

Should Firms Spend More on Research and Development and Advertising During Recessions?

Whenever a recession occurs, there is a heated dialog among marketing academics and practitioners about the appropriate levels of marketing spending. In this article, the authors investigate whether firms should spend more on research and development (R&D) and advertising in recessions. They propose that the effects of changes in firms' R&D and advertising spending in recessions on profits and stock returns are contingent on their market share, financial leverage, and product-market profile (i.e., business-to-consumer goods, business-to-business services, business-to-business goods, or business-to-consumer services). They estimate the model using a panel of more than 10,000 firm-years of publicly listed U.S. firms from 1969 to 2008, during which there were seven recessions. Their results support the contingency approach. The authors compute the marginal effects, which show how the effects of changes in R&D and advertising spending in recessions vary across firms. The marginal effects provide evidence of inadequate spending (e.g., 98% of business-to-consumer goods firms underspend on R&D), proactivity (e.g., 96% of business-to-business services firms are at approximately the right levels on advertising), and excess spending (e.g., 92% of business-to-consumer services firms overspend on advertising). Using the authors' approach and publicly available data, managers can estimate the effects of their firms' and competitors' R&D and advertising spending on profits and stock returns in recessions.

Keywords: recession, advertising, research and development, marketing metrics, profits, stock returns

There are only two things in a business that make money—
innovation and marketing; everything else is cost.

—Peter Drucker (1954)

Recessions are recurring events in major world economies. Although a recession may be triggered by events in a single sector (e.g., the subprime mortgage crisis is purported to have started the most recent recession in the United States), its effects are widespread. Recessions entail a significant contraction in demand for goods and services, lowering sales, cash flows, and profits. Despite the wisdom in Drucker's quote, in recessions, most firms cut franchise-building investments in innovation and marketing to conserve resources (e.g., Ryan 1991). In this study, we investigate how changes in research and development (R&D) and advertising spending in recessions affects firm performance.

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We focus on the effects of recessions on firm performance because recessions can lead to permanent realignments in the marketplace (Nishimura, Nakajima, and Kiyota 2005). For example, during the 2001 recession in the United States, more than 20% of the firms in the bottom quartile of performance in their industries rose to the top quartile, and more than 20% in the top quartile fell to the bottom quartile. Moreover, 70% of the firms that increased revenue or profits during the 2001 recession sustained those gains in the ensuing economic recovery, while fewer than 30% of the firms that lost ground regained their positions (Baveja, Postma, and Pritzl 2002).

In recessions, firms are pressed to control costs to maintain liquidity; thus, R&D programs, which may have limited ability to increase short-term cash flow, receive close scrutiny. However, if a firm cuts its R&D spending in recessions, it risks losing its long-term technological advantage. Such dilemmas frequently come to light in the business press. For example, when Kevin Johnson, chief executive officer of Juniper Networks Inc., was pressed to cut costs to survive the 2008 recession, he had to decide what to do about the firm's \$800 million research budget, which constituted only 20% of Juniper's revenue but was fuel for its sales growth. He decided against R&D cuts, noting, "We've tightened up on other areas so we can fund more R&D" (Worthen 2009, p. B1). However, not all firms make the same decision; as a report from the Federal Reserve (Barlevy 2005, p. 1) notes, "R&D, one important source of economic growth, falls rather than rises in recessions, even for firms that do not appear to be credit constrained."

A similar situation occurs for advertising programs in recessions. While some observers (e.g., Clark 2008) recommend an aggressive approach, consistent with Welch and Welch's (2009, p. 68) comment that "first and foremost, we suggest you resolve to make 2009 a year during which you stay outward-facing and on the offensive," most firms seem to view advertising as a dispensable luxury in recessions (Biel and King 1990). As MBS Blog (2008) notes, "as companies slash advertising in a downturn, they leave empty space in consumers' minds for aggressive marketers to make strong inroads. [Therefore, the recession] provides an unusual opportunity to differentiate yourself and stand out from the crowd,... but it takes a lot of courage and convincing to get senior management on board with that."

Studies on advertising effectiveness in a recession report mixed findings (for a review, see Tellis and Tellis 2009). Some (Kamber 2002) report that increasing advertising in recessions increase firms' earnings, while others (Kijewski 1982) report that cutting advertising in recessions does not affect profits. Lamey et al. (2007) report that in recessions, resource-strapped consumers switch disproportionately to low-priced store brands from advertised national brands, lowering the returns to advertising. With respect to R&D spending, Graham and Frankenberger (2008) report that increases in R&D spending in recessions increase firm profits and intangible value. However, they do not consider firm-level contingencies, which may moderate the rewards for R&D spending in recessions.

Focusing on the 2001 recession in the United States, Srinivasan, Lilien, and Rangaswamy (2005) find that a firm's trait they term "marketing proactivity"—viewing the recession as an opportunity and executing a marketing response to capitalize on that opportunity—improves firm performance. However, their research uses a subjective performance measure at a single point in time, raising questions about the generalizability of the findings.

Thus, the findings on the effectiveness of firms' R&D and advertising spending in recessions are mixed, leading to the following research questions: First, all else being equal, what contingent factors moderate the effects of R&D and advertising spending on performance in recessions? Second, taking into account the contingencies, what are the patterns in firms' performance rewards for R&D and advertising spending in recessions, and what can they indicate about when managers should increase their R&D and advertising during recessions?

We use a two-pronged empirical approach to address this study's research questions. First, we build a contingent model of the effects of R&D and advertising spending on firm performance in recessions. We propose that firm-level contingencies (Zeithaml, Varadarajan, and Zeithaml 1988)—that is, the firm's market share (Buzzell and Gale 1987), financial leverage (Jensen and Meckling 1976), and product-market profile (whether it operates in the business-to-business [B2B] or business-to-consumer [B2C] marketplace and whether it offers services or goods)—moderate the effects of R&D and advertising spending in recessions on firm performance. We develop and test hypotheses about the effects of these contingencies on firms' R&D and advertising spending effectiveness in recessions on accounting profit, a

contemporaneous performance metric, and stock returns, a forward-looking performance metric. Second, we use the parameter estimates from the contingent model to compute the marginal (i.e., overall) effects of changes in R&D and advertising spending in recessions on firm performance. For example, for each firm, using the marginal effect (negative, positive, or not statistically different from zero) of its R&D and advertising spending in recessions on profits, we assess whether that firm is overspending, underspending, or spending at approximately the right level, respectively. The contingent effects explain why R&D and advertising spending is more or less effective across firms in recessions. If we take into account all the contingent effects, the marginal effects indicate the overall effectiveness of R&D and advertising spending in recessions.

We use a large panel of publicly listed U.S. firms from Standard & Poor's Compustat database, which includes 10,580 firm-years between 1969 and 2008, to model the contingent rewards to R&D and advertising spending in recessions. We use the National Bureau of Economic Research's (NBER) definition of a recession, which yields seven recessions during this period. We employ a modeling approach that accommodates unobserved firm heterogeneity, lagged effects of performance, and serial correlation in errors (Boulding and Staelin 1995).

We find that, all else being equal, in recessions, the greater the firm's market share, the more an increase in R&D spending increases its profits, and the more an increase in advertising spending decreases its profits. However, the greater the firm's financial leverage, the more an increase in advertising spending in recessions increases profits. (We find no comparable effect for R&D spending in recessions.) Focusing on stock returns, the results are similar with respect to market share (i.e., the greater the firm's market share, the more an increase in R&D spending increases its stock returns, and the more an increase in advertising spending decreases its stock returns). In addition, the effects of changes in R&D and advertising spending in recessions on firm performance vary across firms in different product-market profiles.

Using the estimates of the contingent effects, we compute the marginal effects of spending, which generate insights into whether firms are underspending, overspending, or spending at approximately the right levels of R&D and advertising in recessions and nonrecessionary periods. We find that in recessions, while more than half of B2B goods firms have R&D and advertising spending levels that are at approximately the right level (68% and 59% of profit, respectively), 16% and 6% are overspending and 16% and 35% are underspending on R&D and advertising, respectively. In addition, most B2B services firms (96%) have approximately the right advertising levels in recessions. We also find that the stock market rewards B2B goods and B2C services firms for increases in R&D spending in recessions (29% and 42%, respectively) and for increases in B2C services firms' advertising spending in recessions (58%). In some cases (e.g., R&D spending of B2C goods firms, advertising spending of B2B services firms), the stock market either does not reward or punishes firms for such increases in R&D and advertising spending in recessions.

More generally, using our approach and publicly available data, managers can estimate the effects of their firms' and competitors' R&D and advertising spending on profits and stock returns in recessions. For completeness, we also compute the marginal effects of advertising and R&D spending on profits and stock returns in nonrecessionary periods.

We proceed as follows: First, we develop the hypotheses of the contingent effects of firm characteristics on the effects of R&D and advertising spending on firm performance in recessions. Then, we describe our empirical research approach and the model specification to test the hypotheses. Next, we present the data and measures. Following that, we present the results of the contingent and marginal effects and discuss how firms can use our insights and approach to improve the effectiveness of their R&D and advertising spending in recessions. We conclude by discussing the study's contributions to managerial practice and marketing theory and identifying its limitations and opportunities for further research.

Hypotheses

The contingency theory Zeithaml, Varadarajan, and Zeithaml (1988) propose suggests that the effects of a firm's actions on its performance are moderated by characteristics of both the firm and the marketplace in which the firm operates. Our goal is to test for contingencies that have prior theoretical support and for which the data are publicly available to permit testing. Thus, we propose that the firm's market share (Buzzell and Gale 1987), which provides market power, and financial leverage (Jensen and Meckling 1976), which constrains its strategic options, moderate the rewards for R&D and advertising spending in recessions.

