Fang Wang & Xiao-Ping (Steven) Zhang

Reasons for Market Evolution and Budgeting Implications

Identifying market evolution is a necessary step in persistence analysis of marketing input–output relationships. Using the advertising–sales relationship to represent general marketing input–output dynamics, the authors theoretically distinguish two types of market evolution: (1) intrinsic evolution, in which sales evolve independent of advertising and temporary advertising can generate persistent effects, and (2) induced evolution, in which sales evolution is supported by sustained advertising budgets in an intrinsic-stationary market and there are no real persistent effects of temporary advertising. The proposed intrinsic market evolution test can identify intrinsic-evolving and intrinsic-stationary markets. The authors analyze five major budgeting implications and provide methods to quantify temporary and sustained budgeting. In general, in an intrinsic-evolving market, budgeting can be short-term focused, whereas in an intrinsic-stationary market, the focus should be on sustained budgeting. Percentage budgeting at a sufficient level can create induced evolution. Contrary to conventional wisdom, temporary, intensive advertising campaigns are often not necessary. Empirical illustrations demonstrate the two types of evolutions and the relationships between budgeting methods and sales performance.

Keywords: intrinsic market evolution, induced evolution, budgeting, time-series methods, persistent effects

Consider the following scenario: After an intensive store promotion and exposure on the Oprah Winfrey show, Slim-Fast experienced a sudden sales increase. By closely monitoring daily store data, brand managers wanted to determine whether the sales increase would persist or soon disappear. If the sales increase persisted, they could budget marketing efforts to expand the brand. Otherwise, long-term marketing would need to be budgeted to sustain the brand (Busch 2007). In another example, with the news that Michelle Kwan would withdraw from the 2006 Winter Olympics, NBC's viewing rate suffered, and the station needed to formulate corresponding changes of marketing inputs and budgeting strategies to offset the negative impact (Bauder 2006).

Marketing managers often face similar situations in which they need to know (1) when the sales performance caused by temporary (short-term) marketing efforts will persist without any further marketing action and when sustained (long-term) spending is needed to maintain sales performance, (2) what are the functions/effects of temporary versus sustained budgeting in achieving and maintaining market performance (e.g., Is a temporary, intensive marketing campaign necessary?), and (3) how to design budgeting strategies to attain and sustain market performance. For example, many marketing managers want to follow certain budgeting methods, such as percentage budgeting, and to design temporary and intensive marketing campaigns to boost sales. Are these practices effective?

To answer these questions, we conduct a theoretical intrinsic market evolution (IME) study based on a fundamental time-series model, using the advertising–sales relationship as an example of general marketing input–output dynamics. We test whether a marketing input, such as advertising, is a necessary exogenous variable for market evolution, and we distinguish two types of evolution in two types of market dynamics: intrinsic evolution in intrinsic-evolving markets and induced evolution in intrinsic-stationary markets. The proposed concepts are important to understand and quantify temporary versus sustained budgeting to reach and maintain sales targets and thus are fundamental for designing budgeting strategies. This article discusses five major budgeting implications and shows that (1) the budgeting of advertising as a percentage of prior sales can be beneficial (because it maintains marketing-induced sales evolution) and (2) contrary to conventional wisdom, temporary and intensive advertising campaigns are often not needed to achieve sustained (long-term) sales gains.

These budgeting issues cannot be analyzed by the time-series market evolution method in extant literature (see Dekimpe and Hanssens 1995b; Pauwels et al. 2004). This method examines evolving (evolutionary) markets by conducting unit root tests on market output series, such as sales, and suggests that if markets evolve, temporary marketing inputs can generate sustained effects (Dekimpe and

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Hanssens 1995a, b; Franses, Srinivasan, and Boswijk 2001; Srinivasan, Leszczyc, and Bass 2000). Then, parameters of the marketing input–output relationships under study are estimated by time-series vector autoregressive (VAR) models. A limitation of this method is that it treats the underlying market output–input feedback relationship as a preset component of the market dynamic. Thus, it does not and cannot differentiate whether market evolution reflects the intrinsic-evolving nature of the market or is a consequence of continuous marketing inputs.

Theoretically, because the existing method does not identify causes of market evolutions, it cannot comprehensively explain the relationships between market evolution and marketing inputs. For example, prior research has suggested that temporary advertising can create persistent effects in an evolving environment. However, if sales evolution is a consequence of continuous advertising support rather than a result of the evolving nature of the market, such suggestion overemphasizes the effects of temporary advertising and misleads marketing managers to initiate temporary, intensive advertising campaigns.

Practically, because the existing method treats the budgeting process (i.e., market feedbacks) as a preset component, it reports parameters of established relationships but falls short in directing budgeting practices. Therefore, it cannot address questions such as how the market dynamics (represented by the VAR) will change if the underlying budgeting rules change or how to design a budgeting strategy to achieve certain market performance.

For example, among the scenarios of temporary versus permanent marketing effort and response (Dekimpe and Hanssens 1999) observed in the market, one is called "business as usual" (i.e., temporary advertising change and temporary sales change), and the other is called "evolving business practice" (i.e., permanent advertising change and permanent sales change). These two scenarios may indeed reflect the same market nature with different (temporary versus permanent advertising changes) budgeting practices. That is, if marketing managers budget for temporary advertising changes rather than permanent advertising changes in the evolving-business-practice scenario, sales changes may become temporary. Thus, this scenario becomes a business-as-usual one. The existing method cannot quantitatively identify whether these scenarios reflect the same market nature and cannot advise marketing managers on how to change their budgeting strategy to achieve an evolving business practice.

In reality, the budgeting mechanism is not a preset presumption of marketing input–output relationships but rather an essential part of an active marketing management process of which managers can and need to take control. Theoretically, marketing model analysis must reflect that the output–input feedback mechanism is the decision of marketing managers rather than an invisible market force. Practically, more important to marketing managers are the budgeting implications of a market evolution study—that is, how they can budget for both temporary and sustained marketing spending to achieve market/sales goals.

Our theoretical study is fundamentally different from the method in extant literature (Bronnenberg, Mahajan, and Vanhonacker 2000; Dekimpe and Hanssens 1995b; Franses, Srinivasan, and Boswijk 2001; Pauwels and Srinivasan 2004; Srinivasan, Leszczyc, and Bass 2000) in that we do not take underlying budgeting rules for granted. Rather, we study the relationship between budgeting and market evolution. Whereas the existing method interprets persistence of marketing effects according to the evolution of market outputs, we show that when an output series evolves, the underlying market nature can be either intrinsic evolving or intrinsic stationary with respect to a marketing input series under study. That is, by building on the market evolution examined by the existing method, we further distinguish two types of market evolution: intrinsic evolution and induced evolution. On the basis of this distinction, we draw different conclusions from the existing method about the sustained effects of marketing efforts, and we quantify the necessary sustained spending and temporary marketing campaign expenses within the overall marketing budget.

Using the advertising–sales relationship as an example of the general marketing input–output dynamics, we outline the relationships among market nature, advertising spending, and sales evolution in Figure 1. We suggest that if a market is intrinsic evolving, sales evolve independent of advertising, and temporary changes in advertising spending generate persistent and permanent sales changes. Such favorable marketing environments exist in business cases, such as superior product/service quality or geographic expansion of a strong brand, in which customers become loyal after they try a product. With our methodologies, managers can quickly identify and grasp these opportunities when information other than store data is limited.

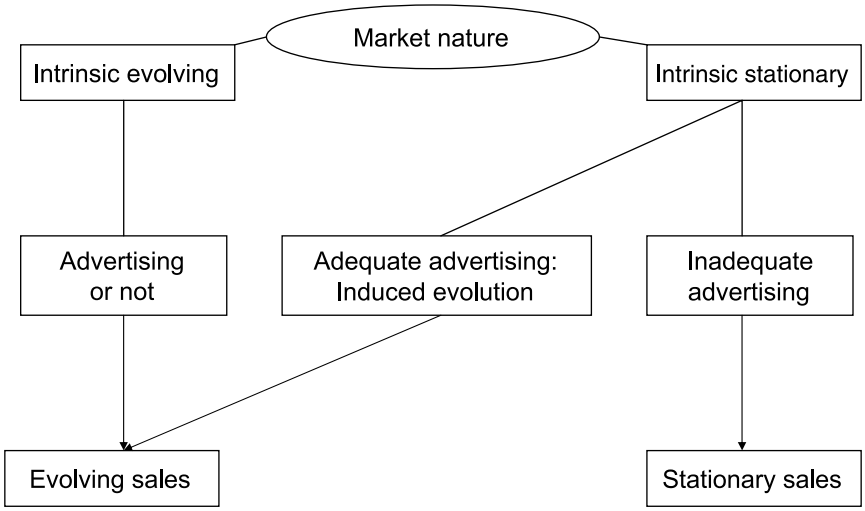
When a market is intrinsic stationary, temporary changes in advertising spending initiate sales changes, but it is the sustained budgeting that sustains long-term market performance. This means that though customers may respond to a market stimulus, the stimulus does not fundamentally change their habitual behaviors. That is, when the stimulus disappears, customers gained through this method might return to their previous shopping choices. Marketing managers need to focus on sustained budgeting. Temporary, intensive advertising campaigns are neither sufficient nor necessary to achieve long-term goals.

