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Marketing's Credibility: A Longitudinal Investigation of Marketing Communication Productivity and Shareholder Value

Practitioners and scholars have questioned marketing communication's credibility because it has not been linked to firm shareholder value. Using secondary longitudinal data, the authors show that the impact of marketing communication productivity (MCP) on shareholder value is positive and nonlinear. In particular, the influence of MCP on the forward-looking performances of Tobin's q and stock return is curvilinear with an inverted U shape. The authors also investigate the moderating role of research-and-development investment and competitive intensity. The findings have implications for marketing managers regarding how to model and benchmark MCP and the dangers of blindly improving the productivity of advertising and sales promotion expenditures.

Marketing scholars and practitioners have long been concerned about the accountability of marketing communication expenditures (e.g., advertising, sales promotions). In their classic article, Aaker and Carman (1982) report that firms greatly overadvertise. In an echo of this claim, Prasad and Sen (1999), in their review of studies since 1982, find a pattern of continued overadvertising across firms. More recently, Rust and colleagues (2004) comprehensively review the literature and pinpoint various researchers' concerns about the productivity of advertising and sales promotion expenditures. In particular, to rebuild confidence in advertising and marketing investment, Rust and colleagues (2004, p. 76) suggest the urgent need to "show how marketing adds to shareholder value, [because] the perceived lack of accountability has undermined marketing's credibility, threatened marketing's standing in the firm, and even threatened marketing's existence as a distinct capability within the firm."

The trade press has identified a similar problem. According to McLaughlim (1997, p. 5), "the most sacred word in advertising had been creativity; now it's accountability." Clients are demanding the most cost-efficient media planning with measurable returns. Kumar and Petersen (2004, p. 28) point out that "company [chief financial officers] are charged with the task of getting the most out of company resources [such as] marketing communication investments." Kraft Foods has suggested moving away from guesswork and gut feelings and toward the systematic assessment of advertising productivity (Dittus and Kopp 1990). Achenbaum (1992, p. 25) calls attention to the "crisis of advertising productivity" because many customers tend to zap past, zip through, and tape over marketers' multimillion dollar selling and marketing messages. More recently, it has been noted that "there's hardly a marketing executive today who isn't demanding a more scientific approach to help defend marketing strategies from the chief financial officer" (*BusinessWeek* 2004). Thus, reversing the marketing productivity crisis represents a high-profile, hot-button issue for both business practitioners and marketing scholars.

However, several challenges hinder marketers from fully understanding and effectively improving marketing communication accountability. First, an appropriate measurement is needed of marketing communication productivity (MCP), which we define as the ratio of marketing outputs (sales level, sales growth, and corporate reputation) to marketing communication expenditures (broadcast, print, and outdoor advertising and sales promotion expenditures). A methodologically sound measure of MCP remains challenging because firms often target their advertising and sales promotion expenditures to promote multiple outcomes simultaneously, such as both visible sales and market performance and invisible customer equity and corporate brand reputation. Thus, the traditional approach of using a single outcome-based measure (e.g., simple ratio of sales to marketing expenditures) may not offer a valid assessment of MCP. In addition, although a vast literature pertains to sales responses to advertising (e.g., Vakratsas and Ambler 1999), the theorized shape of the response curve (i.e., linear, nonlinear concave, or convex) has been, at best, inconsistent and inconclusive (see Holstius 1990). In this sense, a subjectively specified measure based on the conflicting advertising–sales function that uses regression techniques is

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inappropriate for assessing MCP. Extant marketing studies have not addressed these challenges sufficiently with rigorous methodological techniques.

Second, there needs to be a proper assessment of the dynamic contributions of MCP to the firm's market value over time. Specifically, in assessing the value of marketing communications, most prior research has related advertising and sales promotions to accounting performance measures, such as profits (e.g., Dekimpe and Hanssens 1995; Mueller 1990). However, Aaker and Jacobson (2001, p. 485) challenge this practice by proposing that accounting-based measures of return on investment (ROI) and book equity alone "cannot adequately explain firm value, because they fail to capture the benefits of investing in intangible assets such as brands." Similarly, Ambler (2004) notes that ROI is driven by short-term considerations and often fails to reflect the dynamic impact of marketing assets. In addition, because accounting measures such as ROI are backward looking in nature (i.e., capture firm value in terms of historical or concurrent performance), they are not robust for evaluating the future contribution of MCP (Rust et al. 2004).[1] Therefore, the long-term value of the invisible outcomes (e.g., corporate reputation, brand equity) of a marketing expenditure is less likely to be evident according to accounting book values. Instead, research should address how MCP adds to a firm's market value in terms of forward-looking stock market performance, such as Tobin's q (Dutta, Narasimhan, and Rajiv 1999; Rao, Agarwal, and Dahlhoff 2004) and stock returns (Aaker and Jacobson 1994; Mizik and Jacobson 2003). Unfortunately, prior literature has rarely related MCP to the market-based measure of firm value and thus has failed to address the real, long-term credibility of marketing communication expenditures.

Against this background, we attempt to (1) develop a theory-based measurement of MCP and (2) assess MCP's association with firm shareholder value empirically. In particular, we define MCP on the basis of economic growth theory and the resource-based view (RBV) and measure it in a time-series-based context using the Malmquist modeling method (Caves, Christensen, and Diewert 1982; Malmquist 1953). This nonparametric method satisfies the challenging requirements of measuring MCP because it captures the multiple objectives of marketing communications in multiple periods and without a prior assumption about the response function. Unlike most regression approaches that offer a comparison with average performers under the assumption of central tendencies, the Malmquist technique benchmarks each firm's productivity against the best practices that perform above average (Färe et al. 1992). In addition, its dynamic time-series nature accommodates the lagged, carryover effects of advertising and sales promotion. Our application of the Malmquist time-series technique not only extends prior work on cross-sectional and time-invariant counterpart models (cf. Horsky and Nelson 1996; Murthi, Srinivasan, and Kalyanaram 1996) but also provides a direct answer to a series of calls for scientific measures of marketing productivity (McLaughlim 1997; Rust et al. 2004).

Furthermore, we develop and test a theoretical framework that predicts that firms that are more efficient in converting advertising and promotion investments into sales and corporate reputation may create greater shareholder value over time. Because MCP facilitates the level and speed of future cash flows while reducing their volatility and vulnerability (Srivastava, Shervani, and Fahey 1998, 1999), we suggest that it also should promote shareholder value in terms of the forward-looking market value measured by Tobin's q and stock return.

Another important insight of our framework is that we do not predict a monotonic linear relationship between MCP and firm market value but rather nonmonotonic curvilinear influences of MCP. Because of the possible conflict between productivity and customer satisfaction (Anderson, Fornell, and Rust 1997), the unrestricted pursuit of improvements in MCP may actually harm firm shareholder value. There is a limit to the incremental performance contributions of MCP, and departing from the optimal point (too low or too high increases of MCP) may lead to reduced Tobin's q and stock return. We also hypothesize about why and how the impact of MCP changes across firms with different levels of research and development (R&D) investment and competition intensity.

Next, we present the hypotheses development for the impact of MCP and the moderated relationships, followed by details of our suggested process for measuring MCP. Using secondary longitudinal data from *Fortune*'s large companies, we find that MCP is positively related to Tobin's q and stock return. For practitioners, this finding helps justify advertising and sales promotion budgets and supports marketing's long-term credibility. However, the supported inverted U-shaped relationship between MCP and firm market value suggests some "dangers" of blindly improving MCP. Our work represents a first step in measuring and valuing marketing communication investments, which must be taken before the productivity crisis can be reversed.

MCP and Shareholder Value

Neoclassical production theory in economics posits that, in general, productivity represents the conversion of economic inputs (e.g., labor, capital) into desirable outputs (i.e., sales, profits) or the ratio of the outputs of an economic activity to the inputs required by that activity. According to Caves, Christensen, and Diewert (1982) and Farrell (1957), in a production setting, managers attempt to improve the value of a firm by operating it in the most productive manner. That is, managers maximize the firm's desirable outputs or outcomes with the minimal amount of inputs or resources. This definition of productivity in an economic production context has been well accepted in marketing (Bucklin 1978; Murthi, Srinivasan, and Kalyanaram 1996; Sevin 1965).

Following this stream of research, we define MCP as the optimally weighted ratio of marketing outputs (sales level, sales growth, and corporate reputation) to marketing

[1]Using the backward-looking performance measure of ROI, the impact of advertising is mixed, according to the literature (e.g., positive: Chauvin and Hirschey 1993; Mizik and Jacobson 2003; negative: Erickson and Jacobson 1992; Holstius 1990).

communication expenditure (advertising media spending in broadcast, print, and outdoor and sales promotion expenditure).[2]

Figure 1 presents our theoretical framework of MCP and shareholder value. This framework provides a base from which we predict (1) how MCP adds to a firm's shareholder value in a curvilinear manner and (2) the moderating role of contextual factors (R&D and environmental competition intensity) for returns on MCP.

Curvilinear Influences of MCP

In this section, we offer the logic for the dynamic impact of MCP and predict that MCP has nonlinear influences on shareholder value. That is, an initial increase of MCP will enhance the forward-looking performance of Tobin's q and stock returns, but beyond an optimal point, further increases in MCP will become harmful.

An initial increase of MCP over time is positively associated with a firm's market return (i.e., Srivastava, Shervani, and Fahey 1999). Marketing communication productivity can accelerate cash flows in several ways. Efficient marketing communication investments offer the same levels of sales and brand reputation with less advertising and promotion spending. The saved expenditures, which represent extra working capital, then can be invested in other high net present value projects that address long-term performance (Anderson, Fornell, and Rust 1997; Mittal et al. 2005). Over time, this cost saving and higher productivity may accelerate cash flows (Srivastava, Shervani, and Fahey 1999). Furthermore, because the time for market acceptance may be reduced through learning and the persuasion effects of productive and successful advertising, the product adoption and diffusion rate might be facilitated (Erickson and Jacobson 1992; Vakratsas and Ambler 1999). In addition, superior marketing communication programs build customer equity, which leads to higher future repurchases and margins (Keller 1998; Keller and Aaker 1993; Rust 1986). Indeed, productive advertising and promotion help promote product awareness, initial product trials, and repeated purchases (Chauvin and Hirschey 1993; Luo and Donthu 2001; Szymanski, Bharadwaj, and Varadarajan 1993). From another perspective, investors may regard an improvement in efficient marketing and advertising expenditures as good news in the financial markets, which can have a positive impact on the long-term implications of future cash flows (e.g., Hiemstra and Jones 1994). Furthermore, productive advertising and sales promotion programs may reduce the vulnerability and volatility of cash flows through reduced brand-switching intentions and decreased customer churn rates (Reichheld 1996; Vakratsas and Ambler 1999). Customers who retain a higher brand identity with the firm tend to be more responsive to future advertising and promotions. Dynamically, this tendency may lead to reduced market risks for the firm (Srivastava, Shervani, and Fahey 1999). Because MCP results that are too low and employed with inefficient and unproductive marketing communications investments mean overspending in advertising and promotions (Aaker and Carman 1982; Rust et al. 2004), the wasted and inefficient resources likely hamper the speed and level of cash inflows to the firm.