Furthermore, in recessions, consumers' purchasing power declines, and their uncertainty about their future purchasing power increases, leading them to delay and sometimes avoid purchasing products (Goodman 2009). Moreover, customers (consumers and organizations) in different product markets face different purchasing situations in recessions. Therefore, we propose that the firm's product-market profile (Schmalensee 1985) moderates the effects of its R&D and advertising spending in recessions on its performance.

Two widely used schemes for product-market profiles involve (1) firms in B2B versus firms in B2C markets (Dwyer and Tanner 2008) and (2) firms offering goods versus firms offering services (Parasuraman, Zeithaml, and Berry 1985). Accordingly, we consider four product-market profiles—B2C goods, B2B services, B2B goods, and B2C services—that we expect could differentially influence the effects of R&D and advertising spending in recessions on firm performance. Given the limited prior research on the effects of product-market profiles on stock returns, we do not develop formal hypotheses but observe the effects empirically.

Moderating Effects of Market Share in Recessions

Market share and R&D in recessions. Firms with greater market share may benefit more from R&D spending in recessions than those with lower market share for several reasons. Firms with greater market share may not only

achieve economies of scale in their R&D programs (Buzzell and Gale 1987) but also have greater market power, enabling them to leverage their R&D outputs effectively in the depressed demand conditions characterizing recessions. In recessions, consumers may perceive high-market-share firms as being more likely to survive the recession than low-market-share firms (Pearce and Michael 2006) and thus be more willing to purchase new products (outputs of their increased R&D spending) from them than from their smaller competitors, differentially rewarding the R&D spending of high-market-share firms. In addition, given the widespread decline in R&D spending in recessions, the economies of scale of high-market-share firms may enable them to lower the marginal costs of incremental R&D investments, thus leading their R&D spending to be more profitable.

With respect to stock returns, investors may also expect the benefits mentioned previously. In addition, they may anticipate that the greater market power of high-market-share firms will lead to greater returns from their increased R&D spending during the economic recovery that normally follows the recession. Therefore, investors may raise their expectations of the risk-adjusted future cash flows of high-market-share firms investing in R&D in recessions, increasing their stock returns. Given these arguments, we propose H_{1RD}^P and H_{1RD}^S :

H_{1RD}^P : During a recession, the profit impact of a firm's R&D spending increases as its market share increases.

H_{1RD}^S : During a recession, the stock return impact of a firm's R&D spending increases as its market share increases.

Market share and advertising in recessions. Firms' advertising programs increase and induce customers to buy products. By definition, firms with high market share have high levels of customer awareness and market penetration (Bloom and Kotler 1975). Therefore, increasing such firms' advertising spending in recessions, when customers are reluctant to buy products, may increase the firm's costs without commensurate increases in sales. Moreover, in recessions, customers may be averse to changing their buying patterns, making customer acquisition efforts costly. In recessions, high-market-share firms, which already serve much of the market, may find customer acquisition even more expensive than low-market-share firms because customers who are willing to switch in recessions may be seeking low-priced products with low profit margins (Anderson and Sullivan 1993). Thus, new customers that high-market-share firms acquire in recessions through increased advertising may be less profitable than their current customers. Thus, for high-market-share firms, increasing advertising spending in recessions may decrease profits.

With respect to stock returns (in line with the arguments for profits), investors may anticipate that successful customer acquisition efforts of high-market-share firms' increasing advertising in recessions will be unprofitable, decreasing their long-term cash flow expectations and thus lowering stock returns for high-market-share firms. Thus, we propose H_{1AD}^P and H_{1AD}^S :

H_{1AD}^P: During a recession, the profit impact of a firm's advertising spending decreases as its market share increases.

H_{1AD}^S: During a recession, the stock return impact of a firm's advertising spending decreases as its market share increases.

Moderating Effects of Financial Leverage in Recessions

Following Jensen and Meckling (1976), we define "financial leverage" as the extent to which a firm uses debt to finance its assets. A firm with high financial leverage may be constrained in its ability to acquire funds, increasing its rigidity and limiting its strategic options (Grewal and Tansuhaj 2001). A firm's financial leverage affects its strategy through agency problems with bondholders and shareholders (Myers 1977); therefore, financial leverage is negatively related to both R&D (Ho, Tjahjapranata, and Yap 2006; Long and Malitz 1983) and advertising spending (Grullon and Kanatas 2006; Long and Malitz 1983).

Financial leverage and R&D in recessions. When a firm with high financial leverage increases R&D spending (a discretionary item) in a recession, it signals that R&D programs are central to the firm's competitive advantage. This suggests that the firm expects that the returns to its R&D spending (i.e., from commercially viable products and technologies) will exceed the cost of capital resulting from the higher financial leverage. Thus, we expect that firms with high financial leverage that increase R&D spending in recessions will be developing superior new products with well-defined competitive advantage, which should result in high levels of customer acceptance at relatively low cost, increasing their sales and profits.

With respect to stock returns, as we noted previously, firms with high financial leverage have cash flow obligations arising from the principal and interest repayments on their debt. Thus, when highly leveraged firms make discretionary R&D investments in recessions, investors may infer that the firm has high expectations about its near-term R&D outputs and increase their expectations of the firm's future cash flows. Furthermore, because investors cannot easily differentiate between good- and bad-quality firms, they expect good-quality firms to undertake actions that are costly for bad-quality firms (Myers and Majluf 1984). For highly leveraged firms, investing in R&D in a recession is a costly action, considering the risk and uncertainty of outputs from R&D investments (Ho, Tjahjapranata, and Yap 1997; Long and Malitz 1983). Thus, firms that invest in R&D in recessions signal to investors that they are good-quality firms increasing the security for their lenders, lowering their cost of capital, and increasing investors' expectations of future risk-adjusted cash flows, leading to increases in stock returns. Thus, we propose H_{2RD}^P and H_{2RD}^S:

H_{2RD}^P: During a recession, the profit impact of a firm's R&D spending increases as its financial leverage increases.

H_{2RD}^S: During a recession, the stock return impact of a firm's R&D spending increases as its financial leverage increases.

Financial leverage and advertising in recessions. When a firm has a high level of financial leverage, it usually decreases its advertising spending, a discretionary item (Grullon and Kanatas 2006; Long and Malitz 1983). Thus, when a highly leveraged firm increases its advertising spending during recessions, it is clearly prioritizing its advertising program. That increase suggests that it has something special to communicate about its products to differentiate it from its competitors in the marketplace during difficult economic times, leading to a greater increase in sales and profits for its advertising spending in recessions.

The preceding arguments apply for stock returns as well. In addition, the arguments for the signaling effects of financial leverage (to the investors) for R&D spending in recessions are relevant here. Because advertising spending is discretionary, increased advertising spending in recessions should signal the superior quality of the leveraged firm to investors, increasing stock returns. Thus, we propose H_{2AD}^P and H_{2AD}^S:

H_{2AD}^P: During a recession, the profit impact of a firm's advertising spending increases as its financial leverage increases.

H_{2AD}^S: During a recession, the stock return impact of a firm's advertising spending increases as its financial leverage increases.

Moderating Effects of Product-Market Profile

As we discussed previously, we expect the effects of firms' R&D and advertising spending in recessions on profits to differ depending on their product-market profiles—B2C goods, B2B services, B2B goods, and B2C services firms. Given the limited prior research, we do not develop formal hypotheses with respect to the effects of product-market profiles on stock returns here, but we observe the effects empirically.

We consider these effects on a relative basis and formulate our hypotheses using B2C services firms as the baseline category. For ease of exposition, we develop the hypotheses pertaining to R&D spending (and advertising spending) in recessions of firms in the different product-market profiles compared with B2C services firms in the following sequence: (1) B2C goods firms (different in terms of goods vs. services from B2C services firms), (2) B2B services firms (different in terms of B2B vs. B2C from B2C services firms), and (3) B2B goods firms (different in terms of B2B vs. B2C and goods vs. services from B2C services firms).

R&D spending in recessions: B2C goods firms versus B2C services firms. The intangibility of services may lead to faster dissipation of innovation rents from new services than from new goods because low-cost competitors can cost-effectively imitate new services (Song, Di Benedetto, and Zhao 1999; Tufano 1989). In recessions, the dissipation levels in innovation rents of services, compared with those of goods, may be even lower when the overall demand for services is reduced (Rampell 2009). Therefore, R&D spending in recessions will increase profits more in B2C goods firms' than in B2C services firms. Thus, we propose H_{3RD}^P:

H_{3RD}^P: During a recession, the profit impact of R&D spending for a B2C goods firm is greater than that for a B2C services firm.

Advertising spending in recessions: B2C goods firms versus B2C services firms. Consumption and happiness studies show that consumers are happier when they spend money on experiences (i.e., services) rather than on goods (e.g., Nicolao, Irwin, and Goodman 2009). There is some evidence that, in recessions, consumers' preference for services over goods may be even stronger, especially when advertisers can tap into the experiential aspect of service consumption (Rosenbloom 2010). In addition, recessions cause consumers to forgo or delay buying products (Lamey et al. 2007). Specifically, consumers tend to delay purchasing tangible goods (whose purchase may induce feelings of guilt) more than intangible services (Danziger 2004). The arguments here suggest that during recessions, increases in advertising of B2C goods firms may decrease profits compared with B2C services firms. Therefore, we propose H_{3AD}^P:

H_{3AD}^P: During a recession, the profit impact of advertising spending for a B2C goods firm is less than that for a B2C services firm.