When an evolving sales series is observed in an intrinsic-stationary market, there must be a sustained advertising budget to maintain the sales evolution, or induced evolution. Induced evolution exists when a firm does not have a distinct winning market position and relies heavily on marketing inputs as a competition tool.

We organize the rest of the article as follows: We begin by providing a brief review of the theoretical background. Then, we define and propose a test for intrinsic-evolving versus intrinsic-stationary markets and discuss induced evolution. Next, we analyze the budgeting implications. We provide empirical illustrations and conclude with a summary of the main findings.

To present our theoretical analysis, we use the advertising–sales relationship as an example of the general marketing input–output relationship. We suggest that the concepts and modeling methods can be used for any relevant marketing input–output analysis.

FIGURE 1
Relationships Among Market Nature, Advertising Spending, and Sales Evolution



Theoretical Background

We briefly review some relevant theoretical concepts, including evolution versus stationarity, unit root testing, and a classic first-order time-series lag model. On the basis of these concepts, we then conduct our IME analysis.

Stationarity Versus Evolution and Unit Root Tests

The stationary and evolving nature of a series, such as sales and advertising, can be identified through unit root tests. A data-generating process in unit root tests can be written as follows (Greene 2003):

$$z_t = \phi z_{t-1} + \mu + e_t, \quad (1)$$

where z_t is a time series, ϕ is an autoregressive parameter, μ is a constant, and e_t is white noise. When there is no unit root (i.e., $|\phi| < 1$), the series is stationary, and any shock to it will decay and disappear. When there is a unit root (i.e., $|\phi| = 1$), the series is evolving, and any changes to it will have permanent effects. Unit root tests, such as the Dickey–Fuller test, the augmented Dickey–Fuller test, and the Phillips and Perron test, are one-sided tests for hypotheses (H_0: $\phi = 1$; H_1: $\phi < 1$) (Dickey and Fuller 1979, 1981; Greene 2003).

A Classic Time-Series Model

A classic first-order time-series lag model, which we use to analyze the effect of advertising on sales, is as follows:

$$S_t = c + \alpha S_{t-1} + \beta A_t + e_t, \quad (2)$$

where S_t are sales at a given time t, A_t represent advertising expenses at time t, the model assumes that sales decay over time at a decay rate $(1 - \alpha)$, c is a constant, β is the effectiveness of A_t, and e_t represents market noise uncorrelated with S_t and A_t. We chose the first-order lag model not only because it has been widely used to study the marketing input–output relationship (Aaker, Carman, and Jacobson 1982; Leone 1995; Russell 1988) but also because it has a simple format and demonstrates basic principles in time-series analysis.

For the simplicity of market dynamic analysis and without loss of generality, in the following analysis, we consider only the case in which the constant c = 0 because c does not affect the dynamic relationship between S and A but rather acts as a control variable:

$$S_t = \alpha S_{t-1} + \beta A_t + e_t. \quad (3)$$

IME Analysis

In studying the persistent effects of advertising, prior research has inferred market dynamics by analyzing sales evolution and has concluded that when sales evolve, a temporary advertising change can generate a persistent sales change. However, because a sales series reflects the combined results of the underlying market dynamics and advertising inputs, studying evolution of a sales series alone cannot separate the advertising effects from the underlying sales dynamics or identify the real nature of a market response under study. In the following IME analysis, we show the insufficiency of unit root tests in reflecting market nature and propose IME concepts and a new test.

Intrinsic-Evolving Versus Intrinsic-Stationary Markets

In testing the unit root of a sales series, we examine (from Equation 1) the following:

$$S_t = \phi S_{t-1} + \mu + e_t. \quad (4)$$

The difference between Equations 2 and 4 is the advertising input, βA_t. Without advertising effects, Equations 2 and 4 are identical. Unit root tests on sales series can reflect the intrinsic market dynamics by examining the decay rate (i.e., $1 - \phi$ in Equation 4 or $1 - \alpha$ in Equation 2). The nature of a

marketing environment is determined by α. That is, $\alpha = 1$ indicates an intrinsic-evolving market because the sales series S_t evolves independent of advertising inputs. The increase of S_t introduced by temporary advertising will be sustained. In contrast, $\alpha < 1$ indicates an intrinsic-stationary market. The increase of S_t introduced by advertising shocks will decay and disappear.

With advertising effects, ϕ and α are different. Because standard unit root tests examine ϕ and not α, they are not sufficient to identify the intrinsic market dynamics. Because both S_{t-1} and A_t (see Equation 2) affect S_t, we need to differentiate the two causes of market evolution—namely, the intrinsic market nature and advertising effects.

Induced Evolution

To differentiate the causes of sales evolution, we need to consider patterns of advertising budgets in relation to sales. Thus, we consider the following:

$$\gamma_t = \frac{A_t}{S_{t-1}}. \tag{5}$$

From Equations 3 and 5, we can create a market-response dynamic, as follows:

$$S_t = (\alpha + \beta\gamma_t)S_{t-1} + e_t. \tag{6}$$

We can denote the following from Equation 6:

$$\phi_t = \alpha + \beta\gamma_t. \tag{7}$$

Because standard unit root tests examine ϕ, we show from Equation 7 that advertising expenditures are critical in creating sales evolution. A sales series can evolve from an intrinsic-evolving market or from continuous advertising spending. The two causes for sales evolution refer to different marketing environments and pose different budgeting implications. Such distinction is not discussed in previous literature.

Consequently, as we mentioned previously, we differentiate two types of sales evolutions: intrinsic evolution and induced evolution. Intrinsic evolution exists when a unit root is present for a sales series and $\alpha = 1$. In an intrinsic-evolving market, sales evolve independent of advertising support. Temporary advertising expenditures will lead to sustained changes in market performance. An intrinsic-evolving market is a superior business environment, for example, during the growth stage of the product life cycle or because of superior product quality, which causes customers to become loyal after they are attained through advertising.

When $\alpha < 1$ and a unit root exists in a sales series, sales evolution is supported by sustained advertising expenditures. This is considered induced evolution. From Equation 7, we can create induced evolution by satisfying a budgeting rule, as follows:

$$\gamma_t \geq \gamma = \frac{1-\alpha}{\beta}, \tag{8}$$

where γ is a threshold percentage and, thus, γS_{t-1} is a budgeting threshold. When the budgeting threshold is met, sales evolution can be observed. Induced evolution exists when a firm that does not have a distinct winning position (e.g., a company in a mature stage of the product life cycle) relies heavily on marketing inputs as a competition tool.

Induced evolution is an intrinsic-stationary environment in disguise; that is, without advertising support, sales changes will decay and disappear. Such evolution is fundamentally different from intrinsic evolution in that sustained advertising budgeting is needed to "make" a stationary market evolving. Most evolving situations identified in the literature (e.g., Dekimpe and Hanssens 1995b; Ouyang, Zhou, and Zhou 2002) are induced evolution because unit roots exist but α estimates are lower than 1. We demonstrate subsequently that in induced evolution, advertising series must evolve to support sales evolution.

As Figure 1 shows, an intrinsic-evolving market generates sales evolution independent of advertising, whereas sales evolution appears in an intrinsic-stationary market only when there is adequate, sustained advertising spending to maintain the induced evolution. When advertising spending is inadequate in an intrinsic-stationary market, the sales series will be stationary.

IME Test

In standard unit root tests, evolution of a single series, such as sales, is tested regardless of the effects of marketing input factors under study, such as advertising. Using standard unit root tests might limit marketing research that elaborates on interactive input–output relationships rather than the performance of a single series. The lack of a unit root on a sales series shows that the market is intrinsic stationary (see Figure 1). However, the presence of a unit root only confirms that sales are evolving. The reasons for such evolution (i.e., whether it is due to an intrinsic-evolving market or induced by continuous marketing inputs in an intrinsic-stationary market) cannot be identified. Therefore, a further test is needed.