Thus far, we have argued that increasing MCP positively affects firms' market returns. However, we expect that this impact may not be strictly linear. Just as in the case of too low MCP with overspending, an extremely high increase of MCP with minimum spending in advertising and promotion programs may not be optimal. As Anderson, Fornell, and Rust (1997, p. 129) point out, because firms that try to achieve high productivity (i.e., reduce labor costs, cut employee training expenditures) experience lowered levels of customer satisfaction, their "future profitability may be threatened." This potential conflict between productivity and customer satisfaction suggests that the unrestricted pursuit of high productivity and efficiency through relentlessly "lean" marketing and advertising expenditures can lead to a backlash that involves compromises and hindrances in customer equity efforts, initiatives to achieve premeditated levels of customer awareness and corporate exposure, and new product innovations (Dutta, Narasimhan, and Rajiv 1999; Szymanski, Bharadwaj, and Varadarajan 1993). These consequences eventually lead to diminished future performance returns of MCP. In addition, because firms tend to enhance productivity by first cutting the expenses that are most wasteful, subsequent efforts to improve MCP by further cutting advertising and promotion expenditures may cause harm over time and lead to reduced market returns. In other words, there is a limit to the positive incremental return to MCP. At the margin, increasing MCP beyond an optimal point may eventually result in negative returns. This line of reasoning for the curvilinear influence of MCP is also supported by recent empirical accounting and finance research, which finds nonlinear relationships between market value and various predictive variables (Byrd and Hickman 1992; Hiemstra and Jones 1994; Ng 2005; Sougiannis 1994). For example, Ng (2005) finds a curvilinear relationship between corporate ownership and Tobin's q. According to Hiemstra and Jones (1994), trading volume has a nonlinear influence on stock returns. Indeed, Hiemstra and Jones argue (p. 1642) that "changes in stock market volatility can only be properly modeled with nonlinear models."

Taken together, this discussion suggests that departing from an optimal point—that is, increases in MCP that are too low or too high—leads to decreases in the forward-looking market value, exhibiting an inverted U-shaped relationship.

> H_1: MCP has an inverted U-shaped influence (positive linear but negative quadratic coefficients) on the forward-looking performance measures of Tobin's q and stock return.

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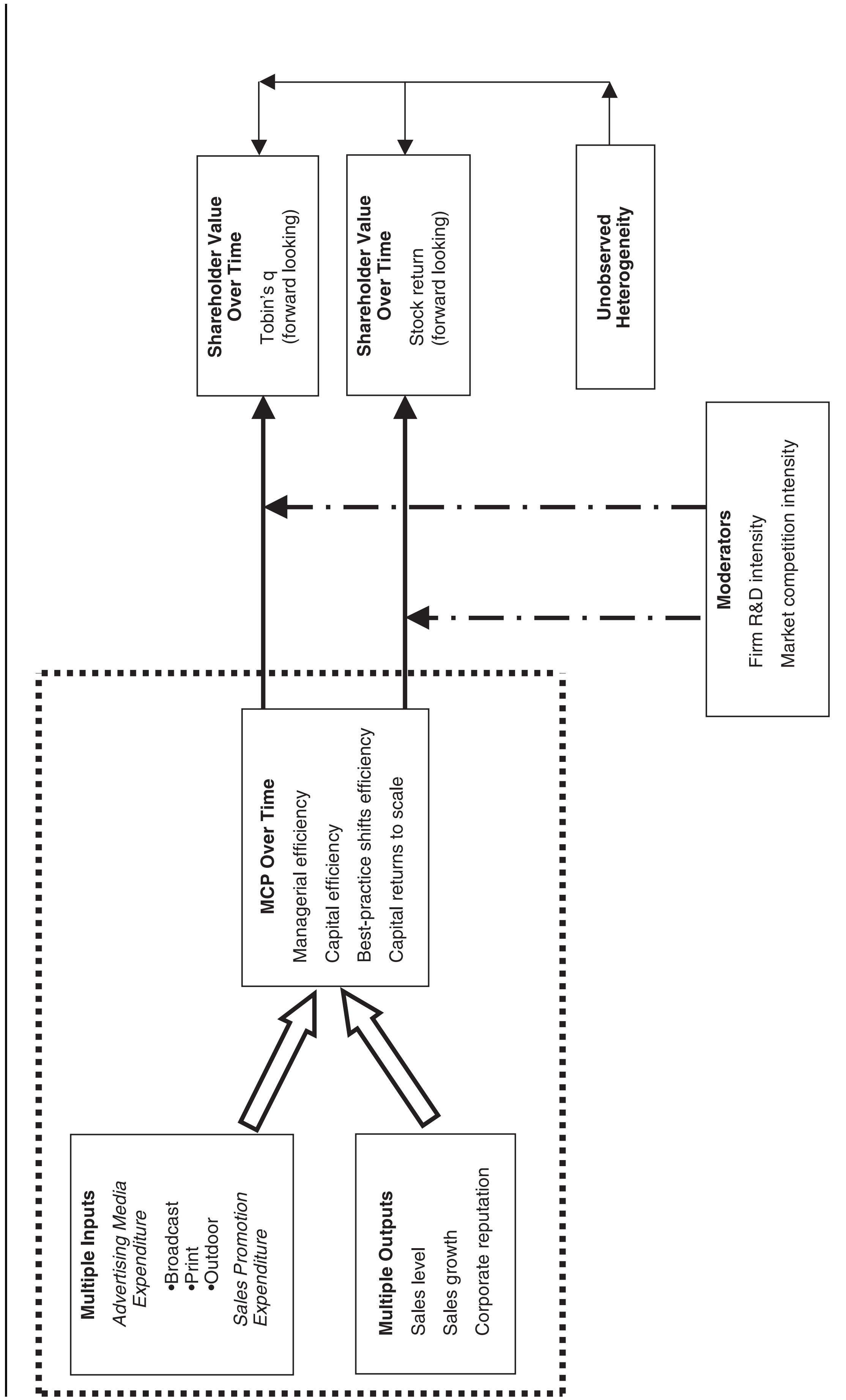
[2]Our MCP modeling approach fits with Penrose's (1959) original work on the RBV, which argues that the process of converting resources determines a firm's competitive advantage more than does the level of resources. In addition, because the RBV pertains to best performances and above-average rents (Hansen, Perry, and Reese 2004), our model coincides with the RBV neatly in that it compares each firm with the best-practices frontiers. Our MCP measures examine the productivity (not level) of advertising and promotion expenditure.

FIGURE 1
A Framework of MCP and Shareholder Value



The Moderating Role of R&D Intensity and Competition

We expect that the association between MCP and shareholder value may not be universal but rather may change according to the organizational context. We turn to the RBV perspective (Barney 1986; Penrose 1959; Wernerfelt 1984) and Srivastava, Shervani, and Fahey's (1998) market asset framework to gather the logic surrounding some moderators of this association.

A firm's R&D intensity may change the strength of the association between MCP and market value. In the literature, R&D and marketing are deemed to be complementary resources (Dutta, Narasimhan, and Rajiv 1999; Srivastava, Shervani, and Fahey 1998). Because the RBV considers firms different bundles and configurations of strategic resources, the synergistic interaction between superior marketing and R&D may create additional long-term value, beyond the direct impact of efficient marketing programs. Productive marketing and advertising investments likely obtain valuable feedback from the market and customers, which facilitates R&D and new product innovations. In turn, this offers enhanced cash flow to the firm. In addition, intense R&D in the new product development process can "ensure speedy and successful commercialization of technologies and products at a low cost" (Dutta, Narasimhan, and Rajiv 1999, p. 551; see also Gupta, Raj, and Wilemon 1987). Thus, superior MCP coupled with higher R&D intensity over time may lead to even greater speed and levels of cash flow, along with lower vulnerability and volatility, which can promote greater market value in the long run (Griffin and Hauser 1996; Srivastava, Shervani, and Fahey 1999). Working from the RBV perspective, Dutta, Narasimhan, and Rajiv (1999) find that R&D capability facilitates the positive influence of marketing capability and brings complementary rents into the firm dynamically, beyond the contribution of superior marketing efficiency alone.

In summary, on the basis of the RBV and prior findings, we suggest that in conjunction with higher R&D intensity in the firm over time, MCP leads to greater firm market value.

H_2: MCP has a stronger influence on the forward-looking performance measures of Tobin's q and stock return in firms with higher (versus lower) R&D intensity.

Finally, we predict that environmental competition intensity expands the complementary rents of MCP and intense R&D, as we state in H_2. In particular, in a competitive market, buyers may choose from more substitutes of products and services. To lock in buyers, firms strategically build brand loyalty and create exit barriers that facilitate the speed and level of their cash flows. Similar to Schumpeter's (1934) notion of continuous entrepreneurial innovations due to market competition, in more competitive markets, firms are motivated (reactively or proactively) to leverage not only efficient advertising programs but also R&D investments over time to dynamically upgrade and renew cash-cow brands to shield themselves from head-to-head competition for more entrepreneurial rents. The more competitive the market, the more firms may rely on marketing and R&D skills simultaneously to ensure the successful commercialization of their existing and new technologies, products, and services (i.e., Griffin and Hauser 1996; Mizik and Jacobson 2003).

In short, the complementary effect of marketing and R&D (Dutta, Narasimhan, and Rajiv 1999) may be expanded in more competitive markets, which would lead to greater cash flows and firm market value. Therefore, it is likely that MCP has the strongest influence on Tobin's q and stock returns when firms have higher R&D intensity *and* operate in highly competitive markets.[3]

H_3: MCP has the strongest influence on the forward-looking performance measures of Tobin's q and stock return in firms that have high R&D intensity *and* are in more competitive markets.