R&D spending in recessions: B2B services firms versus B2C services firms. With respect to R&D and nature of the marketplace (B2B versus B2C) in recessions, cash-strapped consumers may reduce purchases of newly developed services, whereas business customers may be unable to reduce purchases of new services that are crucial for their organization's operations (NPD Group 2010). Also, given the rational nature of B2B customers, new products emerging from B2B service firms' R&D efforts may find superior acceptance in recessions, leading to greater increases in sales and profits than for B2C service firms. Therefore, during recessions, the profit impact of increases in R&D spending of B2B services firms is greater than for B2C services firms. Thus, we propose H_{4RD}^P:

H_{4RD}^P: During a recession, the profit impact of R&D spending for a B2B services firm is greater than that for a B2C services firm.

Advertising spending in recessions: B2B services firms versus B2C services firms. In general, B2B firms (whose customers are other firms) spend much less on advertising as a percentage of sales than B2C firms (roughly a 1:10 ratio; Schonfeld & Associates 2010), and their customers are more sensitive to changes in downstream consumer demand (inevitable during recessions) than to changes in supplier advertising. Therefore, during a recession, increases in advertising by B2B firms, compared with that by B2C firms, may increase advertising costs without commensurate increases in sales, lowering profits. Thus, we propose H_{4AD}^P:

H_{4AD}^P: During a recession, the profit impact of advertising spending for a B2B services firm is less than that for a B2C services firm.

R&D spending in recessions: B2B goods firms versus B2C services firms. As we discussed previously, we antici-

pate that increases in B2B firms' R&D spending in recessions will yield greater profits than increases in B2C firms' R&D spending and that increases in goods firms' R&D spending in recessions will yield higher profits. Thus, we propose H_{5RD}^P:

H_{5RD}^P: During a recession, the profit impact of R&D spending for a B2B goods firm is greater than that for a B2C services firm.

Advertising spending: B2B goods firms versus B2C services firms. As we discussed previously, we anticipate that during recessions, increases in B2B firms' advertising spending yield lower profits than increases in B2C firms' advertising spending, and increases in goods firms' advertising spending in recessions yield lower profits than increases in services firms' advertising spending. Integrating these effects, we propose H_{5AD}^P:

H_{5AD}^P: During a recession, the profit impact of advertising spending for a B2B goods firm is less than the impact for a B2C services firm.

Method

Research Approach

We use a two-pronged research approach to answer our research questions. First, we build a contingent model of the effects of R&D and advertising spending on firm performance in recessions. Then, we empirically test whether, all else being equal, an increase in a contingent factor (e.g., market share) in a recession significantly changes the effects of R&D and advertising spending on firm performance (e.g., profits, stock returns). Following that, we use the estimates of all the contingent effects to compute the marginal effects (i.e., total effects) of R&D and advertising spending on firm performance in recessions. For each firm, according to the marginal effects (negative, positive, or not statistically different from zero) of R&D and advertising spending on its profits, we assess whether the firm is over-spending, under-spending, or spending at approximately the right level in recessions, respectively. Likewise, we assess whether an increase in the firm's R&D and advertising spending in recessions increases or decreases stock returns. We explain our research approach with an illustration.

Let Y represent a performance metric of interest to a firm (e.g., profit) that is affected by spending X (e.g., advertising) in a recession (captured by a dummy term *Recession* [1 if it is a recession year and 0 if not]). The relationship between X and Y for a firm can be specified as follows¹:

$$(1) \quad Y = \omega_0 + \omega_1 X + \omega_2 \text{Recession} \times X + \omega_3 \text{Recession}.$$

In Equation 1, ω_1 and ω_2 capture the effects of X on Y in recessions and nonrecessionary periods, respectively. We capture the main effect of the recession on Y through ω_3 . We assume that the relationship between X and Y (in reces-

¹We have suppressed trend terms, other firm characteristics, and error terms for clarity of exposition. In our estimation, to allow for complete model specification, we also allow Z_1 to directly affect Y , which we have also suppressed in Equation 2.

sions and in nonrecessionary periods) is influenced by a contingency Z_1 (e.g., market share). Consistent with our theoretical approach, in turn, let ω_1 and ω_2 be affected by Z_1 . Thus, we augment Equation 1 to include the following:

$$(2a) \quad \omega_1 = \psi_{01} + \psi_{11}Z_1, \text{ and}$$

$$(2b) \quad \omega_2 = \psi_{02} + \psi_{12}Z_1.$$

Incorporating Equations 2a and 2b into Equation 1 while controlling for the main effect of Z_1 on Y (through ω_4) yields

$$(3) \quad Y = \omega_0 + (\psi_{01} + \psi_{11}Z_1) \times X + (\psi_{02} + \psi_{12}Z_1) \times \text{Recession} \\ \times X + \omega_3 \text{Recession} + \omega_4 Z_1.$$

From Equation 3, we note that the marginal effect of X on Y (i.e., what happens to Y when X changes) is

$$(4) \quad dY/dX = (\psi_{01} + \psi_{11}Z_1) + (\psi_{02} + \psi_{12}Z_1) \times \text{Recession}.$$

The marginal effect of X on Y measures the effectiveness of changes in X with respect to Y , taking both Z_1 and the recession into account. In nonrecessionary periods ($\text{Recession} = 0$), two terms ($\psi_{01} + \psi_{11}Z_1$) constitute the marginal effect of X , and in recessions ($\text{Recession} = 1$), four terms ($\psi_{01} + \psi_{11}Z_1$) + ($\psi_{02} + \psi_{12}Z_1$) constitute the marginal effect. This approach enables us to calculate the marginal effects of changes in R&D and advertising spending in recessions on profits (and stock returns), taking all contingencies into account.² Thus, for example, $dY/dX > 0$ (when Y is profit) implies that a firm is underspending on X .

Therefore, contingent effects identify conditions (i.e., the effect of Z_1 , recession, or both) when marketing spending (X) should be increased or decreased. We denote ψ_{01} , ψ_{11} , ψ_{02} , and ψ_{12} as the constituent contingent effects of Z_1 on the $X - Y$ relationship, which are essential for computing the marginal effect. Thus, the sign of the marginal effect (e.g., of advertising spending in recessions by B2B goods firms on profit) may be different from one of its constituent contingent effects.

From a theory-building perspective, the coefficient ψ_{12} (the three-way interaction) assesses how Z_1 influences the $X - Y$ relationship beyond nonrecessionary periods (captured through ψ_{11} in the model). For example, a negative sign of ψ_{12} (as hypothesized in H_{1AD}^P) suggests that an increase in a firm's market share (Z_1) decreases the effect of advertising spending (X) on profit (Y) in a recession.

Note that although the marginal effects measure the effectiveness of changes in marketing spending, which is relevant for managerial practice, the constituent contingent effects are not by themselves directly managerially meaningful. However, these contingent effects (three-way interactions) are useful to extend theoretical understanding of what drives the rewards to changes in R&D and advertising spending.

Model Specification

Our goal is to find a model formulation that captures the main effects of firms' R&D and advertising spending and

their interactions with other firm and market characteristics and the occurrence of recessions on performance. We adapt the approach Boulding and Staelin (1995) propose to relate firms' R&D and advertising spending in recessions to their performance, contingent on firm and market characteristics. After appropriate log-transformation and first differencing, the Boulding and Staelin approach permits ordinary least squares estimation of the model and incorporates the effect of lagged performance and lagged spending, which are relevant to our setting. We begin with the following general equations, which express firm profits Y_{it}^P (stock returns Y_{it}^S) as a function of R&D and advertising spending³:

$$(5) \quad Y_{it}^P = RD_{it}^{\beta_{it}^P} AD_{it}^{\theta_{it}^P} SIZE_{it-1}^{\gamma_{it-1}^P} MKTSHR_{it-1}^{\lambda_{it-1}^P}$$

$$LEV_{it-1}^{\delta_{it-1}^P} \left(\prod_{k=1}^4 \delta_{pk}^{\text{RECTERM}_{kt}} \right) e^{\alpha_{it}^P + \varepsilon_{it}^P},$$

$$(6) \quad \beta_{it}^P = \beta_0^P + \beta_{11}^P(MKTSHR_{it-1} \times REC_t) + \beta_{12}^P(LEV_{it-1} \times REC_t) \\ + \beta_{13}^P(B2CGOODS_i \times REC_t) + \beta_{14}^P(B2BSERVICES_i \\ \times REC_t) + \beta_{15}^P(B2BGOODS_i \times REC_t) + \beta_{16}^P REC_t \\ + \beta_{17}^P MKTSHR_{it-1} + \beta_{18}^P LEV_{it-1} + \beta_{19}^P B2CGOODS_i \\ + \beta_{20}^P B2BSERVICES_i + \beta_{21}^P B2BGOODS_i,$$

$$(7) \quad \theta_{it}^P = \theta_0^P + \theta_{11}^P(MKTSHR_{it-1} \times REC_t) + \theta_{12}^P(LEV_{it-1} \times REC_t) \\ + \theta_{13}^P(B2CGOODS_i \times REC_t) + \theta_{14}^P(B2BSERVICES_i \\ \times REC_t) + \theta_{15}^P(B2BGOODS_i \times REC_t) + \theta_{16}^P REC_t \\ + \theta_{17}^P MKTSHR_{it-1} + \theta_{18}^P LEV_{it-1} + \theta_{19}^P B2CGOODS_i \\ + \theta_{20}^P B2BSERVICES_i + \theta_{21}^P B2BGOODS_i, \text{ and}$$

$$(8) \quad \varepsilon_{it}^P = \rho \varepsilon_{it-1}^P + \mu_{it}^P,$$

where

RD_{it} = R&D spending of firm i in time period t ;

AD_{it} = advertising spending of firm i in time period t ;

$SIZE_{it-1}$ = size of firm i at time $t - 1$ (lagged by a year), which incorporates the idea of economies of scale in firm productivity;

$MKTSHR_{it-1}$ = market share of firm i at time $t - 1$ (lagged by a year);

LEV_{it-1} = financial leverage of firm i at time $t - 1$ (lagged by a year);

$REC_t = 1$ if year is a recession year, and 0 if otherwise;

$B2CGOODS_i = 1$ if firm i 's product-market profile is B2C goods, and 0 if otherwise;

²We thank an anonymous reviewer for useful suggestions on the development of this section.