Here, we illustrate the concept of a statistical test that can discriminate between intrinsic evolution and induced evolution on the basis of the principle of the Dickey–Fuller test. With the same methodology, other available unit root tests, such as the Phillips and Perron test, can be used to test the nature of the market evolution.

On the basis of the classic first-order lag model (Equation 2), we test the following hypotheses:

$$H_0: \alpha = 1, \text{ and } H_1: \alpha < 1. \tag{9}$$

Because this test on Equation 2 has a similar structure as the standard unit root test, we use the principle of the Dickey–Fuller test. We calculate the IME test statistic as follows:

$$IME_t = \frac{\hat{\alpha} - 1}{SE(\hat{\alpha})}, \tag{10}$$

where SE is the standard error. We can then use the Dickey–Fuller critical values, c_{DF}, to determine the single-side rejection region: $IME_t < c_{DF}$. Note that other test criteria (Leybourne and McCabe 1994; Pantula, Gonzalez-Farias, and Fuller 1994) can also be used.

In summary, to evaluate a market dynamic, standard unit root tests can first be used to test sales evolution. If the sales series is not evolving, the underlying market is intrinsic stationary. If the sales series is evolving, the proposed IME test can be performed to examine intrinsic evolution versus induced evolution (i.e., the intrinsic-stationary nature of the market).

Note that the IME test is different from the cointegration test. As a generalization of the unit root test, the IME test explores the intrinsic evolution of a market output (e.g., sales) while controlling for a marketing input (e.g., advertising). In contrast, the cointegration test explores the linear relationship between evolving time series. It does not explore the intrinsic evolution of the market output time series.

Budgeting Implications

The IME concepts and analysis can clarify the effects of and need for temporary versus sustained advertising under various market scenarios, thus guiding marketing managers in the budgeting process. We discuss some major budgeting implications next.

Implication 1

> In intrinsic-evolving markets, budgeting of marketing inputs can be relatively flexible and short-term focused. In intrinsic-stationary markets, budgeting is a demanding task and should be long-term focused.

Advertising budgets at time t, A_t, can be viewed as two components: temporary marketing effort (A_t^T), or shock, and sustained marketing spending (A_t^s):

$$A_t = A_t^s + A_t^T. \tag{11}$$

By definition, a temporary marketing effort (A_t^T) (e.g., short-term, intensive advertising campaigns) is short lived (i.e., $A_t^T = A^T$ for t = T, and $A_t^T = 0$ for $t \neq T$) and is often used to generate sudden market changes. In contrast, sustained marketing spending (A_t^s) is a commitment for the long run and, in general, is nonzero for all t (or for a long horizon), which usually results from a planned budgeting strategy (or formula) for a long-term goal. For example, sustained marketing spending can be persistent advertising spending or a function of market output factors, such as sales. Sustained spending can be used to maintain sales evolution or a long-term (sustained) sales level.[1]

In an intrinsic-evolving market, sales evolution is independent of advertising support, and continuous budgeting is not necessary ($A_t^s = 0, \forall t$) to sustain sales changes caused by temporary marketing efforts. Marketing managers can budget for temporary advertising campaigns ($A_t^T = A^T$) only and can expect a sustained sales increase when the campaign ends (i.e., A_t^T return to 0 when $t \neq T$).

In an intrinsic-stationary market, sustaining a desired sales level or creating an induced evolution requires sufficient sustained budgets. Without a sustained budget, sales changes will diminish to zero. If the sustained budget is not sufficient (i.e., does not meet the budgeting threshold in Equation 8), sales will diminish to a level at which the sustained budget can support them. Because we need to change the sustained budget to sustain sales changes, responsive budgeting is required to create induced evolution. To sustain a sales change, ΔS, we need to budget the change of the sustained advertising spending as $\Delta A^s = \Delta S(1 - \alpha)/\beta$.

Implication 2

> In an intrinsic-stationary market, under the assumption of linear advertising effects, percentage budgeting at a sufficient level can create and sustain induced evolution, whereas constant budgeting maintains a sales level.

Here, we demonstrate the dynamic relationships between budgeting and sales performance with two popular and simple budgeting methods: percentage budgeting and constant budgeting.

Budgeting for sales evolution: percentage budgeting. Percentage budgeting is a responsive budgeting method because the budget changes with sales changes. We can represent it as follows:

$$A_t = \gamma_b S_{t-1}, \tag{12}$$

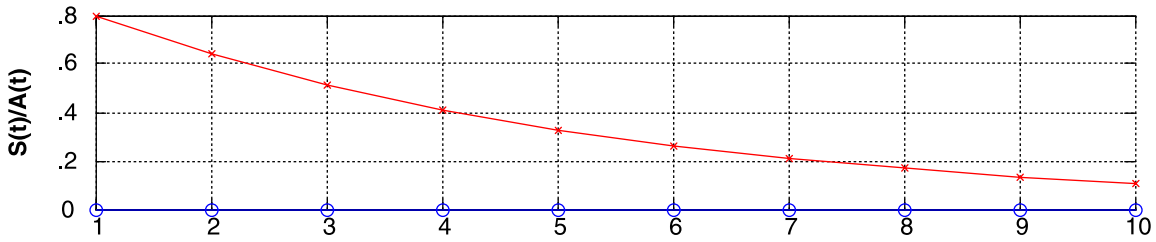
where γ_b is a budgeting percentage in business practice. Firms employing percentage budgeting can directly compare the percentage in use (γ_b) with the threshold percentage (γ). When $\gamma_b < \gamma$, the firm is underbudgeting. The advertising budget is insufficient to create sales evolution, and in absolute values, the budget will decrease with sales until it reaches the minimum level. When $\gamma_b = \gamma$, sales evolution is created, and temporary changes, either positive or negative, will cause both advertising and sales to change. In this case, an evolving-business-practice scenario (Dekimpe and Hanssens 1999) occurs.

Figure 2 demonstrates various percentage-budgeting situations in a hypothetical intrinsic-stationary market, where $\alpha = .8 < 1$, $\beta = 1$, and the threshold percentage $\gamma = (1 - \alpha)/\beta = .2$. Figure 2, Panel A, shows that when there is no advertising budget (i.e., $\gamma_b = 0$), the sales will decay at rate $1 - \alpha = .2$. When the percentage budget is not adequate (i.e., $\gamma_b = .1 < \gamma$), the sales level cannot be sustained but decays at a slower rate (see Figure 2, Panel B). Figure 2, Panel C, shows induced evolution when the percentage-budgeting level is adequate to maintain sales evolution (i.e., $\gamma_b = \gamma$). Note that Figure 2, Panel D, shows a special case of excessive budgeting (i.e., $\gamma_b > \gamma$). In this case, in addition to the required sustained spending, $A^s = \gamma S_{t-1}$, for an induced evolution, there is an excessive budget of $(\gamma_b - \gamma)S_{t-1}$. The effects of excessive budget are then accumulated and sustained because of the induced evolution, leading to the continuous sales increase. Such an excessive budget can be

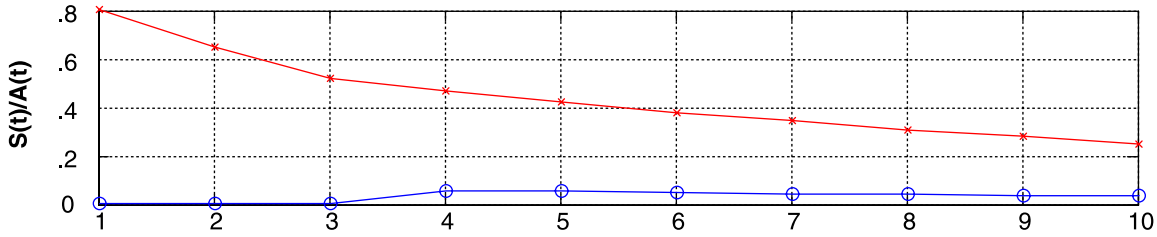
[1]Note the difference between the terms "sustained spending" that we use and "maintenance spending" that Hanssens and Ouyang (2002) use. In Hanssens and Ouyang's study, maintenance spending refers to marketing costs to preserve the higher sales level generated by a triggering marketing effort. Maintenance spending is directly related to a temporary marketing effort. In contrast, our concept of sustained spending refers to continuous spending. It is necessary to have a budgeting mechanism for sustained spending to support induced evolution, but it is not necessary to have a triggering effort to create sales evolution.