Measuring MCP: The Modeling Process

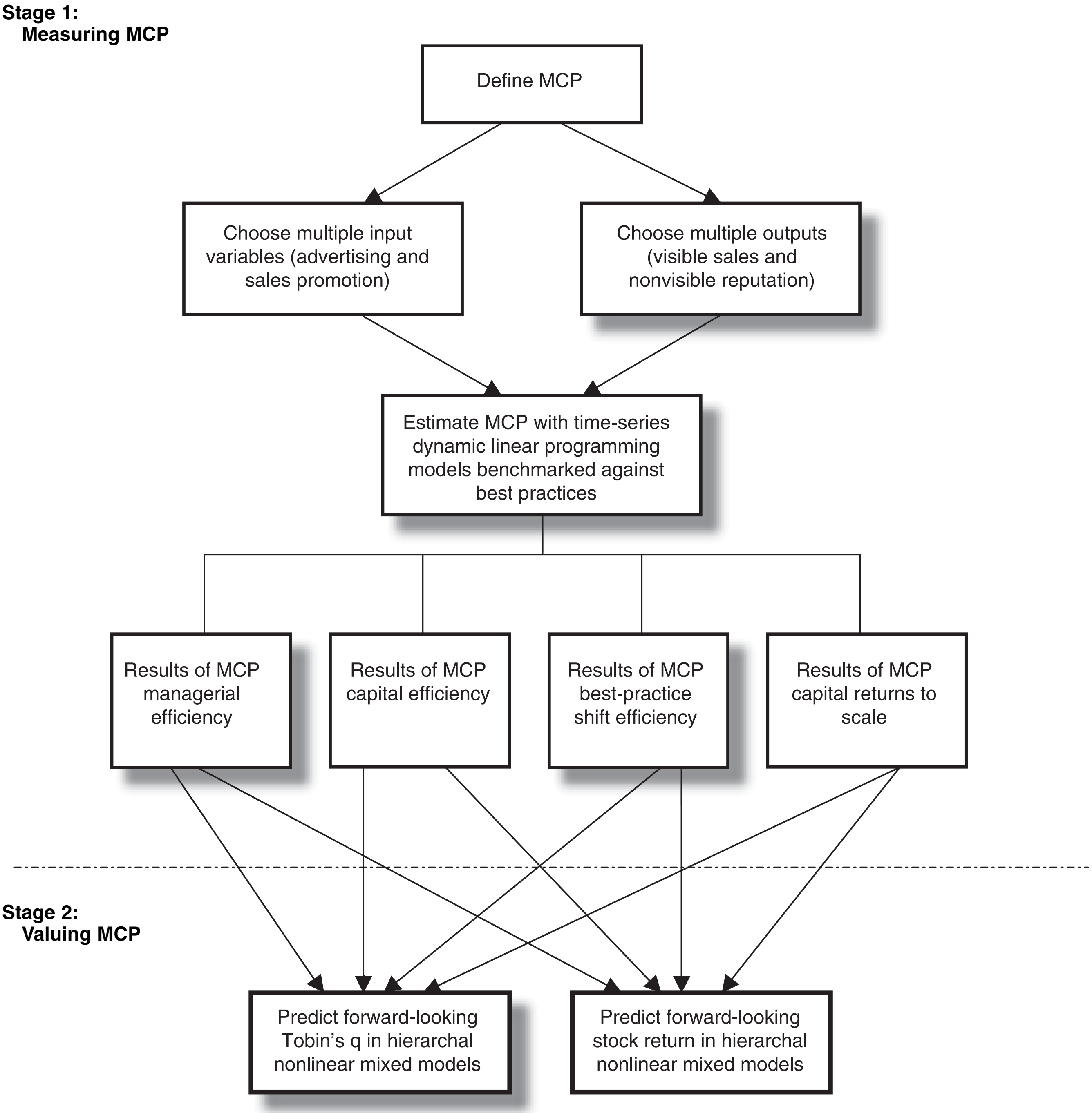
We now detail a process of modeling MCP that is based on the time-series Malmquist approach. We present a flow chart of this process in Figure 2. As we show in the flow chart, there are two significant stages involved in our modeling process. Stage 1 focuses on measuring MCP, and Stage 2 focuses on valuing MCP (as we detail in the "Analyses and Results" section). In Stage 1, we first define MCP as the conversion ratio of marketing communication inputs to outputs, which requires a logical identification of the multiple inputs to multiple outputs.

For the inputs of MCP, we focus on two main categories: advertising media spending and sales promotion expenditures. Advertising media spending includes three dimensions: expenditures in broadcast, print, and outdoor. Specifically, a firm's advertising expenditures in broadcast media equals the sum of television and radio expenditures, including network television spots on ABC, CBS, NBC, Fox, WB, UPN, and Pax TV and television spots on 575-plus stations in the top 100 U.S. markets, which encompasses more than 180 programs per month and 37 cable networks, as well as four radio networks and spot radio spending on 4000 stations in more than 225 markets. The MCP input of advertising expenditures in print media equals the sum of newspaper, magazine, and other expenditures, including more than 140 newspapers in 60 of the top U.S. markets, more than 230 consumer magazines, and Sunday magazines. The MCP input of advertising expenditures in outdoor media is the total expenditures in more than 300 outdoor plant operator markets. Finally, the MCP input of sales promotion expenditures is the sum of spending in sales promotions, direct mail, co-op spending, coupons, catalogs, business and farm publications, and special events.

Next, we specify three outputs of MCP—sales level, sales growth, and corporate reputation—because marketing communication expenditures influence these outcomes simultaneously. Note that measuring the sales level requires an approach to control the influence of other relevant variables and carryover effects of advertising and marketing

[3]Although the main effects of competition may be positive or negative, we investigate only the moderating effect.

FIGURE 2
MCP Methodology Flow Chart



expenditures (i.e., Kim, Bhargava, and Ramaswami 2001; Vakratsas and Ambler 1999), as we discuss subsequently. The MCP output of sales growth is the three-year compounded annual growth rate of sales in the primary Standard Industrial Classification of the firm (Rao, Agarwal, and Dahlhoff 2004). The MCP output of corporate reputation is defined as the firm's overall appeal to the public and is based on its historical actions and future prospects (McGuire, Schneewels, and Branch 1990; Roberts and Dowling 2002). According to *Fortune* (2005), this variable assesses the perceived reputation of the large U.S. firms and is based on the research of more than 10,000 financial analysts and investors.

After we specify the inputs and outputs of MCP, we introduce the dynamic Malmquist approach to estimate MCP. The intuition of this approach is that firms attempt to consume the least possible amount of inputs to achieve the same level of desired outputs from time t to time t + 1. If a firm cannot reduce its inputs (i.e., use fewer resources) without hurting its output levels, it is considered productive over time. Otherwise, it is unproductive and inefficient. Thus, productive firms as a whole represent the so-called best-practice frontier that dynamically benchmarks each firm's MCP in the transformation of inputs into outputs (Färe et al. 1992; Luo 2004).

To calculate MCP from t to t + 1 for each firm, Malmquist (1953) initially developed dynamic models to assess the total factor productivity of general economic activities over time. Later, Färe and colleagues (Färe et al. 1992; Färe, Grosskopf, and Lovell 1994) constructed the time-series linear programming (or data envelopment analysis [DEA] –based) Malmquist productivity index.[4] As we show in the Appendix, this measure of MCP for each firm can be calculated using two single-period and two mixed-period efficiencies based on DEA programming (Banker, Charnes, and Cooper 1984; Charnes, Cooper, and Rhodes 1978). To the best of our knowledge, the literature has provided no time-series applications of the DEA-based Malmquist approach to measure and value the various components of MCP (for technical details and numeric examples of DEA, see Horsky and Nelson 1996; Luo and Donthu 2005; Murthi, Srinivasan, and Kalyanaram 1996; see also the Appendix).

The Malmquist approach is well suited for measuring MCP and tracking its changes over time because of its methodological advantages. First, it can estimate the productivity of marketing communication expenditures "without a priori information on tradeoffs among inputs and outputs" (Chen and Ali 2004, p. 239). This is advantageous because the function of market responses to advertising and promotions is conflicting and inconclusive (Strong 1925; Vakratsas and Ambler 1999). In addition, some advertising expenditures are intended to promote corporate brands, whereas others are intended to increase sales revenue, and still others aim for a little bit of both. Therefore, without prior knowledge about which part of the advertising and marketing expenditure produces which part of the outputs, the Malmquist approach is very suitable. Second, unlike regression techniques that use one output at a time (Caves, Christensen, and Diewert 1982), Malmquist models are not limited by the number of outputs, which is desirable for measuring MCP because marketing communications can achieve multiple outcomes (i.e., visible outcomes, such as sales, and invisible outcomes, such as reputation) at the same time.[5] Third, the time-series nature of Malmquist modeling offers an advantage for benchmarking MCP because advertising and sales promotion expenditures have lagged and carryover effects; outcomes may unfold over a long period in the marketplace (Färe et al. 1992).

The Malmquist approach also fits well with the RBV of the firm (e.g., Barney 1986; Penrose 1959). According to Penrose (1959), a firm's best practices in the process of converting resource inputs to outputs (or MCP in our context) ultimately determine firm performance, not just the levels of those inputs. Hansen, Perry, and Reese (2004, p. 1280) recently acknowledged that "RBV is fundamentally a theory about extraordinary performers or outliers. The statistical methods used in applying the theory must account for individual firm differences, but should not be based on means, which statistically neutralize firm difference." The Malmquist approach is just such a method and identifies best-practice frontiers and benchmarks MCP at the individual level.

The final step in Stage 1 is to decompose the overall MCP into several subcomponents across firm-year observations (see the Appendix). Intuitively, the first dimension of MCP reflects the change of MCP from time t to t + 1 in terms of managerial efficiency, which we label MCP1 (i.e., the effects of moving toward the best-practice frontiers). This efficiency represents how much improvement in MCP can be achieved if managers enhance their skills of managing marketing communication programs compared with the best practices. Another dimension is the change of MCP from time t to t + 1 in terms of capital efficiency, which we label MCP2 (i.e., the effects of moving between the best-practice frontiers with different returns-to-scale model specifications). This efficiency represents how much improvement in MCP can be achieved if managers can promote the economies of scale when using marketing communication capitals. It also offers a dimension that represents the change of MCP from time t to t + 1 in terms of best-practice shift efficiency, which we label MCP3 (i.e., the effects of moving away from the best-practice frontiers from t to t + 1). This efficiency indicates how much improvement in MCP can be achieved through factors that are unrelated to marketing communication managerial skills but are associated with intertemporal, uncontrollable variables, such as industry changes, communication innovations, and environmental variables. Finally, the dimension of returns to scale of marketing communications capital (i.e., the effects of moving along the best-practice frontiers) is a categorical variable that can be increasing, constant, or decreasing. We create two dummy variables (MCPd1 and MCPd2) for these three kinds of returns to scale.

Next, we describe the multiple sources of secondary data we collected to measure MCP. Then, we present the analysis approach in Stage 2, which investigates the value of MCP by relating its subdimensions to Tobin's q and stock returns.

Data and Measures

We obtained data on the advertising and promotions expenditures, sales revenue, corporate reputation, Tobin's q, stock return, accounting profitability, and firm characteristics

[4]Compared with parametric alternatives such as stochastic frontier, thick frontier, distribution-free analyses, and translog specification, the Malmquist linear programming estimates are more stable in Monte Carlo simulation studies (e.g., McAllister and McMannus 1993) and offer richer managerial implications (e.g., Luo 2004; Luo and Donthu 2005; Wheelock and Wilson 1999).

[5]Although multivariate analysis methods such as canonical correlation can deal with multiple outputs and inputs, they are essentially parametric approaches that assume normal distribution and central tendency (i.e., they compare with average performers rather than best practices). In addition, canonical correlation can estimate only one set of coefficients across all firms and thus produce, at best, only one index of MCP for each firm (cf. the Malmquist approach offers a more complete understanding of different facets of MCP). We thank an anonymous reviewer for highlighting this point.

variables from multiple archived sources. Specifically, we collected secondary data from four sources: COMPUSTAT, Competitive Media Reporting (CMR), the *Fortune* reputation index, and the Center for Research in Security Prices (CRSP). To evaluate the contribution of MCP to firms' market value, we selected the large publicly traded *Fortune* 1000 companies (and the top marketers and advertisers) for eight consecutive years (1995–2002). We report the details of the cross-sectional time-series databases and the variables in Table 1.

To estimate MCP over time, we need data for the four marketing communication expenditure inputs (i.e., in broadcast, print, outdoor, and sales promotion) and three outputs (sales level, sales growth, and corporate reputation). The MCP input variable data come from the CMR archives, which offer fairly comprehensive information about the breakdown of advertising and promotion expenditures by the large firms in top markets (e.g., Anderson, Fornell, and Mazvancheryl 2004; Rao, Agarwal, and Dahlhoff 2004). Although COMPUSTAT also offers information on advertising and sales expenditures, many data points are missing because firms are not required to report this type of expenditure (see Joseph and Richardson 2002). In addition, unlike the CMR data set, COMPUSTAT does not break down advertising expenditure data into different types of media spending.