³We employ a similar formulation to express firm stock returns as a function of R&D and advertising spending, with the corresponding coefficients denoted with a superscript "s."

B2BSERVICES_i = 1 if firm i's product-market profile is B2B services, and 0 if otherwise;

B2BGOODS_i = 1 if firm i's product-market profile is B2B goods, and 0 if otherwise;

β_0^p, θ_0^p = the coefficients capturing the main effect of firm's R&D spending and advertising in nonrecessionary periods, respectively;

$\gamma_1^p, \gamma_2^p, \gamma_3^p$ = the coefficients capturing the main effects of firm size, market share, and financial leverage;

δ_{pk} (k = 1 to 4) the coefficients capturing the main effect of recession (k = 1) and the interaction effects of recession and product-market profiles B2C goods (k = 2), B2B services (k = 3), and B2B goods (k = 4), respectively. The coefficients are estimated through the definition of the variables RECTERM_{kt} (k = 1 to 4), where RECTERM_{1t} = REC_t, RECTERM_{2t} = REC_t × B2CGOODS_i, RECTERM_{3t} = REC_t × B2BSERVICES_i, and RECTERM_{4t} = REC_t × B2BGOODS_i, respectively;

$\beta_{11}^p, \beta_{12}^p$ = the coefficients capturing the three-way interaction effects between the firm's R&D spending in recessions and market share, and firm's R&D spending in recessions and financial leverage, respectively;

$\beta_{13}^p, \beta_{14}^p, \beta_{15}^p$ = the three-way interaction effects between the firm's R&D spending in recessions and whether it is a B2C goods firm (β_{13}^p), a B2B services firm (β_{14}^p), or a B2B goods firm (β_{15}^p);

$\beta_{16}^p - \beta_{21}^p$ = the coefficients capturing two-way interaction effects between the firm's R&D spending and recession (β_{16}^p); market share (β_{17}^p); financial leverage (β_{18}^p); and whether the firm is a B2C goods firm (β_{19}^p), a B2B services firm (β_{20}^p), or a B2B goods firm (β_{21}^p), respectively (we include these two-way interaction terms in the model with three-way interaction effects to ensure the correct interpretation of marginal effects);

θ_{mn}^p (1 ≤ m ≤ 2, 0 ≤ n ≤ 9) the same substantive two- and three-way interaction effects interpretation about the effects of advertising as the corresponding coefficient has for the effects of R&D spending on Y^{pit};

α_i^p = unobserved fixed factors; and

ε_{it}^p includes $\rho\varepsilon_{it-1}$ and μ_{it} autoregressive and random unobserved factors, respectively.

The Web Appendix (<http://www.marketingpower.com/jmmy11>) provides a detailed specification of the model.

Data

We used the Standard & Poor's COMPUSTAT database to collect data on publicly listed U.S. firms for the period 1969–2008. The final data set with complete information on the lagged variables, necessary for instrumental variable estimation in the model for firm profits in recessions, includes 10,580 firm-years. Table 1 provides the distribution of firm-years in the data set across the four product-market profiles, and Table 2 describes the profiles of the firms. Next, we describe the measures.

We used the National Bureau of Economic Research (NBER) declaration of a recession, which is, in general, the one the media cites and is thus most salient to consumers, and identified seven recession years: 1970, 1974, 1980, 1982, 1990, 2001, and 2008. We classified a year as a recession year if the majority of the year occurred during an NBER-classified recessionary trough (Frankenberger and Graham 2003; Graham and Frankenberger 2008). We measured the firm's profit by the return on its assets (i.e., earnings before interest, taxes, and depreciation divided by its total assets).⁴ We calculated stock returns using monthly stock returns data from the Center for Research in Security Prices using the formula $\log[\prod_{m=1}^{12}(1 + \text{Ret}_{im})]$, where Ret_{im} is the return for the firm i's stock in month m during the year (Mizik and Jacobson 2008). This decreased the sample of firms to 10,580 to 5145 in the stock returns model.

⁴Because the return on assets can be negative, we took the natural logarithm of the firm's return on assets after adding 1 to it and then dropped 60 firm-years, a negligible number in our sample, for which the return on assets was less than -1.

TABLE 1
Distribution of Firms by Product-Market

Product Market	Number of Firm-Years	Percentage
B2B goods	7617	72
B2B services	1270	12
B2C goods	1058	10
B2C services	635	6
Total	10,580	100

Notes: We used the firm's primary four-digit SIC code to classify firms as B2B goods (e.g., chemicals, primary metal), B2B services (e.g., business services, engineering, accounting, research, management and related services), B2C goods (e.g., food and kindred products, apparel), and B2C services (e.g., hotels, travel agents). We excluded the farming sector from the data set.

TABLE 2
Profile of Firms

Variable	Mdn	M
Market capitalization (\$ million)	129	3,396
Total assets (\$ million)	139	3,213
Sales (\$ million)	156	2,682
R&D/sales	.037	.142
Advertising/sales	.019	.041
Return on assets	.050	.032
Stock returns	.031	.076

Notes: The descriptive statistics are for the sample of 10,580 observations used for the estimation of the profit model.

We obtained data on firms' R&D and advertising from COMPUSTAT.⁵ The effects of R&D and advertising spending on performance persist beyond the year in which those expenses are incurred (Hirschey and Weygandt 1985). We

⁵Research and development expenses in COMPUSTAT include company-sponsored R&D, purchased R&D when reported as a special item, expenses from continuing operations (for those engaged in primary business of R&D), and software development expense (COMPUSTAT manual, pp. 222–23; see <http://www.standardandpoors.com> [accessed on April 15, 2010]). Advertising expenses in COMPUSTAT include the cost of advertising media (radio, television, newspapers, and periodicals) and promotional expenses (COMPUSTAT manual, p. 200).

address this issue in two ways. First, we measured R&D (and advertising) spending with a stock measure over five- (three-) year periods with an annual discount rate of .15 (.40). We subsequently demonstrate the robustness of our results to an alternative amortization period. Second, we use a log first- and ρ -differencing approach to estimation that incorporates the effects of R&D (advertising) spending in current (t), previous ($t - 1$), and two-year lag ($t - 2$) to account for previous years' R&D (advertising) spending. We measured market share as the firm's total sales divided by the sales of all firms in the firm's primary two-digit Standard Industrial Classification (SIC) code, an approach that produces results consistent with those using finer three- or

TABLE 3
R&D and Advertising in Recessions: Firm Profits and Stock Returns

Effects	Hypothesized Model		Alternative Measure of R&D and Advertising Spending	
	Profits	Stock Returns	Profits	Stock Returns
Effects of Interest (Three-Way Interactions)				
R&D × recession × market share	.003 (.001)***	.001 (.000)***	.002 (.000)***	.000 (.000)
advertising × recession × market share	-.002 (.001)***	-.001 (.000)***	-.002 (.000)***	-.001 (.000)***
R&D × recession × financial leverage	-.002 (.003)	-.000 (.001)	.000 (.003)	-.001 (.001)
advertising × recession × financial leverage	.005 (.002)**	-.001 (.000)	.005 (.002)**	-.000 (.000)
R&D × recession × B2C goods	.035 (.015)**	.007 (.004)*	.021 (.013)*	.005 (.004)
advertising × recession × B2C goods	-.044 (.020)**	.011 (.006)**	-.050 (.018)***	.009 (.005)*
R&D × recession × B2B services	.069 (.014)***	.009 (.004)**	.033 (.012)***	.006 (.003)*
advertising × recession × B2B services	-.055 (.020)***	.012 (.005)**	-.060 (.017)***	.009 (.004)**
R&D × recession × B2B goods	.067 (.013)***	.007 (.004)*	.036 (.011)***	.004 (.003)
advertising × recession × B2B goods	-.057 (.019)***	.011 (.005)**	-.057 (.016)***	.008 (.002)**
Control Variables				
Recession	-.129 (.069)*	-.072 (.020)***	-.039 (.063)	-.053 (.015)***
R&D	.126 (.041)***	-.007 (.015)	.081 (.035)**	.018 (.014)
Advertising	.031 (.036)	.006 (.011)	-.058 (.024)**	-.001 (.001)
Market share	-.026 (.024)	-.010 (.005)*	-.007 (.022)	-.007 (.005)
Financial leverage	.094 (.006)***	.006 (.001)***	.081 (.005)***	.007 (.001)***
Firm size	-.056 (.024)**	-.009 (.005)	-.050 (.022)**	-.013 (.005)***
Two-Way Interactions				
R&D × recession	-.050 (.013)***	-.004 (.004)	-.020 (.012)*	-.004 (.003)
advertising × recession	.044 (.019)**	-.014 (.005)***	.046 (.016)***	-.010 (.004)**
R&D × market share	.005 (.002)**	.000 (.001)	.010 (.002)***	.001 (.000)*
advertising × market share	.001 (.002)	-.001 (.000)***	.001 (.001)	-.000 (.000)
R&D × financial leverage	.008 (.003)**	-.000 (.001)	.004 (.003)	-.001 (.001)*
advertising × financial leverage	-.010 (.002)***	.000 (.000)	-.011 (.002)***	.000 (.000)
R&D × B2C goods	-.072 (.048)	.005 (.017)	-.007 (.039)	-.005 (.015)
advertising × B2C goods	-.026 (.042)	-.014 (.012)	.018 (.029)	.003 (.009)
R&D × B2B services	-.080 (.041)**	.017 (.016)	-.007 (.033)	-.015 (.014)
advertising × B2B services	-.046 (.036)	-.016 (.011)	.058 (.023)**	.003 (.008)
R&D × B2B goods	-.098 (.039)**	.011 (.015)	.006 (.031)	-.013 (.014)
advertising × B2B goods	-.018 (.035)	-.016 (.011)	.059 (.022)***	.001 (.008)
recession × B2C goods	.038 (.078)	.072 (.022)***	-.083 (.072)	.054 (.016)***
recession × B2B services	.119 (.075)	.072 (.020)***	-.032 (.067)	.054 (.015)***
recession × B2B goods	.116 (.070)*	.078 (.020)***	-.011 (.063)	.051 (.015)***
Constant	-.001 (.002)	.000 (.000)	-.003 (.002)*	-.000 (.000)
Observations	10,580	5145	12,809	5917
R-square	.045	.053	.033	.072
Overall F-value (p -value)	16.19***	9.31***	14.65***	13.88***