FIGURE 2
Percentage Budgeting

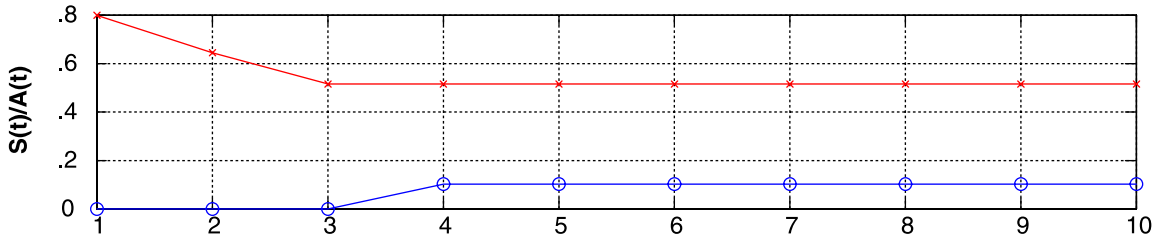
A: α = .8, γ = 0



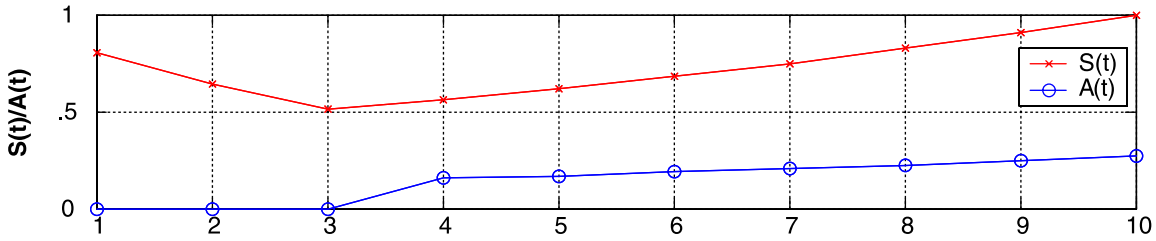
B: α = .8, γ = .1



C: α = .8, γ = .2



D: α = .8, γ = .3



Time t, Budgeting Starts at t = 4

treated as a series of positive temporary shocks in an induced-evolving market.

A closer examination of the advertising–sales dynamic reveals how previous research has misinterpreted temporary marketing actions by suggesting their persistent effects in induced evolution. In induced evolution (i.e., $\gamma_b = \gamma$), a marketing expense shock, A^T, leads to a sales increase by $\Delta S = \beta A^T$. Then, as a result of the embedded percentage budgeting, the increased sales lead to the increase of sustained budget A_t^s by $\Delta A^s = \gamma \Delta S = (1 - \alpha)A^T$, which in turn sup-

ports the sales. Thus, although the effect of the marketing shock *appears* to be persistent, it is the increased sustained spending that maintains the new sales level. The marketing shock A^T is just a "down payment" of sustained marketing costs to sustain the sales increase it causes. If a sufficient percentage budgeting is not followed, the "persistent effect" of a marketing shock will disappear. Thus, in induced evolution, the temporary marketing expense shock A^T does not have a true persistent effect.

Combining Equations 3 and 12 generates a long-term equilibrium relationship between advertising and sales, as follows:

$$S_t = \left(\frac{\alpha}{\gamma_b} + \beta\right) A_t + e_t. \tag{13}$$

This theoretically explains Baghestani's (1991, p. 671) observation that "the observed business firms' decision rules fixing advertising spending as a percentage of sales revenue may hold as a long-run equilibrium condition."

We use a simple percentage-budgeting model to demonstrate that responsive budgeting at a sufficient level can sustain induced evolution. However, note that simple percentage budgeting is not the only way to create induced evolution; more sophisticated budgeting models can be developed and deserve further investigation.

Budgeting for a sales level: constant budgeting. Constant budgeting ($A_t = A_c$) is an easy-to-follow budgeting method, especially for managers focusing on cost control and resource allocation/optimization issues. Constant budgeting can generate a continuous sales increase in an intrinsic-evolving market, and it maintains a sales level in an intrinsic-stationary market.

In an intrinsic-stationary market, it can be inferred from the market dynamics (Equation 3) that for a constant marketing budget level, A_c, sales can be sustained at

$$S(A_c) = \frac{A_c}{\gamma} = \frac{\beta A_c}{1-\alpha}. \tag{14}$$

With constant budgeting, an equilibrium is reached at $S(A_c)$, and the system presents a stationary nature in that any positive and negative sales changes will eventually disappear (i.e., temporary marketing actions have no persistent effect).

Figure 3 illustrates sales performance at various levels of constant budgeting after a marketing shock of one unit. It shows that the sustained sales performance is determined by sustained spending (A^s or A_c). A temporary marketing campaign affects only how fast (i.e., the route) a new sales level can be achieved.

Implication 3

When budgeting, marketing managers need to consider both the market environment and the intrinsic nature of the market. In an intrinsic-stationary market, percentage budgeting is preferable in positive market environments, whereas constant budgeting can be beneficial in negative environments.

Here, we demonstrate the choice of budgeting methods under positive and negative market environments. Figure 4 compares sales dynamics under percentage and constant budgeting after factors other than advertising cause sudden sales changes (shocks) at Time 10. The figure shows that with a sales increase, percentage budgeting causes the sales to evolve and stay at a higher level, whereas with constant budgeting, sales return to a previous equilibrium level. With a negative shock, percentage budgeting results in a lower sales level, and constant budgeting helps regain the lost sales.

Implication 4

To create induced evolution, the advertising series must evolve.

In induced evolution, advertising must evolve with sales because it needs to support sales evolution. The following equations are derived from the market dynamics (Equation 3), budgeting component model (Equation 11), and percentage-budgeting model (Equation 12) (for a derivation, see the Appendix):

$$S_t = (\alpha + \beta\gamma_b)S_{t-1} + \beta A_t^T + e_t, \tag{15}$$

and

$$A_t = (\alpha + \beta\gamma_b)A_{t-1} + A_t^T - \alpha A_{t-1}^T + \gamma_b e_{t-1}. \tag{16}$$

As we analyzed previously, the induced evolution is created when $\alpha + \beta\gamma_b = 1$ in Equation 15. Because $\alpha + \beta\gamma_b$ also appears in Equation 16, the advertising budget must be an evolving process under induced evolution.

Implication 5

Temporary, intensive marketing actions are neither sufficient nor necessary for sustained market gains in an intrinsic-stationary market.