For MCP output variables, we first used sales level that has controlled the carryover effects of advertising (i.e., Chauvin and Hirschey 1993; Vakratsas and Ambler 1999) and the impact of other relevant factors, such as R&D, firm size, and competition.[6] Specifically, we employed the following functions:

$$(1)\qquad SALES_t^{\sim} = SALES_t - SALES_{t\_predicted}, \text{ where}$$

$$\begin{aligned} SALES_{t\_predicted} = {} & a + b_0 SALES_{t-1} + b_1 \times iADV_{t-1} \\ & + b_2 \times RD_t + b_3 \times RD_{t-1} + b_4 \times SIZE_t \\ & + b_5 \times SIZE_{t-1} \\ & + b_6 \times \text{Focus of FIRM}_t \\ & + b_7 \times \text{Focus of FIRM}_{t-1} \\ & + b_8 \times \text{competition}_t + b_9 \times \text{competition}_{t-1} \\ & + e. \end{aligned}$$

COMPUSTAT provided data for the book value of total assets, sales revenue, R&D intensity, firm size, the focus of the firm, industry competition intensity, and other such variables. Firm size is the log of the number of employees, and focus of the firm is the number of industry segments in which the firm operates (Rao, Agarwal, and Dahlhoff 2004). In line with prior literature in marketing and management (i.e., Anderson, Fornell, and Mazvancheryl 2004; Fischer and Pollock 2004), we measured industry competition intensity using the Herfindahl concentration index, which we derived from COMPUSTAT. A low degree of concentration indicates that the marketplace is fragmented and competition intensity is high. We measure R&D intensity as the ratio of R&D spending to total assets for each firm-year observation (Anderson, Fornell, and Mazvancheryl 2004), which we also derived from the COMPUSTAT database.

The second output variable is sales growth, which we also derived from the COMPUSTAT data set and calculated as the three-year compounded annual sales growth rate rather than a simple growth rate, such as $sales_t$ versus $sales_{t-1}$ (Rao, Agarwal, and Dahlhoff 2004). Sales growth could be measured with a simple two-year-based growth rate (t versus t – 1). However, to be more parsimonious, we measured sales growth on the basis of the three-year compounded rate (t versus t – 1 and t – 2). Because this compounded rate is essentially a "smoothed" rate of growth, it has relatively fewer concerns, such as the possible existence of some random dramatic shocks. In general, the compounded annual sales growth rate (t versus t – 1 and t – 2) is preferred to a simple growth rate (t versus t – 1) in both marketing and accounting literature (see Rao, Agarwal, and Dahlhoff 2004).

We obtained data for the final MCP output variable, corporate reputation, from the annual reputation survey of the most admired U.S. corporations (Houston and Johnson 2000; Roberts and Dowling 2002). This measure of perceived overall reputation of the largest U.S. firms uses an 11-point scale (0–10) to assess eight indicators (innovativeness, employee talent, social responsibility, long-term investment value, financial soundness, use of corporate assets, quality of management, and quality of products and services; see *Fortune* 2005). *Fortune* surveys more than 10,000 executives, directors, and securities analysts every year.

Many prior studies have successfully used this corporate reputation score in both marketing and strategy (Houston and Johnson 2000; Roberts and Dowling 2002). In particular, McGuire, Scheeweis, and Branch (1990, p. 170) note that the "*Fortune* reputation is one of the *most comprehensive* and widely circulated surveys of attributes available [for measuring reputation]. Both the quality and number of respondents are comparable or superior to the 'expert panels' usually gathered for such purposes." Thus, research across disciplines seems to accept this best-available measure of corporate reputation. However, because it has been noted that the *Fortune* reputation measure depends on financial performance (e.g., Aaker and Jacobson 2001), we also address this reverse-causality issue in our analyses, as we discuss subsequently, using the approach that Roberts and Dowling (2002) recommend.[7]

[6]Conceptually, it is important to have a "clean" measure of sales level when examining the relevant contribution of marketing expenses at a given point of time. That is, we need to tease out the impact of many other variables and carryover effects of marketing communication expenditures. Dutta, Narasimhan, and Rajiv (1999) use a similar approach to adjust their output variable when evaluating capability efficiency (MCP productivity in our context).

[7]To control the reverse-causality issue between financial performance and corporate reputation (Aaker and Jacobson 2001), we adopted the approach that Roberts and Dowling (2002) recommend. As we discussed in the "Additional Analyses" subsection, our results hold after accommodating this reverse-causality concern. We thank an anonymous reviewer for this point.

TABLE 1
Measures and Data Sources

Measure	Operationalization	Data Sources	Period
MCP	A longitudinal linear-programming-based ratio of multiple outputs (sales revenue, market growth, and corporate reputation) to multiple inputs (broadcast, print, outdoor, and sales promotion expenditures)		1995–2002
Forward-looking performance of Tobin's q	The result of ([share price × number of common stock outstanding + liquidating value of the firm's preferred stock + short-term liabilities – short-term assets + book value of long-term debt]/book value of total assets)	Derived from CRSP and COMPUSTAT	1994–2003
Forward-looking performance of stock return	The result of (current year's share price × number of common stock outstanding + dividends – previous year's share price × number of common stock outstanding/[previous year's share price × number of common stock outstanding])	Derived from CRSP and COMPUSTAT	1994–2003
Backward-looking performance of return on assets	The ratio of net income before extraordinary items to assets	Derived from COMPUSTAT	1995–2002
Sales level	Adjusted for advertising and marketing carryover effect, R&D contemporary and carryover effect, competition justification effect, and firm-size effect	Derived from COMPUSTAT	1994–2003
Sales growth	The compounded annual sales growth rate over the previous three years	Derived from COMPUSTAT	1993–2003
Corporate reputation	*Fortune* reputation index (corporate reputation based on an annual survey of the most admired U.S. corporations)	*Fortune*	1995–2002
Advertising broadcast expenditure	The sum of television and radio expenditures, such as in network television spots on ABC, CBS, NBC, Fox, WB, UPN, and Pax TV and spot television on 575-plus stations in the top 100 U.S. markets; more than 180 syndicated television programs per month, 37 cable networks, and four radio networks and spot radio spending from 4000 stations in more than 225 markets	CMR	1995–2002
Advertising print expenditure	The sum of newspaper, magazine, and print other expenditures including 140-plus newspapers in 60 of the United States' top markets; monitors space in national newspapers, including *The Wall Street Journal*, *USA Today*, and *The New York Times*; 230-plus consumer magazines and Sunday magazines	CMR	1995–2002
Advertising outdoor expenditure	The sum of more than 300 outdoor plant operator markets	CMR	1995–2002
Sales promotion expenditure	The sum of spending in sales promotion, direct mail, co-op spending, couponing, catalogs, business and farm publications, and special events	CMR	1995–2002
Competition intensity	Herfindahl concentration index (derived by using the lagged sales for all the companies in the same two-digit Standard Industrial Classification code for each firm-year observation)	Derived from COMPUSTAT	1994–2002
R&D intensity	R&D expenditure/book value of total $asset_{t-1}$	COMPUSTAT	1994–2002
Firm size	Number of employees	COMPUSTAT	1995–2002
Focus of the firm	Number of industry segments the firm operates	COMPUSTAT	1995–2002

Because we tried to merge data from these different sources and each source has some missing values, our sample size was reduced. After searching other sources, such as Standard & Poor's industry reports, *AdWeek*, Moody's report, Compact Disclosure, and company annual reports, we obtained complete data on 89 companies. As a result, we have 712 data points across the firms from 1995 to 2002.

In line with the work of Jacobson and colleagues (Aaker and Jacobson 1994, 2001; Mizik and Jacobson 2003), we derived the forward-looking performance measures of stock return using both the COMPUSTAT and the CSRP databases. Tobin's q, which is comparable across industries (Anderson, Fornell, and Mazvancheryl 2004; Dutta, Narasimhan, and Rajiv 1999), offers another forward-looking measure of firm market value. We followed prior marketing studies (Lee and Grewal 2004; Rao, Agarwal, and Dahlhoff 2004) to calculate Tobin's q for each firm-year observation. In computing the stock return and Tobin's q, we also controlled for the influence of return on assets (ROA; see Chauvin and Hirschey 1993; Erickson and Jacobson 1992), which we measure as the ratio of net income before extraordinary items to assets, which we derived from COMPUSTAT.

Analyses and Results

Results of Measuring MCP

Because we wanted to benchmark and track the longitudinal changes of several different dimensions of MCP over time, we estimated 39,872 linear programs (4 efficiency models × 2 returns to scale × 712 data points × [8 – 1] years) to derive the MCP components for the sample. In addition, following Färe, Grosskopf, and Lovell's (1994) approach, we ran 22,784 additional linear programming models to determine the returns to scale of marketing expenditure.[8] We summarize the results of the subdimensions and the overall MCP in Table 2. The interpretation of the results is that when MCP > 1 (for MCP dimensions and overall MCP), MCP improves from t to t + 1; when MCP = 1, no change occurs; and when MCP < 1, MCP decreases from t to t + 1.

Our data suggest that MCP improved over time, as we show in Table 2. Overall MCP was stable during 1995–1998, but it increased steeply during 1998–2001. For the individual dimensions of MCP, we observed an overall trend of improved managerial efficiency (MCP1) and dramatic increases (with a peak) in 2000–2001. The capital efficiency of marketing communications expenditure (MCP2) slightly increased during 1995–1999 but then decreased during 1999–2002. In addition, the best-practice shift efficiency (MCP3) seemed to increase over time but decreased during 1997–1998 and 1999–2000. Therefore, both managerial and best-practice shift efficiency seem to be the drivers of the improvement of the firms' overall MCP over time in this sample.

We also break down the overall results of MCP according to the different contextual factors in terms of firm differences in R&D spending and market competition intensity. As we present in Figure 3, Panel A, firms with high R&D intensity tend to have sustained, superior MCP during the 1995–2002 period, especially between 2000 and 2001. There is a significant difference between the high- and the low-R&D groups (with a median split) in their overall MCP changes over time (t = 4.82, $p < .05$). In support of the literature that suggests that high R&D intensity is important for firm performance (e.g., Dutta, Narasimhan, Rajiv 1999; Gupta, Raj, and Wilemon 1987; Rust, Moorman, and Dickson 2002), this finding indicates that it is also positively related to an intermediary marketing outcome of MCP. Furthermore, it supports the recent theoretical argument about the need to investigate intermediary measures of marketing productivity (Rust et al. 2004).

For market competition intensity, as we show in Figure 3, Panel B, the results indicate a significant difference between the high- and the low-competition groups (with a median split) in their overall MCP changes over time (t = 5.29, $p < .05$). Although low competition intensity is associated with higher overall MCP for the most part, during 2000–2002, high market competition is related to improved overall MCP. Because Malmquist MCP results are linear-programming-based nonparametric results, we report both Spearman and Pearson correlation results of the variables in Table 3.