* $p < .10$.

** $p < .05$.

*** $p < .01$.

Notes: Figures are rounded to the third decimal place. In Columns 1 and 2, following Hirschey and Weygandt (1985), we computed R&D and advertising spending as stock measures using five and three years with amortization rates of .15 and .60, respectively. In Columns 3 and 4, we computed R&D and advertising spending as stock measures using four and two years for amortization, respectively.

four-digit SIC codes (Clark 1989). We computed financial leverage as the ratio of the firm's long-term debt to its total assets (Jensen and Meckling 1976).

We measured firms' membership in the four product-market profiles according to their primary four-digit SIC codes using the business description that the Occupational Safety and Health Administration provides (Palepu 1985).⁶ Finally, we measured the firm's size by its sales lagged by a year, adjusted to constant dollars using the gross domestic product deflator (Boulding and Staelin 1995).

Results: Contingent Effects of R&D and Advertising

We estimated the model in Equation A1 (see the Web Appendix at <http://www.marketingpower.com/jmmay11>) using ordinary least squares regression (Boulding and Staelin 1995). We determined the value of ρ (.18) using a grid search mechanism that minimized the sum of squared errors. We estimated two models, one for profits and another for stock returns, which we discuss in the following subsections.⁷

Profits

Table 3, Column 1, presents the results of the model estimation for the firm's profits in recessions.⁸ Recall that we are interested in testing the hypotheses pertaining to the contingent effects represented by the three-way interaction effects. The data fit the model well (F -value = 16.19, $p < .01$); the R-square is not interpretable for this model (Boulding and Staelin 1995). We test the hypotheses by assessing the statistical significance of the related three-way interaction effects. As we hypothesized in H_{1RD}^P and H_{1AD}^P , respectively, the interaction between R&D spending in recessions and market share on profits is positive ($\beta_{11}^P = .003$, $p < .001$) and between advertising spending in recession and market share is negative ($\theta_{11}^P = -.002$, $p < .01$). With respect to the contingent effect of the firm's financial leverage hypothesized in H_{2RD}^P and H_{2AD}^P , respectively, we find no support for the interaction effect between R&D spending in recessions and financial leverage ($\beta_{12}^P = -.002$, not significant [n.s.]) but find support for the positive inter-

⁶Examples of B2B goods are the following four-digit codes: 2221 (broadwoven fabric mills) and 2861 (gum and wood chemicals), examples of B2C goods are 2095 (roasted coffee) and 2384 (robes and dressing gowns), examples of B2B services are 2754 (commercial printing, gravure) and 7311 (advertising agencies), and examples of B2C services are 7011 (hotels and motels) and 7241 (barber shops).

⁷We examined the variance inflation factors for the model and found them to be less than ten, suggesting that multicollinearity is unlikely to be a threat to the validity of the results.

⁸We examined the potential for survivorship bias by estimating a Heckman sample selection model with the following predictor variables: firm size, firm performance, R&D, and advertising spending in a probit model of firm exit. We used the inverse Mills lambda from this model and included it in both the profit and stock return models. We found no significant effect for the inverse Mills lambda on either profits or stock returns.

action effect between advertising spending in recessions and financial leverage ($\theta_{12}^P = .005$, $p < .05$).

Next, we discuss the findings with regard to the contingent effect of product-market profiles. The interaction effects in Table 3 are the contingent effects of R&D (advertising) spending in recessions on profits (stock returns) of firms in other product-market profiles compared with B2C services firms, the baseline product-market profile and the smallest group of firms in the data set, with no loss of generality. As we hypothesized in H_{3RD}^P and H_{3AD}^P , respectively, for B2C goods firms (compared with B2C services firms), an increase in R&D spending in a recession has a positive effect on profits ($\beta_{13}^P = .035$, $p < .05$), while an increase in advertising spending in a recession has a negative effect on profits ($\theta_{13}^P = -.044$, $p < .05$). Furthermore, as we hypothesized in H_{4RD}^P and H_{4AD}^P , respectively, for B2B services firms (compared with B2C services firms), an increase in R&D spending in a recession has a positive effect on profits ($\beta_{14}^P = .069$, $p < .01$), while an increase in advertising spending in a recession has a negative effect on profits ($\theta_{14}^P = -.055$, $p < .01$). Finally, as we hypothesized in H_{5RD}^P and H_{5AD}^P , respectively, we find that an increase in R&D spending in recessions by B2B goods firms compared with that of B2C services firms has a positive effect on profits ($\beta_{15}^P = .067$, $p < .01$) and an increase in advertising spending in a recession has a negative effect on profits ($\theta_{15}^P = -.057$, $p < .01$).

Stock Returns

Table 3, Column 2, presents the results for stock returns. Again, the data fit the model well ($F = 9.31$, $p < .01$). As we hypothesized in H_{1RD}^S and H_{1AD}^S , respectively, the interaction effect between R&D spending in recessions and market share on stock returns is positive ($\beta_{11}^S = .001$, $p < .001$) and the interaction effect between advertising spending in recessions and market share is negative ($\theta_{11}^S = -.001$, $p < .001$). However, we find no support for H_{2RD}^S and H_{2AD}^S (respectively, the interaction effects between R&D ($\beta_{12}^S = -.000$, n.s.) and advertising ($\theta_{12}^S = -.001$, n.s.) in recessions and financial leverage on stock returns).

With respect to product-market profiles (for which we did not develop formal hypotheses), the results indicate that during a recession, the effects of increases in R&D spending by B2C goods firms ($\beta_{13}^S = .007$, $p < .10$), B2B services firms ($\beta_{14}^S = .009$, $p < .05$), and B2B goods firms ($\beta_{15}^S = .007$, $p < .10$) on stock returns are greater than B2C services firms. Likewise, during a recession, the effects of increases in advertising spending on stock returns are greater for B2C goods firms ($\theta_{13}^S = .011$, $p < .05$), B2B services firms ($\theta_{14}^S = .012$, $p < .05$), and B2B goods firms ($\theta_{15}^S = .011$, $p < .05$) than for B2C services firms.

Summary of Contingent Effects Pertaining to Hypotheses

In summary, nine of the ten three-way hypothesized interaction effects ([market share, financial leverage, and product-market profiles] \times [R&D \times recession, advertising \times recession]) in the profits equation and eight of the ten three-way hypothesized interaction effects in the stock returns equa-

tions are significant, in support of the contingency-based approach to model the effects of R&D and advertising spending in recessions on firm performance. We discuss the theoretical implications of the contingent effects in the “Discussion” section.

Robustness Analyses

Do advertising and R&D spending amortization periods matter? Following Hirschey and Weygandt (1985), we measured R&D and advertising spending using a five-year (three-year) period with an annual discount rate of .15 (.40). We reestimated the models using four- and two-year amortization periods for R&D and advertising spending, respectively. The results presented in Table 3, Columns 3 and 4, are generally consistent with those in Columns 1 and 2, demonstrating their robustness to alternative definitions of R&D and advertising spending.

Do other industry characteristics matter? Next, we examined the robustness of the results to variations in competitive intensity (measured by the four-firm concentration ratio of the firm’s industry defined by the two-digit SIC code) and industry turbulence (measured by the coefficient of variation in sales of the firm’s industry, defined by the two-digit SIC code, over three prior years). We found that competitive intensity and industry turbulence did not affect the pattern of profit and stock returns rewards to R&D or advertising spending in recessions.

*Have patterns of returns to R&D and advertising spending changed over time?*⁹ To address whether patterns have changed over time, we estimated the regression models for profits in two additional subsamples that excluded (1) the last recession (2008) and (2) the last two recessions (2001 and 2008). The results of these two models (not reported here in the interest of brevity but available on request from the authors) are consistent with those reported for profits in Table 3, Column 1, demonstrating the stability of the returns to R&D and advertising spending with regard to profits in recessions over time.