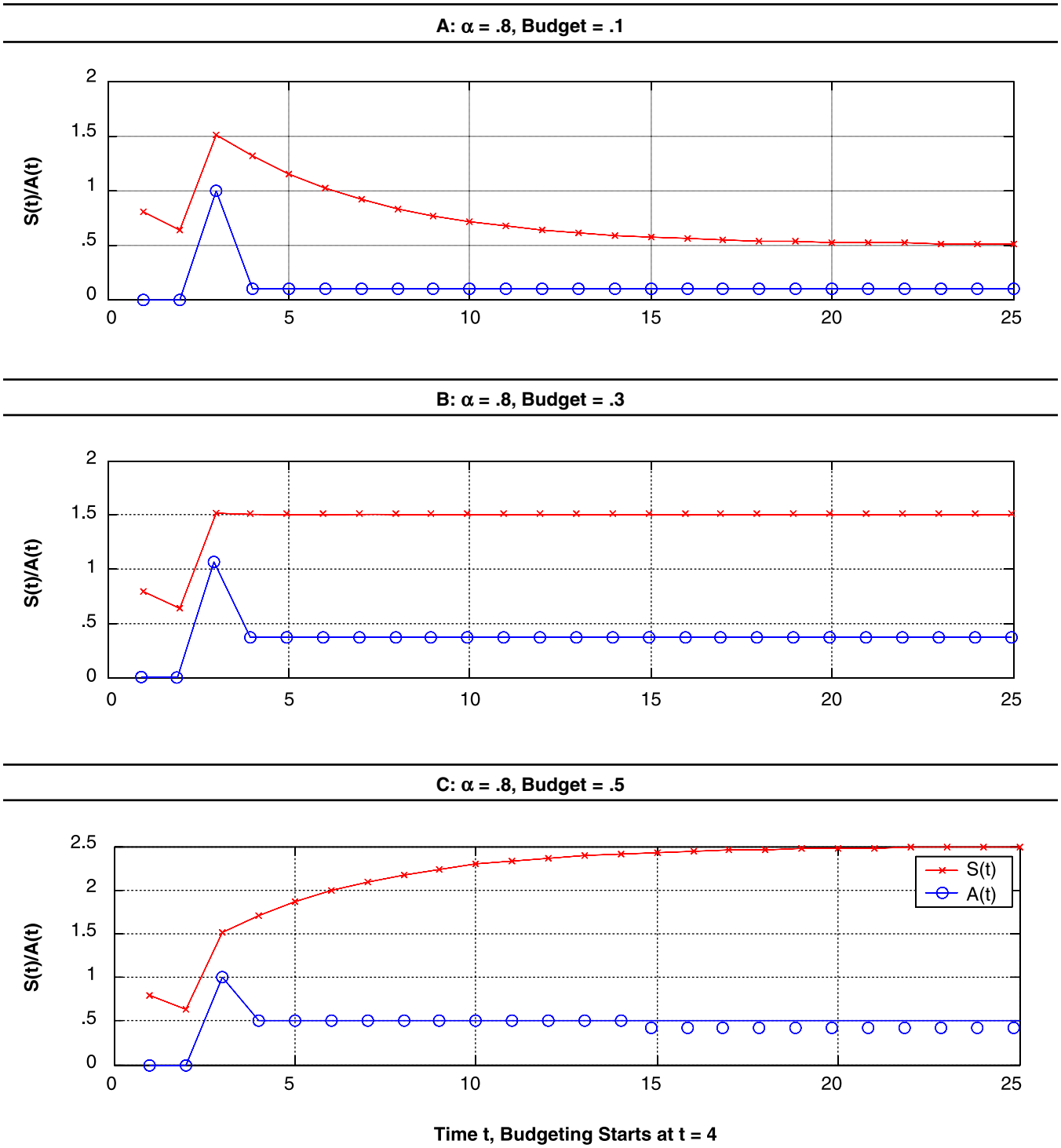
We previously demonstrated that temporary, intensive advertising campaigns are not sufficient for sustained market gains in an intrinsic-stationary market. Here, we demonstrate that such marketing actions are also not necessary for sustained market gains.

In Figure 5, we compare two strategies for objective budgeting, in which marketing managers must reach and maintain a sales level. We consider an induced evolving market that has already reached an equilibrium. The market performance level S_0 is supported by the sustained marketing budget $A_0 = S_0(1 - \alpha)/\beta$. The marketing goal is to increase the market performance by ΔS to a new level, $S = S_0 + \Delta S$.

The first strategy is a popular marketing practice in which marketing managers design temporary, intensive advertising campaigns to boost sales (see Figure 5, Panel A). The temporary marketing action, $A^T = \Delta S/\beta$, at time $t = t_0$ brings the sales to a new level by creating the desired gain ΔS. Afterward, the additional percentage budget $\Delta A^s = \Delta S(1 - \alpha)/\beta$ is applied, and the market gain is sustained.

The second, alternative budgeting strategy is to budget directly at the new sustained spending level $A_0 + \Delta A^s$, with-

FIGURE 3
Constant Budgeting



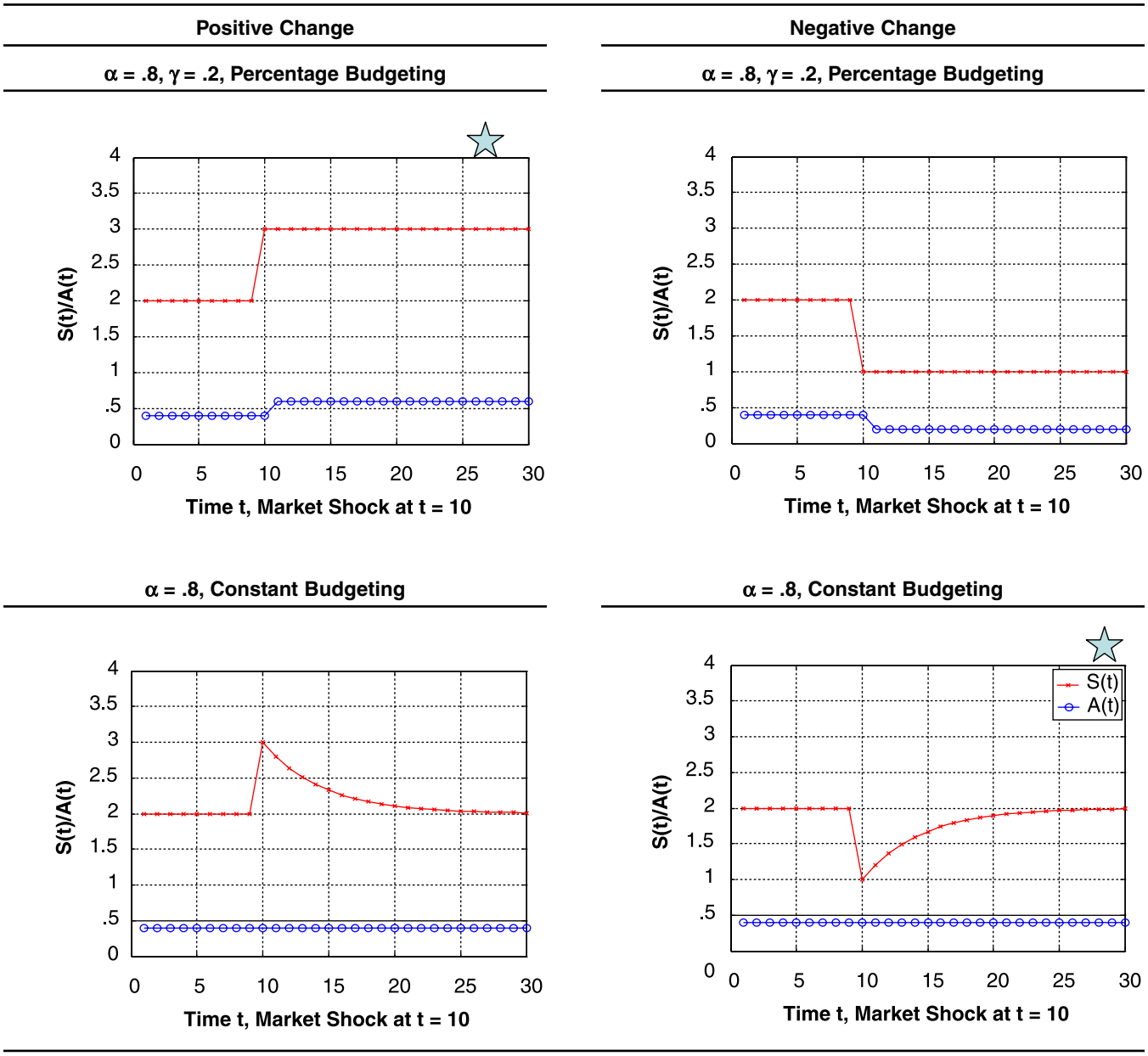
out introducing any marketing shock (see Figure 5, Panel B). With the increased advertising budget, sales increase according to the following curve:

$$(17)\quad S_t = S_0 + \frac{\Delta A^s \times \beta}{1-\alpha}(1-\alpha^{t-t_0+1}) = S_0 + \Delta S(1-\alpha^{t-t_0+1}).$$

With this alternative budgeting strategy, sales eventually reach the marketing goal, $S = S_0 + \Delta S$, and stay there. The smaller the α, the faster it is to reach the desired market level.

A related case, which we demonstrated in Figure 3, Panel C, is managers' use of a temporary campaign (shock),

FIGURE 4
Comparison of Percentage- and Constant-Budgeting Methods Under Negative and Positive Market Changes in an Intrinsic-Stationary Market



Notes: Stars indicate preferable budgeting methods under different market changes.

but it is not intensive enough to reach the marketing goal. Panel C shows that the desired sales level is realized by sustained budgeting. As long as we guarantee the sustained budget $A_0 + \Delta A^s$, the marketing goal can eventually be reached. The temporary marketing action affects only the route to the goal.

Managerial implications are clear: In an intrinsic-stationary market, a temporary, intensive marketing action (a marketing shock) is neither sufficient nor necessary to generate sustained effects to reach a certain persistent marketing goal. The temporary marketing action does not have sustained effects; it only initiates system changes, including budgeting changes through underlying budgeting rules, and affects the transition dynamics (i.e., to make the transition faster). It is indeed the sustained spending that determines the long-term market performance.