Results of Valuing MCP

Hypotheses testing approach. To test H_1–H_3, we employ a hierarchal nonlinear mixed model to control for unobserved heterogeneity and unmeasured nuances in the effects of MCP on shareholder value. Prior studies suggest that for cross-sectional time-series data, large variance may be due to the unobserved heterogeneity in firm-level factors, such as marketing managerial expertise, and time-level factors, such as changes in consumer learning and industry trends over time (Boulding and Staelin 1993; Jacobson 1990). In particular, Jacobson (1990, p. 94) warns that "models and methods that ignore unobservable factors and disregard the consequences of neglecting their effects … generate insidious results." However, because there is no single ideal model recommended to control for the unobservable effects (e.g., Baltagi 2001; Boulding 1990; Grilliches and Hausman 1986; Murthi, Srinivasan, and Kalyanaram 1996), we specify the following nonlinear mixed model to account for two-way (firm and year) random effects with the dependent variables of Tobin's q:[9]

$$(2)\quad \begin{aligned} \text{Tobin's } q_{it} = {} & \mu + \beta_1 \times \text{MCP1}_{it} + \beta_2 \times \text{MCP2}_{it} \\ & + \beta_3 \times \text{MCP3}_{it} + \beta_4 \times \text{MCPd1}_{it} \\ & + \beta_5 \times \text{MCPd2}_{it} + \beta_6 \times \text{CPI}_{it} + \beta_7 \times \text{RD}_{it} \\ & + \beta_8 \times \text{ROA}_{it} + \Sigma\beta_{inter}\text{Interactions}_{it} \\ & + \Sigma\beta_{squar} \times \text{MCP-squared}_{it} \\ & + \Sigma\beta_{intsq} \times \text{MCP-squared} \times \text{Interactions}_{it} \\ & + \Sigma\beta_{cova}\text{Covariates}_{it} + \varepsilon_{it} + \zeta_i + \Omega_t, \end{aligned}$$

[8]We need only two dummy variables for the three different returns to marketing communications expenditures: increasing, constant, and decreasing. The decreasing-returns case is the base in the dummies.

[9]We also tried to specify the model with cubic terms of MCP dimensions but failed to find significant coefficients.

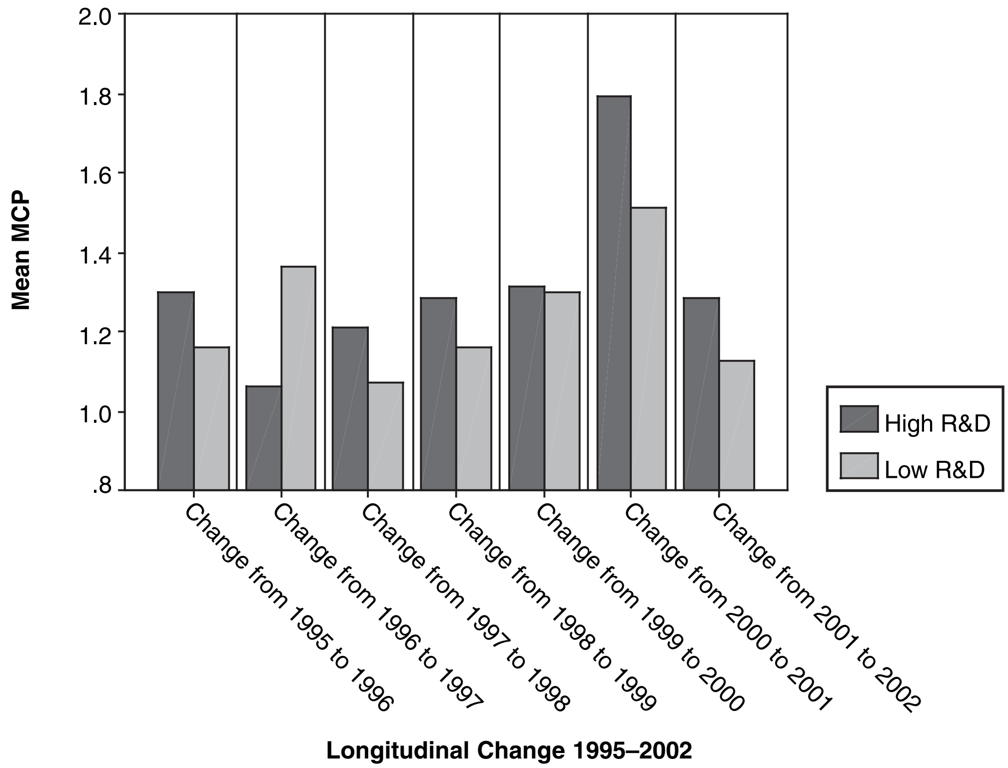
TABLE 2
MCP Summary Statistics

	Overall Productivity Change: 1995–2002	Productivity Change: 1995–1996	Productivity Change: 1996–1997	Productivity Change: 1997–1998	Productivity Change: 1998–1999	Productivity Change: 1999–2000	Productivity Change: 2000–2001	Productivity Change: 2001–2002
MCP: Overall	1.282	1.231	1.213	1.141	1.223	1.307	1.652	1.207
	(.823)	(.699)	(.754)	(.603)	(.604)	(.642)	(1.479)	(.480)
MCP1: Managerial efficiency	1.106	1.204	1.041	1.212	1.093	.948	1.301	.939
	(.599)	(.515)	(.560)	(.760)	(.288)	(.324)	(.996)	(.290)
MCP2: Capital efficiency	1.012	1.014	1.022	1.018	1.070	.990	.990	.983
	(.244)	(.190)	(.288)	(.213)	(.300)	(.117)	(.225)	(.314)
MCP3: Best-practice shift	1.197	1.035	1.205	.961	1.094	1.386	1.283	1.412
	(.406)	(.367)	(.333)	(.237)	(.491)	(.348)	(.333)	(.455)

Notes: MCP > 1 indicates that MCP increased from t to t + 1; MCP < 1 indicates that MCP decreased from t to t + 1; MCP = 1 indicates that MCP did not change from t to t + 1. Entries in parentheses are standard errors.

FIGURE 3
MCP Longitudinal Changes

A: R&D Breakdown



B: Competition Breakdown

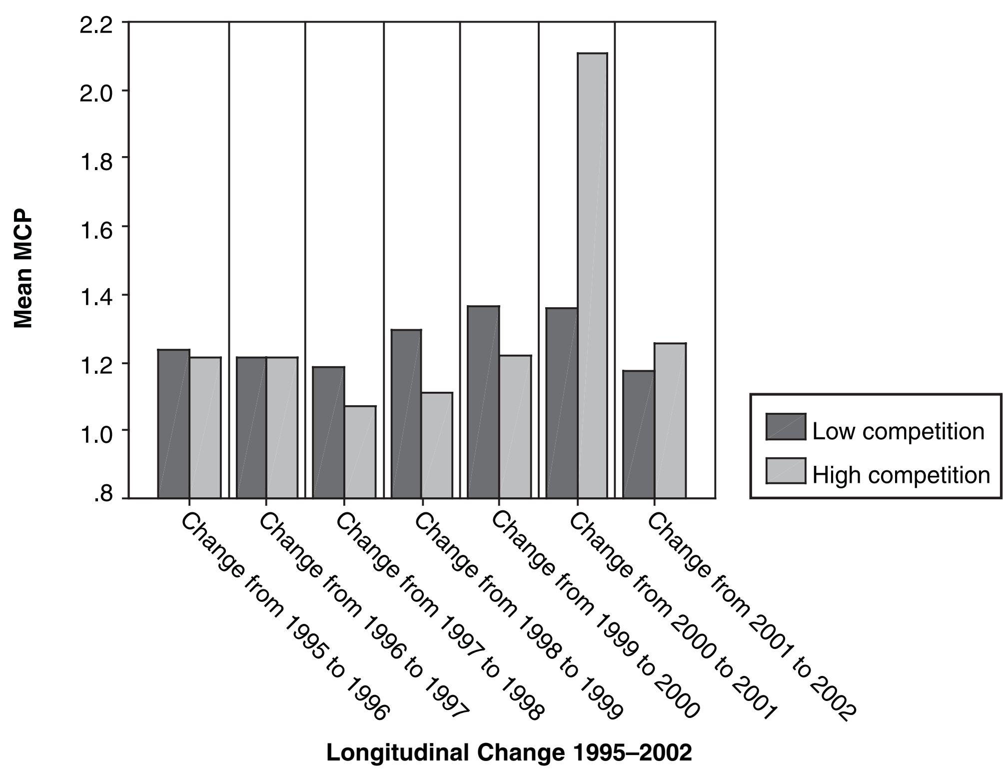


TABLE 3
Parametric and Nonparametric Correlations

	X1	X2	X3	X4	X5	X6	X7	X8	X9
MCP best-practice shift (X1)	1.00	.09*	–.02	.15**	.17**	.03	.18**	.03	.09*
MCP managerial efficiency (X2)	.23**	1.00	.10*	–.12**	.10*	.13**	.09*	.14**	–.01
MCP capital efficiency (X3)	–.09*	.02	1.00	–.04	.14**	.07	.12**	–.03	–.05
MCP returns to scale (X4)	.19**	–.14**	–.02	1.00	.11*	–.04	.10*	.17**	.13**
Tobin's q (X5)	.18**	.10*	.13**	.12**	1.00	.06	.32**	.11**	.11**
ROA (X6)	.06	.11*	.06	–.03	.04	1.00	.18**	.03	.09*
Stock return (X7)	.18**	.10*	.11*	.13**	.35**	.19**	1.00	.10*	.08
Market competition intensity (X8)	.05	.08*	–.06	.15**	.09*	.02	.14**	1.00	.20**
R&D intensity (X9)	.10*	–.07	–.04	.13**	.10*	.10*	.09*	.21**	1.00

*$p < .05$.
**$p < .01$.
Notes: The entries above the diagonal are Pearson parametric correlations, and the entries below the diagonal are Spearman nonparametric correlations.

where

MCP1 = the managerial efficiency dimension of MCP;
MCP2 = the capital efficiency dimension of MCP;
MCP3 = the best-practice shift efficiency dimension of MCP;
MCPd1 = MCP scale dummy 1 with increasing returns to scale;
MCPd2 = MCP scale dummy 2 with constant returns to scale;
MCP-squared = the quadratic terms of MCP1, MCP2, and MCP3;
CPI = competition intensity;
RD = R&D intensity;
ROA = accounting backward-looking performance of ROA;
Interactions_{it} = interaction terms for firm i at time t, or interactions among R&D intensity, competition intensity, and dimensions of MCP; they include all two-way and three-way interactions;
MCP-squared × Interactions_{it} = interaction terms among quadratic terms of MCP1, MCP2, and MCP3, all above two- and three-way interactions for firm i at time t;
Covariates_{it} = covariates for firm i at time t, such as ROA, firm size, focus of the firm, business type, and market service type;
μ = the overall grand intercept;
β_i = the influence of ith explanatory variables;
ε_{it} = the disturbance term, normally and independently distributed with a constant variance σ^2;
ζ_i = the random disturbance of ith firm, constant across periods and normally and independently distributed with a constant unknown variance σ^2_ζ; and
Ω_t = the random disturbance of tth year, constant across firms and normally and independently distributed with a constant unknown variance σ^2_Ω.