Results: Marginal Effects of R&D and Advertising

We use the estimated contingent effects Table 3, Columns 1 and 2, reports and data on a firm’s market share, financial leverage, and product-market profile type to obtain firm-specific marginal effects of R&D and advertising spending on profits and stock returns in recessions and in nonrecessionary periods. Because each marginal effect combines the estimates of the different contingent effects (Table 3), the marginal effect is a multivariate function of random variables (i.e., it is obtained with a measure of uncertainty). We use Krinsky and Robb’s (1986) method, recently used by Mantrala et al. (2007) in marketing, to obtain the standard error and confidence intervals of the firm-specific marginal effects to assess their statistical significance. We obtained 1000 draws of the coefficients for each marginal effect from a multivariate normal distribution. (Mean and

covariance are the estimated coefficients and their covariance matrix, respectively, in Table 3.) These 1000 draws from the joint distribution of the coefficients provide 1000 simulated values of the firm-specific marginal effects. Then, we obtained the lower and upper limits of a 95% confidence interval for each marginal effect (26th and 976th estimates of the sorted simulated values) to assess whether a given firm’s marginal effect was positive and statistically significant, negative and statistically significant, or not significantly different from zero.

Interpretation of the Marginal Effects

The marginal effect of (an increase in) R&D or advertising spending on profits in recessions and its associated statistical significance (negative, positive, or not statistically different from zero) indicates whether the firm is overspending, underspending, or spending at approximately the right level. However, the marginal effects (positive, negative, or zero) of R&D and advertising spending on stock returns have different interpretations from their corresponding marginal effects on profits. If the marginal effect of R&D (advertising) spending on stock returns is positive and significant, the firm is rewarded by the stock market for an increase in R&D (advertising) spending. If the marginal effect of R&D (advertising) spending on stock returns is negative and significant, the firm is punished by the stock market for an increase in R&D (advertising) spending. If the marginal effect of R&D (advertising) on stock returns is not significantly different from zero, the stock market is indifferent to an increase in R&D (advertising) spending.

Summary of Marginal Effects

We generate insights into the marginal effects of R&D and advertising spending in recessions and in nonrecessionary periods by summarizing the overall patterns across firms in the four product-market profiles. Specifically, we discuss the firm-specific marginal effects in recessions as (1) the marginal effect of R&D and advertising spending for (2) B2C goods, B2B services, B2B goods, and B2C services firms in recessions on (3) profits and stock returns respectively (i.e., $2 \times 4 \times 2 = 16$ cells). We summarize the marginal effects of R&D and advertising during recessions (and for completeness, during nonrecessionary periods) on profits in Table 4, Panels A and B, Columns 1 and 2, respectively, and on stock returns during recessions (and nonrecessionary periods) in Columns 1 and 2 of Table 5, Panels A and B, respectively. Given our interest in firms’ R&D and advertising spending in recessions, we display these results graphically in Figure 1.

In each cell (e.g., Table 4, Panel A, B2B goods, recession, R&D marginal effects), we report the mean, minimum, and maximum, respectively, of the firm-specific marginal effects pertaining to the cell (e.g., in B2B goods firms, the minimum, mean, and maximum marginal effects of R&D in recession on profits are $[-.506, -.003, .092]$). Note that the mean of the firm-specific marginal effects in Tables 3 and 4 will not equal the mean marginal effect computed with the sample means of market share and financial leverage. In addition, because firm-specific marginal effects in a

⁹We thank an anonymous reviewer for raising this question.

TABLE 4
Marginal Effects of R&D and Advertising Spending on Profits

A: Marginal Effects of R&D Spending on Profits: Recessions and Nonrecessionary Periods		
Product Market	Recessions	Nonrecessionary Periods
	(Minimum, Mean, Maximum) % Negative, % Zero, % Positive, ($p < .05$)	(Minimum, Mean, Maximum) % Negative, % Zero, % Positive, ($p < .05$)
B2C goods	(.022, .100, .292) 0%, 2%, 98%	(-.039, -.000, .035) 15%, 72%, 13%
B2B services	(-.101, -.002, .053) 6%, 91%, 3%	(-.057, .000, .053) 9%, 83%, 8%
B2B goods	(-.506, -.003, .092) 16%, 68%, 16%	(-.178, .000, .113) 22%, 59%, 19%
B2C services	(-.028, .176, .345) 4%, 8%, 88%	(-.261, -.008, .062) 43%, 32%, 25%

B: Marginal Effects of Advertising Spending on Profits: Recessions and Nonrecessionary Periods		
Product Market	Recessions	Nonrecessionary Periods
	(Minimum, Mean, Maximum) % Negative, % Zero, % Positive, ($p < .05$)	(Minimum, Mean, Maximum) % Negative, % Zero, % Positive, ($p < .05$)
B2C goods	(-.104, -.022, .031) 2%, 98%, 0%	(-.040, .001, .131) 13%, 74%, 13%
B2B services	(-.112, -.001, .076) 3%, 96%, 1%	(-.131, .001, .323) 25%, 46%, 29%
B2B goods	(-.157, .012, .187) 6%, 59%, 35%	(-.110, -.000, .137) 31%, 41%, 28%
B2C services	(-.434, -.167, .055) 92%, 8%, 0%	(-.056, -.002, .027) 11%, 78%, 11%

Notes: For example, for the row "B2C goods," the marginal effects of R&D spending for B2C goods firms in recessions range from a low of .022 to a high of .292 (Column 1, first row of Panel A). No B2C goods firm (0%) overspends, and 98% of B2C goods firms could increase profits by increasing R&D spending during recessions.

given cell may be positive, negative, or zero, comparisons of marginal effects across cells are not meaningful. In the following sections, we discuss the incidence of statistically significant positive, negative, and zero effects during recessions and, for completeness, nonrecessionary periods.

Marginal Effects on Profits

With respect to recessions, the results in Table 4 (Columns 1 in Panels A and B) and Figure 1, Panels A and B, indicate that the general tendency for B2C goods firms (98%) is to underspend on R&D and for B2C services firms (92%) to overspend on advertising. However, 96% of the B2B services firms spend advertising at levels that are approximately right. During recessions, while most B2B goods firms have R&D (68%) and advertising spending (59%) levels that are approximately accurate from a profit perspective, many of them underspend on R&D (16%) and advertising (35%), and others overspend on R&D (16%) and advertising (6%).

During nonrecessionary periods, most B2B goods firms have R&D (59%) and advertising spending (41%) levels that are approximately accurate from a profit perspective, though some of them overspend on R&D (22%) and advertising (31%) and yet others underspend on R&D (19%) and advertising (28%). For B2C goods firms, 72% spend approximately the right amount during nonrecessionary periods on R&D, 78% of B2C services firms spend at levels

that are about right on advertising during nonrecessionary periods, and 11% of B2C services firms overspend on advertising. However, some B2B services firms misspend on advertising during nonrecessionary periods, with 29% and 25% of them underspending and overspending, respectively.

Marginal Effects Related to Stock Returns

The results in Table 5 (Columns 1 in Panels A and B) and Figure 1, Panels C and D, indicate that during recessions, some B2B goods firms (29%) and many B2C services firms (58%) generate positive stock returns in response to increases in R&D and advertising spending, respectively. However, some B2B firms (42% of B2B goods firms and 46% of B2B services firms) obtain negative stock returns in response to increases in advertising spending during recessions.

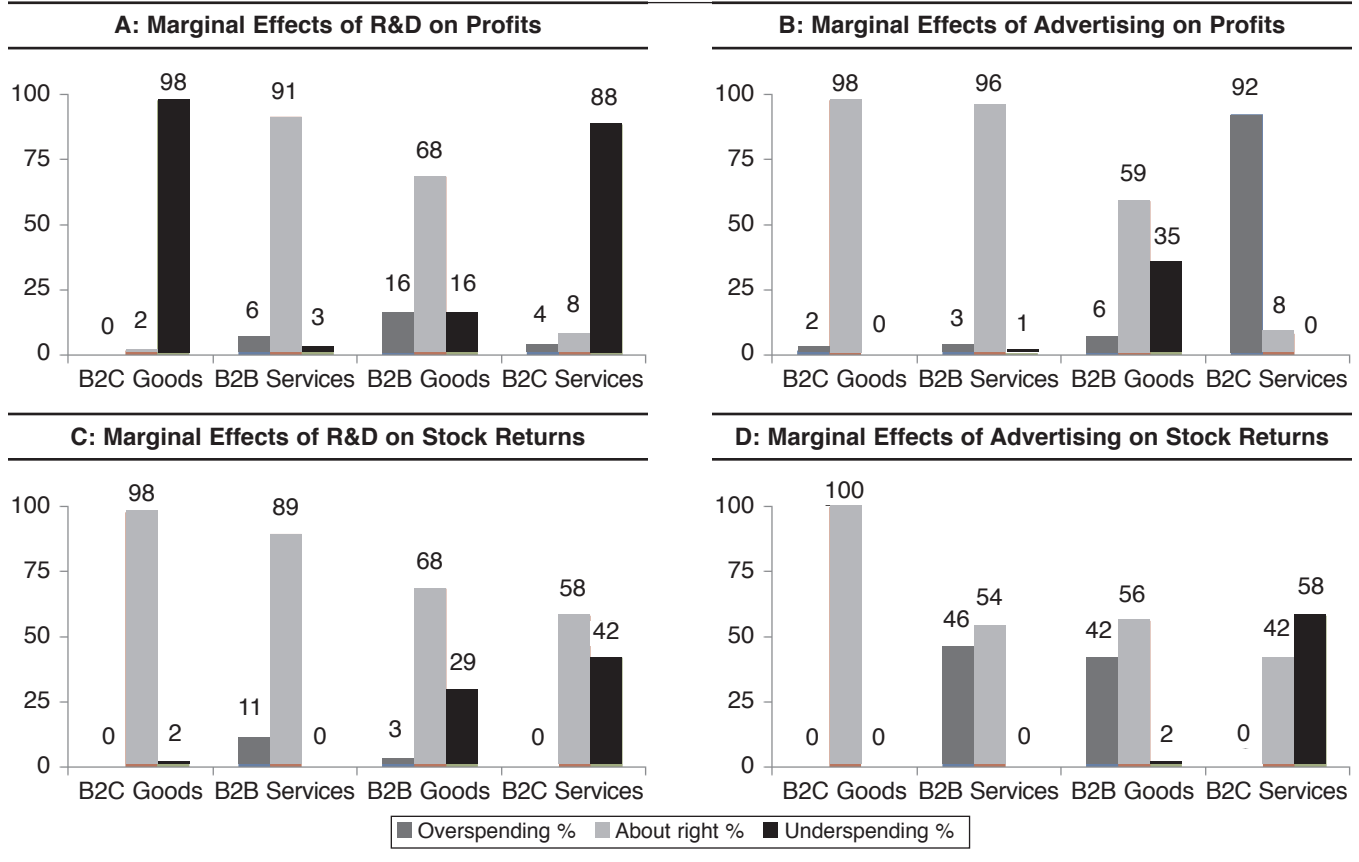
With respect to nonrecessionary periods, the dominant tendency is for null stock returns in response to changes in advertising (58% of B2B goods firms and 82% of B2B services firms). While increases in R&D spending by B2B goods firms (100%) and increases in advertising spending by B2C services firms (97%) garner little positive stock returns during nonrecessionary periods, several B2B goods firms (29%) and many B2C services firms (58%) generate positive stock returns in response to increases in R&D and advertising, respectively, during recessions. Next, we discuss the implications of the findings for managerial practice and marketing theory.