Empirical Illustrations

We use the advertising and sales data of five companies to demonstrate the difference between the proposed IME test and the standard unit root test and the effects of several budgeting practices on sales performance. Note that these empirical illustrations are not intended as a comprehensive empirical investigation of the advertising–sales relationships of these firms; rather, they are intended to demon-

strate the concepts we discussed previously. We chose these specific companies because their data illustrate five combinations of budgeting practice, intrinsic market nature, and sales performance (see Table 1). Our theoretical discussion is based on a univariate model. Thus, we focus on the advertising and sales series and do not consider other marketing inputs.

Figure 6 plots the advertising and sales data. Twenty-two years' worth of annual data (1985–2006) were available for Avon Products, Circuit City Stores, and Hartmarx, and 20 years' worth of annual data (1985–2004) were available for Televideo. We obtained data from 1985 to 2004 from COMPUSTAT and data from 2005 to 2006 from Capital IQ. Data from 2005 to 2006 were not available for Televideo because of company reorganization. We obtained 24 periods of quarterly data for Rivergate Estates (from the first quarter of 1999 to the last quarter of 2004) from Capital IQ.

Table 2 compares the results of the unit root tests and the proposed IME tests. The sales and advertising series of all the companies, except Televideo, have unit roots. From this result, prior research would suggest the persistence effects of temporary advertising for four companies. However, our IME analysis suggests that only two companies, Avon and Rivergate Estates, can effectively use temporary advertising because their intrinsic-evolving markets are identified by the IME tests. The other two firms, Circuit City and Hartmarx, are identified as intrinsic-stationary markets characterized by induced evolution. Temporary advertising has no true persistent effects for these two firms, and therefore they must rely on sustained advertising.

Table 2 also reports cointegration tests when data series are identified as evolving. The cointegration of the advertising and sales series indicates that the subsequent regression analyses are meaningful (Gujarati 2003).

We then conducted regression analysis based on Equations 2 and 12 to demonstrate the companies' underlying budgeting practices (this is a first-order two-variable VAR model identification). Table 3 reports the results. By assessing the significance of γ_b and model fitness through the adjusted R-square from the regression in Equation 12, we

FIGURE 5
Effects of a Temporary Marketing Campaign

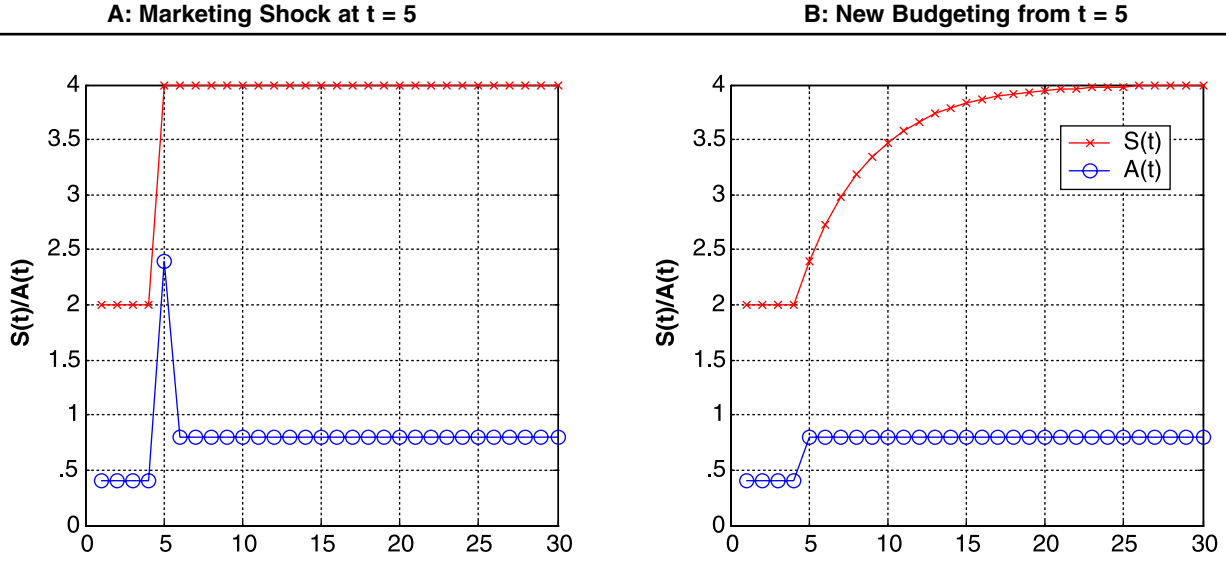
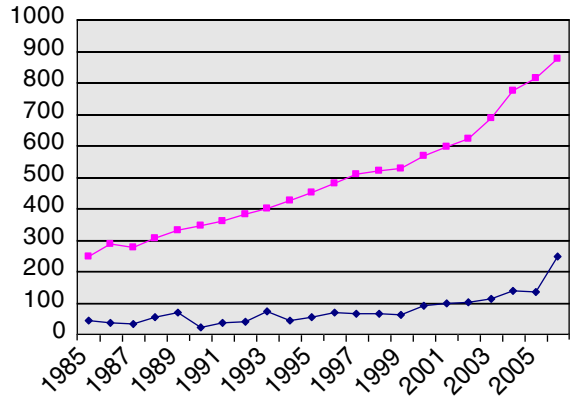


TABLE 1
Five Companies of Various Scenarios of Market Nature, Budgeting Practice, and Sales Performance

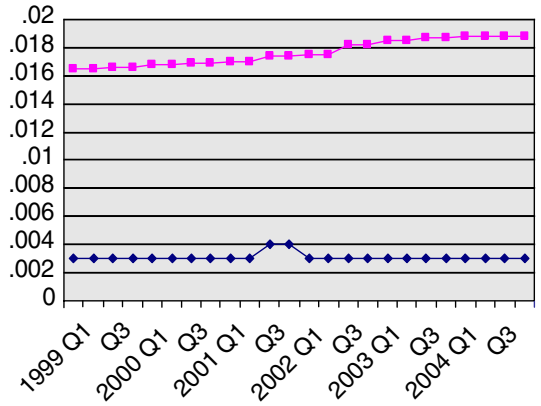
		Budgeting Practice		
Company	**Market Nature**	**Budgeting Rules**	**Budgeting Level**	**Sales Evolution**
Avon	Intrinsic evolving	Percentage budgeting	Sufficient	Yes
Rivergate	Intrinsic evolving	Constant budgeting	Sufficient	Yes
Circuit City	Intrinsic stationary	Percentage budgeting	Sufficient (larger than threshold)	Yes, marketing induced
Hartmarx	Intrinsic stationary	Percentage budgeting	Sufficient (equal to threshold)	Yes, marketing induced
Televideo	Intrinsic stationary	Percentage budgeting	Insufficient (less than threshold)	No, stationary

