect ratio indicates that the advertising of brand B negatively affects the sales of brand A and that its impact size is twice as much as the advertising of brand A increases the sales of brand A. In this particular situation, the table exhibits that brand A should increase its advertising by 67 percent to

## TABLE 6
Advertising Budget Rules in a Competitive Setting

<table>
<thead>
<tr>
<th>Carryover Effects</th>
<th>Relative Current Effects (Brand A: Brand B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Brand A, Brand B)</td>
<td>((1:2))</td>
</tr>
<tr>
<td>((0.75, 0.25))</td>
<td>67%</td>
</tr>
<tr>
<td>((0.75, 0.50))</td>
<td>100%</td>
</tr>
<tr>
<td>((0.50, 0.25))</td>
<td>133%</td>
</tr>
<tr>
<td>((0.25, 0.25))</td>
<td>200%</td>
</tr>
<tr>
<td>((0.50, 0.50))</td>
<td>200%</td>
</tr>
<tr>
<td>((0.75, 0.75))</td>
<td>200%</td>
</tr>
<tr>
<td>((0.25, 0.50))</td>
<td>300%</td>
</tr>
<tr>
<td>((0.50, 0.75))</td>
<td>400%</td>
</tr>
<tr>
<td>((0.25, 0.75))</td>
<td>600%</td>
</tr>
</tbody>
</table>
eradicate brand B's influence and maintain sales. Figure 3 graphically shows the budget rules for brand A to maintain sales by relative current and carryover advertising effects.

Note that when competitors' current effect on the sales of the advertiser's brand is positive, the advertiser is in either advertiser's advantage or symbiotic competition. In either case, competitors' advertising benefits the advertiser's sales. Thus, the advertiser need not worry when competitors increase their advertising and needs to develop a strategy to fully utilize the opportunities coming from competitors' increased advertising. On the other hand, when competitors' current effect is negative, the type of competition is either zero-sum competition or competitor's advantage. The advertiser needs to increase advertising in zero-sum competition to remove competitors' influence and damage competitors' sales. In competitor's advantage, the advertiser can also maintain its sales by increasing advertising but much of the advertising is wasted because it only boosts competitors' sales. To avoid benefiting competitors, the advertiser needs to spend the dollars on different types of promotions by which consumers can develop more direct experiences with and solid confidence in the quality and image of the brand. Such alternative ways will strengthen the brand and increase the effectiveness of advertising for the future advertising battle.

CONCLUSION AND DISCUSSION
Advertisers tend to be easily rattled when competitors commence to increase media advertising spending. It is a normal practice to proportionately match competitors' advertising spending for fear that a decline in share of voice will almost always result in reduction in share of market. However, such a matching strategy will work only in zero-sum competition where competitors' advertising hurts the advertiser's sales and vice versa. In fact, competitors' advertising may or may not hurt the advertiser's sales. If it does not hurt the sales, the advertiser should not panic when facing increased competitors' advertising but take advantage of it to help its sales and use its advertising dollars more effectively.

In this article we conceptualized four competitive situations of advertising effects on sales in a competitive setting. Depending on how the advertiser's advertising affects the competitor's sales and how the competitor's advertising affects the advertiser's sales, the competition will take one form—zero-sum competition, advertiser's advantage, competitor's advantage, and symbiotic competition. We suggested budgeting rules to deal with each situation. In zero-sum competition, when competitors increase advertising, the advertiser needs to aggressively match their advertising activity. In other situations, the advertiser does not have to increase advertising in haste because competitors' advertising does not necessarily harm the advertiser's sales. Specifically, in symbiotic competition, spending modestly is enough, whereas decreasing the amount of advertising is more desirable in the competitor's advantage, and any level of advertising damages the competitors' sales in the advertiser's advantage.

Next, we introduced a mathematical method of estimating advertising effects on sales in a competitive setting based on
... by continuously measuring the carryover effects of advertising of the competing brands over time, the advertiser can learn how effectively they advertise against competitors.

problem of competition. Note that when the carryover effect increases by increments of 0.05, the number of regression models required is 21^m, where m is the number of brands.

Second, by continuously measuring the carryover effects of advertising of the competing brands over time, the advertiser can learn how effectively they advertise against competitors. The goal should be to increase the carryover and current effects, which will allow advertising to last longer and impact sales more greatly. The competitor who has the largest carryover and current effects can be selected as the benchmark. Their advertising spending and practice should be studied to find out the source of such great effects.

Third, the method can be used to analyze the advertising effects of the advertiser’s other brands on the sales of the advertiser’s target brand. From practice and experiences, advertisers realize advertising of one brand can favorably impact another brand’s sales. Using the same method suggested in this study, the advertiser can assess how synergistically one brand’s advertising affects other brands’ sales. Such information is critically important in setting advertising budgets and more optimally allocating money among the brands.

An important area for future research is the interaction effect among advertising expenditures spent for brands. Our model was built on an assumption that the expenditures are linearly rather than inter-

actively composed. To check this interaction possibility empirically, researchers need to include interaction terms in the model. The complexity of such a study would be staggering but the results will be worthwhile.

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