TABLE 5
Marginal Effects of R&D and Advertising Spending on Stock Returns

A: Marginal Effects of R&D Spending on Stock Returns: Recessions and Nonrecessionary Periods		
Product Market	Recessions (Minimum, Mean, Maximum)	Nonrecessionary Periods (Minimum, Mean, Maximum)
	% Negative, % Zero, % Positive, ($p < .05$)	% Negative, % Zero, % Positive, ($p < .05$)
B2C goods	(-.008, .001, .013) 0%, 98%, 2%	(-.003, .000, .010) 0%, 100%, 0%
B2B services	(-.025, -.002, .003) 11%, 89%, 0%	(-.013, -.001, .005) 0%, 100%, 0%
B2B goods	(-.076, .001, .017) 3%, 68%, 29%	(-.003, .000, .003) 0%, 100%, 0%
BB2C services	(.003, .021, .047) 0%, 58%, 42%	(-.003, -.001, .009) 0%, 100%, 0%

B: Marginal Effects of Advertising Spending on Stock Returns: Recessions and Nonrecessionary Periods		
Product Market	Recessions (Minimum, Mean, Maximum)	Nonrecessionary Periods (Minimum, Mean, Maximum)
	% Negative, % Zero, % Positive, ($p < .05$)	% Negative, % Zero, % Positive, ($p < .05$)
B2C goods	(-.012, .000, .013) 0%, 100%, 0%	(-.006, .000, .004) 1%, 97%, 2%
B2B services	(-.030, -.010, .007) 46%, 54%, 0%	(-.007, .001, .004) 5%, 82%, 13%
B2B goods	(-.022, -.004, .026) 42%, 56%, 2%	(-.011, .000, .009) 18%, 58%, 24%
B2C services	(.023, .031, .038) 0%, 42%, 58%	(-.012, -.001, .005) 0%, 97%, 3%

FIGURE 1
Summary of Marginal Effects by Product Market Profile



Discussion

To address whether firms should spend more on R&D and advertising during recessions, we developed a contingency-based approach to model the relationship between a firm's R&D and advertising spending in recessions and its performance and tested that model using a data set that covers seven recessions. Our empirical modeling approach enabled us to incorporate unobserved heterogeneity, serial correlation, and random errors. Our findings are robust to alternative variable specifications and to the inclusion of two industry characteristics (i.e., competitive intensity and industry turbulence) and are in general stable over time.

We find support for a contingency approach to study the performance rewards to R&D and advertising in recessions. Our marginal effects analyses provide evidence of inadequate spending (e.g., 98% of B2C goods firms underspend on R&D), proactivity (e.g., 96% of B2B services firms are at approximately the right levels on advertising), and excess spending (e.g., 92% of B2C services firms overspend on advertising) in recessions.

Managerial Implications

We generate managerial implications for firms' spending in recessions. For managers seeking general guidelines, Tables 3 and 4 provide the overall pattern of marginal effects of R&D and advertising spending by firms in the different product-market profile (percentage underspent, overspent, or spent approximately right in past recessions). Managers seeking more customized guidance can use our statistical approach to generate firm-specific estimates of the effectiveness of their firm's (and their competitors') R&D and advertising spending in recessions.

Which Firms Benefit from R&D and Advertising Spending in Recessions?

The current study offers several findings on the marginal effects of R&D and advertising on profits and stock returns in recessions (Tables 4 and 5) that generate specific managerial guidelines:

1. *B2C goods firms*: (a) Profits: In recessions, most B2C goods firms underspend on R&D and are at approximately

the right levels of advertising with respect to profits. Managers of these B2C goods firms can consider increasing their R&D spending in recessions, which should increase their profits. (b) Stock returns: However, B2C goods firms do not obtain positive stock returns from either R&D or advertising spending.

2. *B2B services firms*: (a) Profits: In recessions, most B2B services firms are at approximately the right levels of R&D and advertising with respect to profits. Managers of these firms need not change their R&D and advertising spending in recessions if they are focused on profits. (b) Stock returns: However, B2B services firm investors do not reward R&D and advertising.
3. *B2B goods firms*: (a) Profits: In recessions, most B2B goods firms spend at approximately the right levels of R&D and advertising with respect to profits. Managers of these firms need not change their spending in recessions. (b) Stock returns: However, some B2B goods firms get positive stock returns in response to R&D spending (i.e., recessions are an opportunity for them) and negative stock returns in response to advertising.
4. *B2C services firms*: (a) Profits: In recessions, most B2C services firms underspend on R&D and overspend on advertising with respect to profits. Therefore, these firms can consider increasing their R&D spending and decreasing their advertising spending in recessions to improve their profits. (b) Stock returns: Many B2C services firms achieve positive stock returns in response to their R&D and advertising spending.

What Are the Returns to Firms' (and/or Competitors') R&D and Advertising Spending in Recessions?

Using our approach and publicly available data on R&D spending, advertising spending, market share, financial leverage, and product-market profiles, managers can compute firm-specific estimates of the effects of their firms' and their competitors' R&D and advertising spending during recessions (and nonrecessionary periods) on profits and stock returns. The Appendix provides detailed instructions describing how managers can implement the approach we propose to generate firm-specific insights.

Table 6 illustrates this approach for four publicly listed firms in our sample during two recent recessions (2001, 2008). For Firm A, the marginal effects of R&D and adver-

TABLE 6
Illustrative Application of Marginal Effects Analysis

Characteristic	Firm A	Firm B	Firm C	Firm D
Product-market profiles	B2B services	B2B goods	B2C goods	B2C services
Recession year	2008	2001	2001	2008
R&D (\$ million)	6015	650	131	34
Advertising (\$ million)	1259	184	489	584
R&D on profit: marginal effect	-.021**	-.001 (n.s.)	.080***	.249***
Advertising on profit: marginal effect	-.001 (n.s.)	.018 (n.s.)	-.018 (n.s.)	-.113**
R&D on stock returns: marginal effect	-.006**	.000 (n.s.)	-.001(n.s.)	.023 (n.s.)
Advertising on stock returns: marginal effect	.001 (n.s.)	-.001 (n.s.)	.002 (n.s.)	.031**

* $p < .10$

** $p < .05$.

*** $p < .01$.

Notes: Implications: Firm A: A decrease in R&D spending increases both profits and stock returns. Firm B: Firm seems to be spending approximately right in R&D and advertising. Firm C: An increase in R&D spending increases profits. Firm D: An increase in R&D spending increases profits (but has no effect on stock returns). A decrease in advertising spending increases profits, while an increase in advertising spending increases stock returns. n.s. = not significant.

tising on profits in 2008 were $-.021$ ($p < .05$) and $.001$ (n.s.), and on stock returns in 2008 they were $-.006$ ($p < .05$) and $.001$ (n.s.), respectively.¹⁰ These results suggest that the firm overspent on R&D and spent approximately the right amount on advertising from a profit perspective. However, Firm D underspent on R&D and overspent on advertising with respect to profit, but the stock market did not reward this firm for increases in R&D spending, though it rewarded the firm for an increase (rather than a decrease) in advertising spending. (Note that the stock market's valuation of a firm's actions is complex, and there is some evidence of mispricing [see Aksoy et al. 2008] a topic that is beyond the scope of this study.)

Interested managers can compare the marginal effects of their firms' (and competitors') R&D and advertising spending on profits and stock returns during recessions with those during nonrecessionary periods to assess how the performance rewards vary with economic cycles.