We summarize the results in Table 4. The mixed model estimates indicate that for the forward-looking performance of Tobin's q, firm random effects have a substantial intraclass correlation coefficient of 19.68% (8.30/[28.25 + 8.30 + 5.62]). Thus, unobserved/omitted firm factors may account for as much as 19.68% of the variance of Tobin's q, according to the variance structure distribution of the three types of errors in Table 4 (Baltagi 2001). Unobserved time random effects are also significant and account for approximately 13.32% of the variance of Tobin's q. These results imply that to reduce omitted variable bias, an analysis of the cross-sectional time-series panel data should not ignore the issue of unobserved heterogeneity and the influence of omitted variables (e.g., Arellano 2003; Boulding and Staelin 1993).

Hypotheses testing results. The findings provide some support for H_1: MCP has an inverted U-shaped influence on the forward-looking performance. As we show in Table 4, marketing communication managerial efficiency positively influences forward-looking Tobin's q (MCP1: t = 3.87, $p < .01$), and too much improvement in MCP1 negatively influences Tobin's q. The squared term of MCP1 is negative and significant (MCP1-squared: t = –3.51, $p < .01$), thus suggesting an inverted U-shaped relationship. Similarly, marketing communication best-practice shift efficiency has a positive influence on Tobin's q (MCP3: t = 2.86), but too great an increase of this efficiency has a negative influence (MCP3-squared: t = –2.36, $p < .05$), as we expected.

H_2 predicted that MCP would have a stronger positive influence on Tobin's q in firms with higher R&D intensity. As we show in Table 4, when coupled with higher R&D intensity, positive changes in marketing communication managerial efficiency (MCP1 × R&D: t = 2.23, $p < .05$) and best-practice shift efficiency (MCP3 × R&D-related: t = 1.66, $p < .1$) lead to higher Tobin's q for the firm. Thus, H_2 is supported for the Tobin's q model, which not only adds

TABLE 4
MCP and Shareholder Value

Variables	ROA: Backward Looking β	(t)	Tobin's q: Forward Looking β	(t)	Stock Return: Forward Looking β	(t)
MCP Dimensions						
MCP1 (managerial efficiency)	7.67	(3.81***)	8.06	(3.87***)	9.28	(4.03***)
MCP2 (capital efficiency)	8.65	(1.86*)	12.21	(3.09***)	12.16	(3.15***)
MCP3 (best-practice shift)	3.73	(1.22)	7.98	(2.86**)	12.73	(3.61***)
MCPd1 (dummy1)	.27	(.98)	5.36	(1.92*)	7.87	(2.52**)
MCPd2 (dummy2)	.13	(.60)	3.55	(1.61)	3.03	(1.31)
Competition intensity (CPI)	8.11	(.83)	13.86	(2.57**)	19.31	(2.82**)
R&D intensity (R&D)	5.62	(1.81*)	7.33	(2.19**)	6.07	(1.85*)
Interactions						
MCP1 × R&D			6.86	(2.23**)	7.22	(2.36**)
MCP2 × R&D	12.45	(3.21***)				
MCP3 × R&D	6.76	(2.62**)	3.32	(1.66*)		
MCP1 × CPI			14.19	(3.57***)	10.42	(2.87**)
MCP2 × CPI			12.11	(2.92**)	13.75	(3.26**)
MCP3 × CPI	4.88	(3.97***)				
MCP1 × R&D × CPI			16.82	(3.84*)	15.20	(3.58***)
MCP3 × R&D × CPI			18.32	(6.18**)		
Curvilinear Terms						
MCP1-squared	16.29	(4.15***)	–15.37	(–3.51***)	–11.76	(–2.21**)
MCP3-squared			–9.28	(–2.36**)		
MCP1-squared × R&D	19.86	(5.86***)	–11.84	(–2.27**)		
MCP1-squared × CPI					–9.45	(–1.83*)
MCP2-squared × CPI			–18.53	(–3.36***)		
MCP1-squared × R&D × CPI			–27.71	(–2.25**)		
ROA	—	—	1.28	(2.31**)	1.87	(4.15***)
Firm size	.01	(.53)	.00	(.22)	.00	(.36)
Markets service types	–.08	(–2.52**)	–.36	(–1.70*)	–.32	(–1.69*)
Business types	–.02	(–1.69*)	–.01	(–.78)	–.03	(–.82)
Focus of the firm	–.03	(–1.23)	–.00	(–.05)	–.04	(–.18)
σ_ε	8.25	(11.32***)	28.25	(35.54***)	26.29	(33.77***)
σ_ζ	1.03	(2.40**)	8.30	(9.33***)	9.12	(11.18***)
σ_Ω	2.16	(3.55**)	5.62	(6.71***)	6.42	(7.21***)
–2 log-likelihood	1726.042		1236.153		1339.145	
Akaike's information criterion	1732.139		1239.347		1344.207	
Hurvich and Tsai's criterion	1732.203		1239.353		1344.283	
Bozdogan's criterion	1741.116		1246.028		1358.411	
Schwarz's Bayesian information criterion	1739.187		1243.125		1352.395	

*$p < .10$.
**$p < .05$.
***$p < .01$.
Notes: MCPd1 = increasing returns (dummy1), MCPd2 = constant returns (dummy2), and the base is decreasing returns to marketing communications expenditures; we do not show nonsignificant interaction terms. Bayesian information criterion imposes a severe penalty for more complicated model specifications. In the stock return model, ROA = unanticipated ROA (or time-series residuals), and MCP measures are all unanticipated residuals because of the efficient-markets rationale from the accounting literature. Because stock return is different from Tobin's q, we used the differences of MCP (or unanticipated MCP) for stock return model and used the levels of MCP for the Tobin's q model.

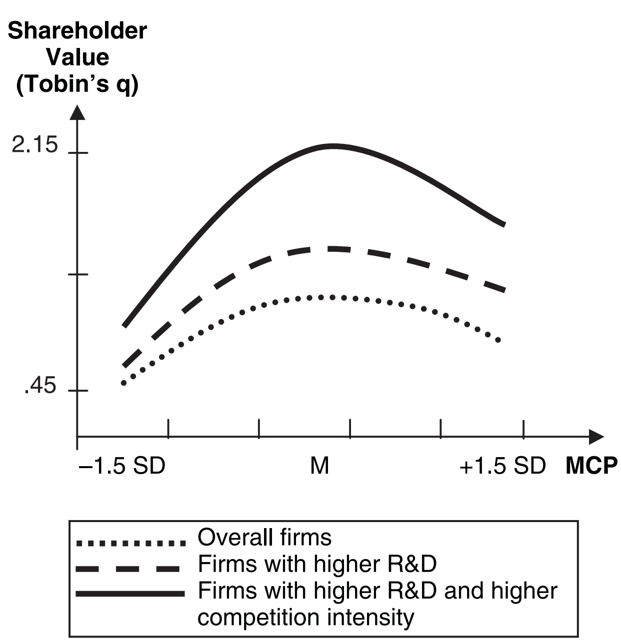
evidence of the complementary rents of marketing and R&D (Dutta, Narasimhan, and Rajiv 1999; Griffin and Hauser 1996; Gupta, Raj, and Wilemon 1987; Hayes, Wheelwright, and Clark 1988) but also supports the RBV that marketing and R&D resources should be configured as performance-enhancing bundles.

To test H_3, that MCP has the strongest influence on market value in firms that have higher R&D intensity *and* function in more competitive markets, we created three-way interaction terms among MCP dimensions, R&D, and competition intensity. As we show in Table 4, two of the three-way interactions are positive and significant (MCP1 × R&D × CPI: t = 3.84, $p < .01$; MCP3 × R&D × CPI: t = 6.18, $p < .01$), which indicates that a firm's Tobin's q is greater when the firm excels in MCP and R&D and operates in competitive markets over time. This finding suggests that in a competitive market, firms that have higher R&D and efficiently invest in their marketing communication programs are most likely to obtain sustainable competitive advantages dynamically (see Dutta, Narasimhan, and Rajiv 1999; Srivastava, Shervani, and Fahey 1998).

Because we hypothesized the impact of MCP as curvilinear relationships in H_1, we also include the product terms between the moderators (R&D and competition intensity) and the quadratic form of the MCP dimensions. As we show in Table 4, we find some interesting results. For example, because the linear × quadratic interaction terms (MCP1-squared × R&D and MCP2-squared × CPI: t = –2.27 and –3.36, respectively) are significant and negative, we conclude that overly high levels of MCP harm the firm's Tobin's q to a greater degree if the firm has greater R&D and/or operates in more competitive markets. This conclusion is also confirmed by the negative three-way linear × quadratic interaction term (MCP1-squared × R&D × CPI: t = –2.25). Overall, these findings are insightful; when firms face tougher competition and seek to capitalize on R&D, unbounded improvements in MCP (i.e., relentlessly cutting advertising and promotion programs) would be especially harmful to future performance. Thus, these findings lend further support to H_1, H_2, and H_3. Following the steps that Aiken and West (1991) recommend, we illustrate these curvilinear and moderated relationships among Tobin's q, MCP, R&D, and competition intensity in Figure 4.

However, in contrast to the strong support of the hypotheses in the Tobin's q model, the support in the stock return model is less significant. More specifically, in the stock return model, we used the unanticipated changes of ROA and MCP dimensions (Jacobson and Aaker 1987; Mizik and Jacobson 2003), because according to the efficient markets theory, the current stock price incorporates all previous information with profit implications. That is, abnormal stock returns in the financial markets react only to unanticipated information (e.g., Erickson and Jacobson 1992; Kothari 2001). In other words, stock prices are essentially a random (strong or weak) walk. Although criticism of such efficient market arguments exists, in general, the literature seems to support them (e.g., Chauvin and Hirschey 1993; Mizik and Jacobson 2003). Therefore, we define unanticipated changes of ROA and MCP as their deviations of the series from predictions based on prior information (a proxy for expectations). We operationalized these deviations as the residuals from a time-series forecast model (e.g., Grilliches 1995; Mizik and Jacobson 2003). As a further clarification, because stock return is different from Tobin's q (Erickson and Jacobson 1992), we used the differences of MCP (or unanticipated MCP) for stock return model and the levels of MCP for the Tobin's q model in Equation 2. As we report in Table 4, overall, the results provide less support for the hypotheses in the stock return model. In particular, the results indicate that an unanticipated change in marketing managerial efficiency has a positive influence on forward-looking performance of stock return (MCP1: t = 4.03, $p < .01$), but this influence becomes negative (MCP1-squared: t = –2.21, $p < .01$) at too high increases in MCP1, as we expected. Thus, the data further support H_1 that MCP1 has an inverted U-shaped influence on stock return. However, only one linear × quadratic interaction term in stock return (MCP1-squared × CPI: t = –1.83, $p < .1$) is negative, as we expected, and none of the three-way linear × quadratic interaction terms are significant. Thus, these findings show much less support for H_2 and H_3 in the stock return model. These less significant results in the stock return model (compared to Tobin's q) are not totally unexpected; a recent study by Mittal and colleagues (2005) also finds that their marketing variables strongly influence Tobin's q but do not affect stock return significantly.