FIGURE 6
Sales and Advertising Expenditures

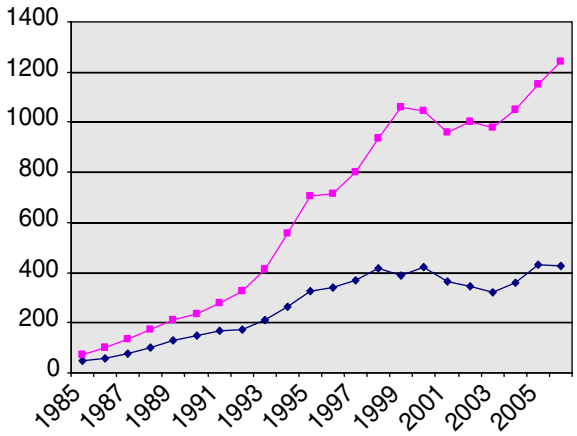
A: Avon



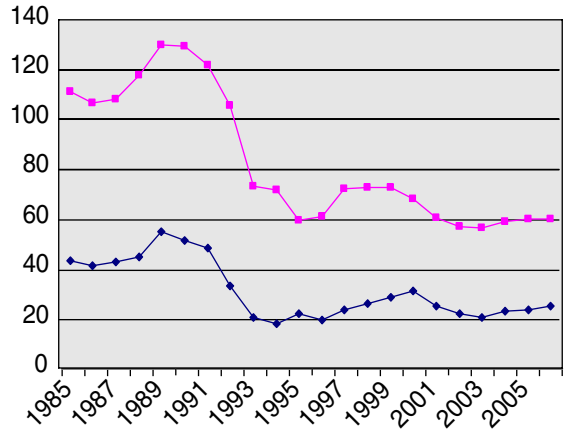
B: Rivergate Estates



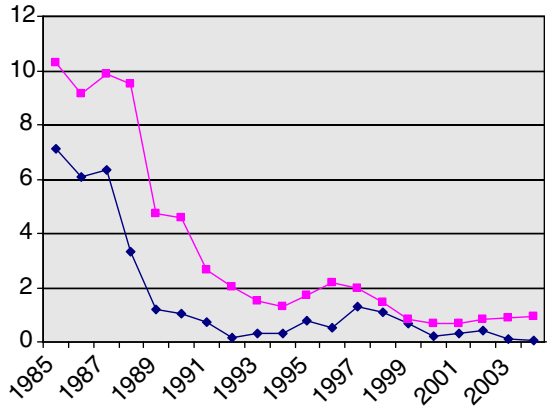
C: Circuit City



D: Hartmarx



E: Televideo



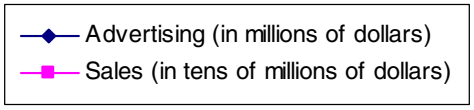


TABLE 2
Comparisons of Unit Root and IME Tests

	Unit Root?				Proposed IME Tests			
	ADF Test		PP Test				ADF/PP Critical Values (5%)	Cointegration (Johansen Test)
Company	Sales	Advertising	Sales	Advertising	IME_t	Intrinsic Evolving?		
Avon	3.38	4.18	3.84	5.29	.20	Yes	–3.05/	Yes
	Yes	Yes	Yes	Yes			–3.01	
Rivergate	–.42	–3.00	–.36	–2.67	–.30	Yes	–3.40/	Yes
	Yes	Yes	Yes	Yes			–3.00	
Circuit City	–.45	–1.25	–.25	–1.24	–3.82	No	–3.05/	Yes
	Yes	Yes	Yes	Yes			–3.01	
Hartmarx	–2.27	–1.79	–1.14	–1.50	–6.66	No	–3.05/	Yes
	Yes	Yes	Yes	Yes			–3.01	
Televideo	–3.29	–3.12	–2.27	–4.05	–5.68	No	–3.05/	N.A.
	No	No	Yes	No			–3.03	

Notes: ADF = augmented Dickey–Fuller test, PP = Phillips and Perron test, and N.A. = not applicable.

TABLE 3
Regression Analysis

	Equation 2: $S_t = c + \alpha S_{t-1} + \beta A_t + e_t$				Budgeting Threshold	Equation 12: $A_t = \gamma_b S_{t-1} + \varepsilon_t$		
Company	c	α	β	Adjusted R^2	$\gamma = \frac{1-\alpha}{\beta}$	γ_b	Adjusted R^2	Budgeting Method in Practice
Avon	50.99	1.01*	2.63	.99	N.A.	.02*	.61	Percentage
	(.38)	(21.76)	(1.77)			(13.60)		
Rivergate	.00	.99*	1.04	.96	N.A.	N.A.	N.A.	Constant
	(.01)	(22.67)	(.79)					
Circuit City	–233.34	.70*	9.42*	.99	.03	.04*	.70	Percentage
	(–.83)	(9.00)	(3.98)			(21.57)		
Hartmarx	41.63	.46*	12.65*	.96	.04	.04*	.65	Percentage
	(1.06)	(5.69)	(6.74)			(23.08)		
Televideo	2.43	.52*	7.38*	.94	.07	.04*	.60	Percentage
	(1.00)	(6.05)	(4.66)			(7.83)		

*$p < .01$.
Notes: N.A. = not applicable.

can infer whether the companies follow percentage budgeting. We find a percentage relationship between advertising and sales of the past year for four of the five companies. Rivergate followed constant budgeting. Except in the third and fourth quarters of 2001, Rivergate's quarterly advertising expenses were fixed at $3,000 from 1999 to 2004.

For companies under intrinsic-stationary markets, we calculated the threshold percentages γ from the α and β values in Equation 2. We compared the budgeting threshold γ and γ_b (the percentage in use) to suggest budgeting sufficiency (see Table 1). When $\gamma_b \geq \gamma$, budgeting is sufficient, and induced evolution is created. If not, budgeting is insufficient.

The data from the five companies illustrate the budgeting implications we discussed previously. First, we show that intrinsic-evolving markets reflect favorable business environments in which marketing managers have more flexibility in budgeting. Avon and Rivergate did not need to meet budgeting thresholds, and with either one of the two budgeting practices (i.e., percentage or constant budgeting), both companies achieved increasing sales performance.

Second, among the three companies with intrinsic-stationary markets, both Circuit City and Hartmarx budgeted at sufficient percentage levels and thus successfully created induced evolution. Circuit City budgeted at a percentage (4%) that exceeded the threshold percentage (3%). Thus, the company achieved steady growth. Indeed, during the past 20 years, Circuit City has attained 2% net profit margin, indicating that it has used advertising to an advantage. Hartmarx meets its threshold percentage (4%) with an average net profit margin of zero and has sustained its sales level since 1993.

Third, Televideo, which also operates in an intrinsic-stationary market, failed to satisfy the budgeting threshold (7%) with a budgeting percentage of approximately 4%. An induced evolution was not achieved, and both sales and advertising continued to fall. Televideo cannot afford to increase its advertising budgets, because on average, it has a

negative 23% profit margin. As we mentioned previously, the company went through a reorganization in 2005.

Discussions and Conclusions

Theoretical Contributions and Relationships to Prior Research

In this article, we conduct a theoretical study on the reasons for market evolution, using advertising–sales dynamics as an example of general marketing input–output relationships. By testing whether a marketing input is a necessary exogenous variable for evolution of an output variable, we distinguish two market natures—intrinsic evolution and intrinsic stationarity—and discuss induced evolution in intrinsic-stationary markets. We suggest that in intrinsic-evolving markets, temporary advertising can generate sustained effects, but in intrinsic-stationary markets, sustained advertising budgeting determines the long-term market performance. Methodologically, we propose a new IME test to distinguish intrinsic-evolving and intrinsic-stationary markets, and we provide methods to quantify temporary and sustained budgeting. The proposed techniques can be used to study any input–output relationship and can be generalized to multivariate models to consider the effects of several marketing inputs in creating sales evolution.

The proposed concepts advance the time-series-based market evolution analysis in the following ways: First, as we mentioned previously, the existing method analyzes the persistence of marketing efforts by examining the evolution of market output variables (Dekimpe and Hanssens 1995b; Franses, Srinivasan, and Boswijk 2001; Srinivasan, Leszczyc, and Bass 2000). As a result, there is no effective method to differentiate marketing hysteresis (i.e., intrinsic evolution), in which "sales would increase with increased advertising and stay there after withdrawal of advertising" (Little 1979, p. 632), from nonhysteresis market evolution (i.e., induced evolution). Our approach theoretically and quantitatively differentiates the two. Second, for induced evolution, our approach draws different conclusions from the existing method. By suggesting persistent effects of marketing efforts in evolving markets without differentiating intrinsic and induced evolution, the existing method overemphasizes the effects of temporary, intensive marketing campaigns. We suggest that temporary, intensive marketing input is neither sufficient nor necessary in intrinsic-stationary markets. Third, our approach can be used to analyze and quantify active budgeting (both short- and long-term) strategies, which the existing method cannot do.

Our approach can provide better explanations of the evolving scenarios summarized in previous literature. With regard to the evolving-business-practice scenario discussed previously, we show that it can be an induced evolution, which reflects the same intrinsic-stationary market as the business-as-usual scenario. In contrast, as we illustrate in the Avon case, an evolving business practice can also result from intrinsic evolution, in which the marketing input happens to evolve. Our IME approach, based on the market nature and budgeting analysis, identifies these different situations, and thus it is more insightful than the performance-based categorization of prior research (e.g., Dekimpe and Hanssens 1999).

In contrast to empirical studies that use multivariate time-series models to examine the effects of marketing drivers, such as promotion (Steenkamp et al. 2005), price (Srinivasan, Leszczyc, and Bass 2000), price promotions (Dekimpe, Hanssens, and Silva-Risso 1999; Nijs et al. 2001; Srinivasan, Leszczyc, and Bass 2000), distribution (Bronnenberg, Mahajan, and Vanhonacker 2000), and firm innovativeness (Pauwels et al. 2004), on long-term market performance, this article is a theoretical study that presents a novel approach. We focus on a univariate model; that is, for simplicity and clarity, we use advertising as an example of a general input because it demonstrates how, all other things being equal, one factor can affect the output. The proposed intrinsic market analysis and approach can be extended to multivariate models and can be used by the empirical studies.