Implications for Theory

Performance rewards to spending in recessions. This article's findings enrich the understanding of the effects of marketing in recessions. Unlike Srinivasan, Lilien, and Rangaswamy (2005), who focus on a single recession, using subjective performance data from surveys of managers, we use actual performance data covering multiple recessions while controlling for the contingent effects of firm characteristics on the rewards to R&D and advertising spending in recessions. Moreover, we investigate both a short-term performance metric, accounting profit, as well as a long-term metric, stock return. The findings from the marginal effects analyses, which identify conditions in which firms overspend on R&D and advertising during recessions, generalize Srinivasan, Lilien, and Rangaswamy's (2005) finding that increases in marketing activities in recessions improve profits for some firms but not for others.

Our findings also help reconcile the mixed findings in the literature on the rewards to R&D and advertising spending. Some studies report a positive effect of increases in R&D and advertising spending in recessions on profits (e.g., Capon, Farley, and Hoenig 1990) and stock returns (Griliches 1981), while others find no effect (e.g., Erickson and Jacobson 1992) on either profits or stock returns. The support for the contingency-based approach suggests that the rewards to firms' R&D and advertising programs during recessions differ by firm characteristics—market share, leverage, and product-market profile—even after controlling for the economic environment (i.e., whether there is a recession). These results also clarify the mixed findings for the profit rewards in response to increases in R&D and advertising spending during recessions (e.g., Graham and Frankenberger 2008; Tellis and Tellis 2009).

Recessions and the effects of firms' R&D and advertising spending on performance. As we noted previously, from

¹⁰We obtained the statistical inference reported in this section using Krinsky and Robb's (1986) method.

a theory-building perspective, a positive three-way contingent effect offers insights into the performance increase (decrease) of R&D (advertising) spending attributable to the recession. Referring to our illustration, the coefficient Ψ_{12} (a three-way interaction) in Equation 3 captures how recession changes the effect of Z_1 in the X–Y relationship, and ψ_{11} captures the X–Y relationship during nonrecessionary periods. Thus, integrating knowledge from the estimates of Ψ_{12} and ψ_{11} helps identify the recession-based boundary condition in a contingent model of how Z_1 influences the X–Y relationship.

As an example, consider the effect of market share and R&D spending on profit. The two-way interaction effect between R&D and market share ($b = .005$, $p < .001$) in Table 3 indicates that in nonrecessionary periods, all else being equal, an increase in market share increases the positive effect of R&D spending on profit. Integrating this result with the positive three-way interaction effect of R&D, market share, and recession ($b = .003$, $p < .001$) in Table 3 indicates that recession strengthens the benefits of R&D spending conferred by market share. Other three-way contingent effects may be interpreted similarly, thus adding recession-based boundary conditions to extant knowledge of advertising and R&D effectiveness.

Contingencies in the effects of R&D and advertising spending on stock returns. From a theoretical perspective, the article's insights into the contingent effects of R&D and advertising spending on stock returns during recessions also contribute to the marketing metrics literature, which has, for the most part, focused on the main effects of R&D and advertising spending (e.g., McAlister, Srinivasan, and Kim 2007). Finally, the rewards to R&D and advertising spending in recessions on profits and stock returns vary across B2C goods, B2B services, B2B goods, and B2C services firms. Although we provide some explanations for these differences, further work that refines the contingent nature of the theory here would be useful.

Limitations and Further Research

This research has limitations that offer opportunities for further research. In our empirical analysis, we did not distinguish between service firms with contractual relationships (e.g., cell-phone contracts) and those with noncontractual relationships that can be easily changed in the short term (e.g., contract with a market research supplier). We might expect differences in the effects of R&D and advertising spending in recessions on performance between these types of service firms. Further research focusing on contractual versus noncontractual services firms could lead to new insights.

In addition, our work is based in the United States, and we do not consider the role of firms' global economic activity. In the period under study, our research indicated that recessions in advanced economies coincided with recessions in United States (Claessens and Kose (2009). Further research that examines cross-country differences in the

effects of R&D and advertising spending in recessions would be a useful extension.

We focused on firms' R&D and advertising spending as proxies for their product development and marketing spending, respectively, and profits and stock returns as proxies for firm performance. However, recessions threaten firm survival, a metric that may be considered in further research. In addition, while changes in firms' advertising and nonadvertising budgets are correlated because elements of integrated programs are frequently aligned (Lilien and Ruzdic 1982), analysis of the effects of distribution channels (e.g., Amazon.com), pricing (e.g., Wal-Mart) and supply chain management (e.g., Dell) strategies on firm performance, including survival, in recessions would be useful.

Our use of secondary data precluded consideration of organizational factors (e.g., culture, market orientation, product portfolios), which are critical in leveraging returns from R&D and advertising spending. Further research could relate organizational factors in recessions to other metrics using complementary methods (e.g., surveys, in-depth interviews).

Additional analyses indicated that R&D and advertising spending patterns of sample firms vary across recessions and nonrecessionary periods and multiple recessions.¹¹ Further research that uses a combination of approaches (e.g., surveys, in-depth interviews) and examines whether managers know of the marginal effects of changes in their advertising and R&D spending during recessions compared with nonrecessionary periods, and learn across multiple recessions would be a useful extension to this work.

Furthermore, a comparison of the marginal effects of R&D and advertising spending on profits and stock returns for the firms in our sample (reported in Tables 4 and 5) suggests that although there is a match in a few cases between the marginal effects on profits and stock returns, in other cases, the marginal effects of R&D and advertising spending on profits differ from the effects on stock returns. These findings, which add to the ongoing debate in the literature on the mispricing of stocks with respect to marketing spending, offer an opportunity for further research.

Finally, we used the NBER definition of recessions, which affects consumer demand. However, recessions vary in their severity, and one way to capture the differences in the severity of the recession is the extent of the decline in the gross domestic output. Future work that explores the effectiveness of marketing spending in recessions of different severity would be useful.

A rising tide may lift all boats, but the corollary to that statement is that successful navigation at low tide shows the sailor's true merit. We view this study as a useful step in exploring the performance implications of marketing activities in a recession, helping marketers determine how best to navigate during such troubled times. We hope this study sheds some light on the subject and stimulates further work in the domain.

The firm-specific R&D and advertising effects β_i 's and θ_i 's are relegated to the error term. We use lags of higher

order than the error term as instruments to obtain consistent estimates of the parameter estimates without estimating the firm heterogeneity parameters β_i 's and θ_i 's.

Appendix Obtaining the Marginal Effects

We describe the statistical procedure managers can use to calculate the marginal effects of an instrument (advertising/R&D) on performance (profits/stock returns) given the idiosyncratic characteristics of the firm (market share/financial leverage/product market profile) and the environment (recession/nonrecessionary period).

1. For a given firm, obtain the data relevant to the marginal effect, which include data on the firm's advertising/R&D spending, market share, financial leverage, and product market profile. The coefficient estimate vectors pertaining to the profits equation $\psi^p = \{\beta_0^p, \dots, \beta_{21}^p, \theta_0^p, \dots, \theta_{21}^p\}$ and the stock returns equation $\psi^s = \{\beta_0^s, \dots, \beta_{21}^s, \theta_0^s, \dots, \theta_{21}^s\}$ and variance-covariance matrix of the estimates pertaining to the profits equation (Σ^p) and the stock returns equation (Σ^s).
2. Draw 1000 values of ψ_j^p ($j = 1, 2, \dots, 1000$) from the normal distribution $N(\psi^p, \Sigma^p)$ and 1000 values ψ_j^s from the normal distribution $N(\psi^s, \Sigma^s)$. The output from this step is a representative set of estimates obtained with their associated uncertainty.
3. (a) Obtain the marginal effect of R&D and advertising spending on profits (in time period t) by differentiating Y_{it}^p in Equation A1 with regard to R&D and advertising, respectively. (b) Evaluate the expression for each value of ψ_j^p ($j = 1, 2, \dots, 1000$) for every firm by using its idiosyncratic values of market share, financial leverage, and product market profile dummy. In addition, if the focal year during which an evaluation is made constitutes a recession year (time period t), evaluate the expression by setting the term REC_t to 1; otherwise, set REC_t to 0. In evaluating the expression, the manager will also be required to control for spending, market share, financial leverage, and whether the previous two years were recession years, because the model also controls for past period contingencies (see Equation A1). (c) Similarly, obtain the marginal effect of R&D and advertising on stock returns (in time period t) as described previously by using Y_{it}^s and ψ_j^s . (d) Denote the marginal effects in each of the j evaluations as $ME_{P, RD, j}$ (marginal effect of R&D on profits), $ME_{P, AD, j}$ (marginal effect of advertising on profits), $ME_{S, RD, j}$ (marginal effect of R&D on stock returns), and $ME_{S, AD, j}$ (marginal effect of advertising on stock returns), respectively.
4. (a) From the 1000 simulated values of $ME_{P, RD, j}$, $ME_{P, AD, j}$, $ME_{S, RD, j}$, and $ME_{S, AD, j}$, obtain the lower and upper limits of a 95% confidence interval for each marginal effect (26th and 976th estimates of the sorted simulated values) to assess whether a given firm's marginal effect was positive and statistically significant, negative and statistically significant, or not significantly different from zero. (b) Apply the logic described in the subsection titled "Interpretation of the Marginal Effects."

Thus, the four-step procedure constitutes a diagnostic tool that determines the marginal effect of a given spending on the particular performance variable of interest during recessions and nonrecessionary periods.

¹¹We thank an anonymous reviewer for this suggestion.

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