FIGURE 4
The Curvilinear Influences of MCP on Shareholder Value



We also examine the influences of MCP on backward-looking performance with ROA. As we report in Table 4, changes in MCP are less significantly related to ROA; only two dimensions are significant statistically, whereas four dimensions are related to shareholder value. These limited findings regarding the influence of MCP on ROA (MCP1: t = 3.81, $p < .01$; MCP2: t = 1.86, $p < .1$) and the impact of few quadratic terms are consistent with prior literature. Empirically, existing studies (e.g., Chauvin and Hirschey 1993; Erickson and Jacobson 1992) have established a positive link between the multiperiod accumulated effective advertising expenditures and profitability ROA. Intuitively, improving MCP by cutting costs increases ROA because cutting operating expenses should consistently enhance accounting profitability ratios (Aaker and Carman 1982).

Note that because the total effects of MCP include (1) direct main effects, (2) indirect effects through ROA, and (3) moderated effects with R&D and competition intensity on Tobin's q and stock return, the total impact may not strictly follow an inverted U shape. In particular, although total effects (direct, indirect, and moderated impact) of MCP have an inverted U shape for the Tobin's q model, as we expected, this is not the case for the stock return model. Nevertheless, because modern marketing theory (Rust et al. 2004) is more concerned with marketing productivity's implications for the forward-looking shareholder value and less concerned with implications for the backward-looking ROA profitability, interpretations of our results should focus more on direct main effects of MCP and their moderated effects with R&D and competition intensity (which have an inverted U shape, as hypothesized) than on the indirect effects through ROA, a backward-looking, short-term performance measure.

Additional Analyses

We adopted several steps to conduct additional analyses to ensure the robustness of our results. Because Malmquist modeling is nonparametric and may be sensitive to data extreme points and measurement error (Banker, Charnes, and Cooper 1984; Färe Grosskopf, and Lovell 1994; Färe et al. 2004), we repeat the modeling analyses with different combinations of variables (i.e., two outputs and four inputs, three outputs and three inputs, and different lags of advertising and R&D in adjusted sales revenue). The results pertaining to MCP across the different specifications are highly correlated (i.e., smallest r = .83, $p < .01$), and the longitudinal changes of MCP are robust. Furthermore, we checked whether our results were robust when using two-year-based sales growth (t versus t – 1). In doing so, we reran all the 39,872 + 22,784 linear programming models with the simple annual growth rate (from t – 1 to t). These results of different dimensions of MCP measures (MCP1, MCP2, MCP3) are highly consistent. The correlation results for the three pairs of MCP based on the three-year compounded sales growth and MCP based on the two-year sales growth were r = .92, .92, and .91 (all *p*s < .01). In addition, as we discussed previously, because there is a reverse-causality concern between financial performance and *Fortune*'s reputation measure, we conducted additional analyses. That is, we teased out the reverse causality of corporate reputation with the residual approach (Roberts and Dowling 2002). Then, we used the estimated "clean" residual corporate reputation (without reverse causality) and conducted one more round of estimation of all the 39,872 + 22,784 linear programming models. We found that the MCP results are robust. Across the dimensions, the correlations r for the three pairs of MCP based on the original score of corporate reputation and MCP based on the residual of corporate reputation are .89, .86, and .88 (all *p*s < .01). Table 5 reports a summary of the different sensitivity analyses in MCP results. Thus, it seems that our empirical work is reliable, and the MCP results are reasonably credible.

In addition, recall that MCP is a rather complex transformation of the three outputs that may correlate with MCP (i.e., significant correlations include $r_{(\text{MCP1 and sales level})} = .11$, $r_{(\text{MCP1 and sales growth})} = .14$, $r_{(\text{MCP1 and reputation})} = .12$, $r_{(\text{MCP2 and sales level})} = .12$, and $r_{(\text{MCP2 and reputation})} = .13$). Thus, we test whether a more parsimonious model might perform just as well. That is, we added the three outputs as covariates on top of those controls in Equation 2 and reestimated this more parsimonious model. The results on the impact of MCP still hold. In particular, the effects of MCP on Tobin's q are robust and in the expected inverted U shape for both MCP1 and MCP3, though MCP2-squared is still nonsignificant as in the base model ($p > .05$). Moreover, in an alternative approach, we tested our hypotheses with a hierarchical regression model (see Luo, Rindfleisch, and Tse 2007; Slotegraaf, Moorman, and Inman 2003) to account for the correlations between MCP and the three outputs and to examine the additional explanatory power of MCP on influencing Tobin's q (beyond that of the three outputs). In particular, we first regress MCP against the three outputs to obtain residuals that have parceled out the correlations with the three outputs. We then employ these residuals as MCP measures when reestimating Equation 2. Again, the results of this alternative modeling approach fail to

TABLE 5
Sensitivity Results of MCP

	Overall Productivity Change 1995–2002	Productivity Change 1995–1996	Productivity Change 1996–1997	Productivity Change 1997–1998	Productivity Change 1998–1999	Productivity Change 1999–2000	Productivity Change 2000–2001	Productivity Change 2001–2002
MCP overall (baseline)	1.282 (.823)	1.231 (.699)	1.213 (.754)	1.141 (.603)	1.223 (.604)	1.307 (.642)	1.652 (1.479)	1.207 (.480)
MCP overall (different sales growth measure)	1.279 (.908)	1.227 (.713)	1.221 (.675)	1.138 (.642)	1.219 (.610)	1.310 (.683)	1.646 (1.511)	1.209 (.486)
MCP overall (different corporate reputation measure)	1.212 (.910)	1.209 (.732)	1.224 (.862)	1.093 (.727)	1.218 (.715)	1.295 (.829)	1.663 (1.385)	1.192 (.523)

Notes: We based MCP baseline results on the three-year compounded sales growth rate and corporate reputation. We based MCP results with different sales growth measure on the two-year simple sales growth rate. We based MCP results with different corporate reputation measure on corporate reputation after accommodating the reverse-causality issue between financial performance and *Fortune* reputation measure.

reject our hypotheses of the inverted U shape and moderated impact of MCP on Tobin's q.

Furthermore, employing Hausman's (1978) tests, we compared the random effects model with the fixed effects models (firm-specific, year-specific fixed effects; see Arellano 2003; Boulding 1990; Boulding and Christen 2003). The Hausman test essentially tests the null hypothesis that the coefficients estimated by the relatively efficient random effects model are the same as the coefficients estimated by the relatively consistent fixed effects model (e.g., Baltagi 2001). A nonsignificant *p* value of this test would suggest that the use of the random effects model is appropriate, and a significant *p* value would indicate that the use of the fixed effects model is appropriate. As we report in Table 6, the Hausman test result is not significant ($\chi^2_{diff} = 2.788$, $p > .05$), thus favoring the specified random effects model in Equation 2. This is consistent with the similar findings in prior studies that also favored random effects modeling (e.g., Anderson, Fornell, and Mazvancheryl 2004; Mittal et al. 2005; Rao, Agarwal, and Dahlhoff 2004). Using the Bayesian information criterion, we conducted further likelihood ratio tests and found that the model with two-way random effects in Equation 2 outperformed ($p < .05$) the rival models with either time or firm random effects. In addition, because random effects modeling assumes an exchangeable covariance structure, we repeat the analyses with different specifications of covariance structure, including unstructured, AR(1), AR(1) heterogeneous, Toeplitz heterogeneous, and compound symmetry (Arellano 2003; Baltagi 2001; Boulding and Staelin 1993). As we show in Table 6, we fail to obtain significant differences (largest $\chi^2_{diff} = 3.081$, $p > .05$) across these covariance structure specifications.

Finally, in Equation 2, we specified random intercepts models (Gonul and Srinivasan 1993) in testing the direct and moderated impact of MCP on Tobin's q. However, because firms might differ in effectiveness in their deployment and exploitation of MCP, we also tried to test the robustness by fitting random coefficient models (Gonul and Srinivasan 1993; Murthi, Srinivasan, and Kalyanaram 1996; Rao, Agarwal, and Dahlhoff 2004). Using likelihood ratio tests, we failed to reject the null hypothesis that there is no significant variation in firm financial value due to the effects of random coefficients. Overall, we believe that the results are fairly robust.

Discussion

Marketing's credibility has been questioned, and the need to link marketing expenditures to financial performance has been stressed. However, the impact of MCP on firm market value has been unclear. In response to these issues, we developed a measure of MCP based on the neoclassical production theory and RBV. Our study tests a conceptual framework that accommodates both the curvilinear influence of MCP on shareholder value over time and the moderating roles of competition and R&D intensity. The key takeaway points of this study are that (1) firms that are more productive in converting advertising and promotion resources into marketing outputs may create greater shareholder value over time, (2) too great an increase in MCP can also be harmful, and (3) these results are especially robust for firms with intense R&D expenditures and that operate in competitive markets.

Implications for Marketing Researchers

Our study answers Rust and colleagues' (2004, p. 83) call for new methodology to measure marketing productivity, in which they clearly identify a key gap in the literature when they state that "few methods currently exist for comprehensively modeling the chain of marketing productivity all the way from tactical actions to financial impact or firm value." Our article explores this issue by introducing Malmquist modeling to measure MCP. The Malmquist approach has direct and handy implications for marketing modelers and strategists interested in evaluating the chain of marketing

TABLE 6
Random Effects Model Specifications Results

	Test Statistics	*p* Value	Conclusion
Model Specification Comparisons			
Random firm and time effects versus fixed firm and time effects	$\chi^2_{diff} = 2.788$	>.05	Random effects model is supported.
Random firm and time effects versus random firm effects only	$\chi^2_{diff} = 21.853$	<.05	Two-way random effects model is preferred.
Random firm and time effects versus random time effects only	$\chi^2_{diff} = 33.096$	<.05	Two-way random effects model is preferred.
Likelihood Ratio Test Comparing Different Covariance Structure in Random Effects Model			
Unstructured versus AR(1)	$\chi^2_{diff} = 2.675$	>.05	Estimates are robust across covariance structure specifications.
AR(1) versus AR(1) heterogeneous	$\chi^2_{diff} = 2.846$	>.05	Estimates are robust across covariance structure specifications.
AR(1) heterogeneous versus Toeplitz heterogeneous	$\chi^2_{diff} = 2.933$	>.05	Estimates are robust across covariance structure specifications.
Toeplitz heterogeneous versus compound symmetry	$\chi^2_{diff} = 3.081$	>.05	Estimates are robust across covariance structure specifications.

productivity and efficiency in novel ways. For example, this technique can be applied to benchmark consumer decision-making productivity and price promotion productivity with time-series consumer panel data (e.g., Dominick's [a grocery store] scanner data, *Consumer Reports*, ACNielsen data) and Internet pricing productivity and cross-channel efficiency dynamically with online clickstream data (e.g., comScore data, firm customer relationship management databases).

In addition, our Malmquist approach extends research on how to test the RBV empirically with scientific modeling techniques. Unlike most regression approaches that compare against average performers and neutralize firm differences with a central tendency, the Malmquist technique deals with best practices and above-average players. Similarly, the RBV is a theory about extraordinary performers (Hansen, Perry, and Reese 2004) and above-normal firms that outperform their industries (Wiggins and Ruefli 2005), a point with which Malmquist measurement modeling fits neatly.

The existing literature seems to be enthusiastic about improving MCP, but it ignores its potential dark side (with one notable exception being the work of Anderson, Fornell, and Rust [1997]). We suggest that an unrestricted increase of MCP may be harmful and cause negative market returns. Achieving overly high productivity may not be the most optimal way to improve firm market value, because doing so may hurt service quality and customer satisfaction, which are critical for firm future performance (Anderson, Fornell, and Rust 1997). The results of the negative quadratic influence of MCP may help explain the "lost" credibility of marketing; unbridled increases in MCP generate suboptimal market value for the firm over time, and only a well-balanced increase in MCP will produce higher Tobin's q and stock returns.