Managerial Implications

Budgeting is an immensely difficult task (Bigne 1995; Mitchell 1993). Our IME analysis and related budgeting discussions and modeling can directly help marketing managers in budgeting tasks. We review some key points here.

First, marketing managers can use the proposed IME test as a quick market assessment tool before detailed information, such as customer surveys, is available. Intrinsic evolution projects a superior business environment, in that all other business factors, marketing and operational alike, together create an environment in which the marketing input under study can produce persistent effects. For example, Avon relies on a direct-sales model in which the sales force pushes products out to consumers. New customers attained by advertising can be retained by Avon's robust operations. The IME concepts and test can help firms identify such superior conditions.

Second, budgeting is more demanding in intrinsic-stationary markets than in intrinsic-evolving markets. For example, although Avon and Rivergate use different rules (constant versus percentage), both obtain good sales results because they are in intrinsic-evolving markets. However, in intrinsic-stationary markets, companies depend on percentage budgeting at a sufficient level to maintain sales evolution. Failing to do so could lead to disastrous results, as in the case of Televideo.

Third, budgeting focuses and timelines are different in intrinsic-evolving and intrinsic-stationary markets. Marketing managers can focus on temporary budgeting in intrinsic-evolving markets, whereas a long-term focus is needed in intrinsic-stationary markets. Although marketing managers tend to initiate temporary, intensive campaigns in the hope of creating sustained market performance, in intrinsic-stationary markets, these campaigns are neither sufficient nor necessary to achieve sustained sales gains. Under tight budgets, managers can directly budget at a sustained spending level, and eventually the sales level can be achieved. In this article, we provide quantification methods for both temporary and sustained budgeting.

Responsive budgeting methods, such as percentage budgeting, can create induced evolution, given that the budgeting threshold is met. Such methods are beneficial in positive market situations with frequent sales increases. For decreased sales performance, such budgeting methods can be damaging. Nonresponsive (e.g., constant) budgeting can help sales return to previous levels.

Note that for the percentage threshold $\gamma = (1 - \alpha)/\beta$, $\partial\gamma/\partial\alpha = -1/\beta$, and $\partial\gamma/\partial\beta = (\alpha - 1)/\beta^2$. Thus, the sensitivity of the percentage threshold is dependent on the advertising effectiveness parameter β. The smaller the β, the less robust is the estimation of the percentage threshold because of parameter estimation errors of market dynamics. Therefore, when β is small, managers need to be more careful in percentage budgeting. The more important task is probably not advertising budgeting but rather improving advertising effectiveness. In such a case, managers should use constant budgeting to prevent sales decline and try to improve marketing effectiveness before employing percentage budgeting.

Limitations and Opportunities for Further Research

As we indicated previously, the proposed concept and method can be extended to existing models, such as market share attraction models (Bronnenberg, Mahajan, and Vanhonacker 2000; Franses, Srinivasan, and Boswijk 2001), multivariate VAR models (Srinivasan, Leszczyc, and Bass 2000), and multivariate higher-order VAR models. Indeed, our ongoing preliminary analysis, which employs a higher-order VAR model and incorporates consumer wear-out effects (Simon 1982), supports similar conclusions and implications.

Herein, we focus on the dynamic relationship between advertising and sales but do not consider profitability with other budgeting constraints. Thus, we cannot assess whether excessive advertising is beneficial for a company. In reality, marketing managers face various budgeting constraints, such as budget limits, contribution margins, additional costs, and competitors' strategies, in determining profitability of advertising expenditures. Therefore, future work should pursue optimal budgeting strategies under these constraints (e.g., limited budgets) with various criteria (e.g., profitability in certain periods). Our method provides a sound foundation to tackle budget optimization problems; for example, when an appropriate advertising–sale model is identified, optimal target budgeting for profitability maximization can be formulated with the use of existing methodologies (e.g., Simon 1982).

Our focus herein is to demonstrate general budgeting implications of the proposed IME analysis. We discuss constant and percentage budgeting to demonstrate the relationship between budgeting rules and market responses. Detailed budgeting strategies and models can be formulated and investigated within the proposed theoretical framework. For example, percentage budgeting is not the only responsive budgeting method. Through higher-order VAR models, other sales–advertising feedback mechanisms can be developed to support sales evolution.

In line with existing time-series models, our model assumes a linear relationship, which, within a certain range, approximates market input–output dynamics and simplifies our analysis. However, the IME concepts and analysis are not restricted to the linear assumption. A linear model, such as that in Equation 2, can be generalized to accommodate nonlinear input–output relationships by taking a transformed input variable as the market input (A_t) in the model. For example, an empirical remedy would be to take the logarithm of the marketing input variable (Simon 1982) to produce the diminishing marginal returns and customer attention threshold effect to the output. All the methodologies and main arguments we presented would still hold after such data transformation, except for budgeting Implication 2. That is, if we use $\log(A_t)$ instead of A_t in Equation 2 (to model the nonlinearity), exponential (nonlinear) budgeting rather than percentage (linear) budgeting might be necessary to create induced evolution.

As do most existing models, our model assumes time-independent marketing dynamics; that is, parameters of marketing dynamics are unchanging over time. However, the time-varying market dynamics are relevant to persistence analysis because they can identify marketing hysteresis, in which marketing spending changes market dynamics. For example, advertising intensiveness and strategy may affect consumer psychology (Vakratsas and Ambler 1999) and thus change advertising effectiveness. That is, advertising may fundamentally change the advertising–sales dynamics (i.e., α and β in our model) and subsequently make a stationary system evolving. Thus, it would be of great interest and importance to further model changing market dynamics that are caused by advertising campaigns. Time-varying analysis methods, such as the moving-window approach and the Kalman filter model, have been used recently to analyze the marketing performance regime change (e.g., Pauwels and Hanssens 2007). The quantitative modeling and analysis of market dynamic changes would provide further insights into budgeting.

In conclusion, we consider an example in which marketing managers must decide whether to continue a new product launch campaign during a midcampaign review on weekly advertising and sales data. They should first conduct an IME test. If an intrinsic-evolving market condition is identified, the managers can make a decision based on the temporary budget availability. Either they can stop the campaign if the budget is needed somewhere else and expect the increased sales to sustain, or they can continue the campaign because any further spending will be beneficial. In contrast, when an intrinsic-stationary environment is identified, the managers must consider the availability of sustained advertising budgets, beyond the planned resources for the product launch campaign, to make a decision. In an intrinsic-stationary market, continuing the campaign makes sense only when sustained advertising budgets are available. If they are not available, the current advertising spending will not change long-term sales performance, and the campaign should be discontinued, unless the temporary profitability of the campaign is desirable.

Appendix: Derivation of Equations 15 and 16

Here, we use the z-transform tool in discrete-time signal processing (Oppenheim and Schafer 1998). We define the z-transform of a time series x_t as

$$X(z) = \sum_{t=-\infty}^{\infty} x_t z^{-t}, \tag{A1}$$

where z^{-1} can be considered a lag operator.

Taking the z-transform of Equation 3, we obtain the following:

$$S(z) = \alpha z^{-1}S(z) + \beta A(z) + E(z), \tag{A2}$$

where S(z), A(z), and E(z) are the z-transforms of S_t, A_t, and e_t, respectively.

Under percentage budgeting, sustained spending and temporary/excess marketing efforts modeled in Equation 11 become

$$A_t = A_t^S + A_t^T = \gamma_b S_{t-1} + A_t^T. \tag{A3}$$

Note that only when the percentage-budgeting factor γ_b satisfies Equation 8 (i.e., when sufficient continuous marketing budgets are provided) can sales changes be sustained and accumulated.

Similarly, taking the z-transform of Equation A3, we obtain the following:

$$A(z) = \gamma_b z^{-1}S(z) + A^T(z), \tag{A4}$$

where $A^T(z)$ is the z-transform of A_t^T.

When we substitute Equation A4 into Equation A2 and solve S(z), we obtain the following:

$$[1 - (\alpha + \beta\gamma_b)z^{-1}]S(z) = \beta A^T(z) + E(z). \tag{A5}$$

Then, when we substitute Equation A5 back into Equation A4 and solve A(z), we obtain the following:

$$[1 - (\alpha + \beta\gamma_b)z^{-1}]A(z) = \gamma_b z^{-1}E(z) + (1 - \alpha z^{-1})A^T(z). \tag{A6}$$

Finally, when we take the inverse z-transform of Equations A5 and A6, we obtain Equations 15 and 16.

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