A burgeoning stream of research has begun to explore the linear, monotonic relationship between shareholder value and its predictive marketing variables (e.g., Anderson, Fornell, and Mazvancheryl 2004; Dutta, Narasimhan, and Rajiv 1999; Gruca and Rego 2005; Lee and Grewal 2004). Our findings of the nonlinear relationships between MCP and firm shareholder value extend this line of research. The financial literature similarly recommends such nonlinear models as the proper way to model stock price changes and stock returns (e.g., Hiemstra and Jones 1994). Therefore, we encourage marketing researchers to look beyond simple, linear relationships in determining firm market value.

The supported impact of interactions between MCP and R&D intensity adds more evidence to Dutta, Narasimhan, and Rajiv's (1999) argument about the complementary rents of marketing and R&D capabilities. Our finding of a positive influence in the three-way interaction among MCP, R&D, and competition intensity on Tobin's q also suggests a hidden point; namely, the synergy between marketing and R&D may be even greater when firms are motivated by market competition for Schumpeter-type entrepreneurial rents (Schumpeter 1934; Wiggins and Ruefli 2005). Other possible contextual moderators should be considered in future efforts to evaluate marketing productivity. In addition, it would be appealing for research to test our framework in a broader sense by including the influences of other perception-based factors, such as pricing strategies and market orientation. We were not able to do so empirically because of the limited availability of archival data. Thus, we call for further efforts with both primary survey data and secondary archival data to extend this line of research.

Implications for Marketing Practitioners

Where is marketing's credibility? Contrary to the common criticisms about advertising accountability and the decline of advertising and promotion productivity, our results indicate a positive influence of MCP on shareholder value. These findings help justify advertising and sales promotion spending, promote the creditability of the marketing function, and establish marketing as a distinct capability within the firm. To put the results into perspective, we calculate that for a typical firm in our sample, which has an average market value of approximately $43 billion, a 1% improvement in MCP (managerial efficiency) will add approximately $45 million more returns in the following year. For a high-tech firm such as Dell, with a market value of around $80 billion, a 1% increase in MCP translates into a substantial financial return: approximately $85 million.

Our Malmquist approach to MCP offers marketers a valuable tool for benchmarking and evaluating the results of advertising and promotion expenditures dynamically. To sell marketing and advertising programs to financial officers, marketers need to quantify the marketing budget and demonstrate marketing's contribution to shareholder value. In this context, our Malmquist-based scientific technique helps solve the thorny situations corporate marketers are currently facing:

> For many years, corporate marketers have walked into budget meetings like neighborhood junkies. They couldn't always justify how well they spend or what difference it all made. They just wanted more money. Old tricks simply don't work, there's hardly a marketing executive today who isn't demanding a more scientific approach to help defend marketing strategies in front of the chief financial officer. Marketers want to know the actual value of each dollar.… The push is from top ranks. [Chief executive officers, chief financial officers,] and even board directors have relentlessly cut costs in every corner of their companies.… The bean counters know that marketing matters. But they're hazy about how much or what kind. (*BusinessWeek* 2004, p. 112)

Although improving MCP largely promotes firm performance, blindly pushing for high MCP can be harmful for firm market value. The nonlinear findings of negative returns on MCP suggest that managers should resist the temptation to improve productivity simply by relentlessly cutting corners. Given a trade-off between productivity and customer satisfaction (Anderson, Fornell, and Rust 1997), an extremely lean marketing budget is not necessarily optimal. In addition, unbounded improvements in MCP, including cutting advertising and promotion programs, would be especially harmful for future performance if the firm faces tougher competition and seeks to capitalize on its R&D capabilities. Thus, these findings advise managers to take a cautious view of improving the productivity of their advertising and promotion expenditures. In conclusion, our study may help management achieve a more complete understanding of MCP, benchmark it against best practices over time, and examine its shareholder value in more depth and sophistication so that the marketing productivity crisis can be reversed.

Appendix Malmquist Linear Programming for MCP

According to Malmquist (1953), a productivity change measure can be calculated by comparing the inputs of a firm at times t and t + 1 according to the maximum factor, by which the input in time t could be decreased such that the firm would continue to produce the same level of outputs at time t + 1. Caves, Christensen, and Diewert (1982) extend this idea and develop the total factor productivity change from t to t + 1; they label it "the Malmquist productivity measure." Combining Caves, Christensen, and Diewert's productivity index and Farrell's (1957) Pareto-based efficiency concept, Färe and colleagues (Färe et al. 1992; Färe, Grosskopf, and Lovell 1994; Färe et al. 2004) construct the linear-programming- (DEA-) based Malmquist productivity change from t to t + 1. This measure of MCP for each firm can be calculated with a series of linear programming models. The composite score of MCP for firm_o, or M_o, requires two single-period and two mixed-period efficiencies for the DEA programming (Banker, Charnes, and Cooper 1984; Charnes, Cooper, and Rhodes 1978), as follows:

$$\text{(A1)} \quad M_o = \left[\frac{D_o^t(x_o^{t+1}, y_o^{t+1})}{D_o^t(x_o^t, y_o^t)} \times \frac{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{D_o^{t+1}(x_o^t, y_o^t)}\right]^{1/2},$$

where $D_o^t(x_o^t, y_o^t)$, $D_o^{t+1}(x_o^{t+1}, y_o^{t+1})$, $D_o^{t+1}(x_o^t, y_o^t)$, and $D_o^t(x_o^{t+1}, y_o^{t+1})$ are relative efficiencies estimated by four linear programming models.

After some mathematical manipulations, we can decompose the Malmquist measurement (M_o) of MCP into several components (e.g., Caves, Christensen, and Diewert 1982; Färe, Grosskopf, and Lovell 1994). As we show subsequently, the first component of MCP1 is the change of productivity from time t to t + 1 that is due to managerial efficiency (or the effects of moving toward the best-practice frontiers). This efficiency represents how much improvement in MCP can be achieved if executives enhance the skills of managing their marketing communication compared with the best-practices. The second component, MCP2, is change in productivity from time t to t + 1 that is due to capital efficiency (or the effects of moving between the best-practice frontiers with different returns-to-scale model specifications). This efficiency represents how much improvement in MCP can be achieved if executives promote the economies of scale when using the marketing communication capitals. The third dimension of MCP3 is the change of productivity from time t to t + 1 that is due to best-practice shift efficiency (or the effects of moving away from the best-practice frontiers from t to t + 1). This efficiency represents how much improvement in MCP can be achieved through factors that are not related to marketing communication managerial skills but rather to uncontrollable factors such as industry communication creativity innovation and environment. Finally, the returns to scale of marketing communications capital (or the effects of moving along the best-practice frontiers) is a categorical variable that can increase, be constant, or decrease in returns to scale (Caves, Christensen, and Diewert 1982; Färe, Grosskopf, and Lovell 1994). The equation is as follows:

$$\text{(A2)} \quad M_o(t, t+1) = \underbrace{\frac{D_{o,t+1}^{VRS}(x_o^{t+1}, y_o^{t+1})}{D_{o,t}^{VRS}(x_o^t, y_o^t)}}_{\text{MCP1}} \times \underbrace{\left[\frac{D_{o,t+1}^{CRS}(x_o^{t+1}, y_o^{t+1})/D_{o,t+1}^{VRS}(x_o^{t+1}, y_o^{t+1})}{D_{o,t}^{CRS}(x_o^t, y_o^t)/D_{o,t}^{VRS}(x_o^t, y_o^t)}\right]}_{\text{MCP2}} \times \underbrace{\left[\frac{D_{o,t}^{CRS}(x_o^{t+1}, y_0^{t+1})}{D_{o,t+1}^{CRS}(x_o^{t+1}, y_o^{t+1})} \times \frac{D_{o,t}^{CRS}(x_o^t, x_o^t)}{D_{o,t+1}^{CRS}(x_o^t, y_o^t)}\right]^{1/2}}_{\text{MCP3}}$$

For the sake of brevity, we illustrate the details of only one linear programming model for $D_o^{t+1}(x_o^t, y_o^t)$. The other linear programming models are similar, with only some changes in the superscript of either t or t + 1. The term $D_o^{t+1}(x_o^t, y_o^t)$ assesses the amount by which marketing communication inputs at time t can be reduced but produce the same amount of output levels at time t when firm M_o is compared with the best-practice frontier at time t + 1.

$$D_o^{t+1}(x_o^t, y_o^t) = \min \theta_o,$$

subject to (1) multiple outputs constraints:

$$\sum_{j=1}^{n} \lambda_j SAL_j^{t+1} \geq SAL_o^t,$$

$$\sum_{j=1}^{n} \lambda_j SAG_j^{t+1} \geq SAG_o^t, \text{ and}$$

$$\sum_{j=1}^{n} \lambda_j REP_j^{t+1} \geq REP_o^t;$$

(2) multiple inputs constraints:

$$\sum_{j=1}^{n} \lambda_j ADB_j^{t+1} \leq \theta\ ADB_o^t,$$

$$\sum_{j=1}^{n} \lambda_j ADP_j^{t+1} \leq \theta\ ADP_o^t,$$

$$\sum_{j=1}^{n} \lambda_j ADO_j^{t+1} \leq \theta\ ADO_o^t, \text{ and}$$

$$\sum_{j=1}^{n} \lambda_j SAP_j^{t+1} \leq \theta\ SAP_o^t;$$

and (3) returns-to-scale constraints for variable returns-to-scale models:

$$\sum_{j=1}^{n} \lambda_j = 1, \text{ and}$$

$$\lambda_j \geq 0, j = 1, 2, \ldots, j = n;$$

where $\lambda_j \geq 0$; j = 1, 2, …, n = sample size; r = 1, 2, …, s outputs; and i = 1, 2, …., m inputs. There are four marketing expenditure inputs (firms' expenditure in broadcast [ADB], print [ADP], outdoor [ADO], and sales promotion [SAP]) and three marketing outputs (sales level [SAL], sales growth rate [SLG], and corporate reputation [REP]). Adjusted sales capture the advertising carryover effect and the influence of other variables, such as R&D. The parameter theta essentially means the degree to which the inputs can be reduced without hurting the levels of outputs (e.g., Horsky and Nelson 1996; Luo 2004; Murthi, Srinivasan, and Kalyanaram 1996). Thus, the optimal minimized theta represents the best scenario in which a firm can achieve the highest possible efficiencies in marketing communication overall productivity benchmarked against the best-practice frontier. In addition, $D_o^t(x_o^t, y_o^t)$ measures the amount by which marketing communication inputs at time t can be reduced while producing the same amount of output levels at time t compared with best practices at time t; $D_o^{t+1}(x_o^{t+1}, y_o^{t+1})$ measures the amount by which marketing communication inputs at time t + 1 can be reduced while producing the same amount of output levels at time t + 1 compared with best practices at time t + 1; and $D_o^t(x_o^{t+1}, y_o^{t+1})$ measures the amount by which marketing communication inputs at time t + 1 can be reduced while producing the same amount of output levels at time t + 1 compared with best practices at time t.

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