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The Impact of Economic Contractions on the Effectiveness of R&D and Advertising: Evidence from U.S. Companies Spanning Three Decades

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The critical role of research and development (R&D) and advertising in the marketing strategy of the firm is well established. This paper conceptually and empirically examines why and how much the effectiveness of these two marketing instruments differs between times of economic expansions versus periods of economic contractions—and whether these results depend on the cyclicality of the industry in question. We consider a key marketing metric (market share) and a key financial metric (firm profit). Our empirical setting is 1,175 U.S. firms across a time period spanning over three decades. We find that R&D and advertising contribute to firm performance but that their effectiveness is not constant across the business cycle. Increasing advertising share in contractions has a stronger effect on profit and market share than increasing advertising share in expansions. Likewise, investments in R&D in contractions lead to higher gains in market share and profit than R&D investments in expansions, albeit only in subsequent years. If in contractions the firm faces tight budget constraints and has to choose between either maintaining R&D or advertising, our simulation results show that maintaining R&D is associated with better company performance. We find that advertising effectiveness, in general, and in contractions, in particular, is systematically moderated by the degree of cyclicality of the industry in which the firm operates. In relatively stable industries, advertising effects are small or even nonsignificant, and they do not go beyond the year the firm advertises. However, in highly cyclical industries, advertising effects are long-lasting, its total effect being 50% larger (market share) and 200% larger (profits) than in industries of average cyclicality. The effect of industry cyclicality on advertising effectiveness is especially pronounced in contractions. Collectively, these findings provide valuable and actionable insights into how firms should respond to contractions in order to grow profits and market share.

Key words: economic contractions; R&D; advertising
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Danger Opportunity

The Chinese use two brush strokes to write the word "crisis." One brush stroke stands for danger, the other for opportunity. —John F. Kennedy

1. Introduction

Research and development (R&D) and advertising are among the most important marketing strategy variables (Mizik and Jacobson 2003). Previous research has shown that marketing decisions concerning the intensity of use of these instruments depend systematically on the state of the economy (Barlevy 2007, Deleersnyder et al. 2009). Inspired by these findings and the recent economic turmoil, marketing scientists are becoming increasingly interested in the effect of economic contractions on the effectiveness of R&D and advertising. In good times, management's decisions, whether good or bad, will certainly help steer the success of the firm. In bad times, however, the decisions made have a direct impact on the survival of the firm as the margin for errors is thinner. Even though economic contractions cause considerable turmoil in the market, these trying times offer opportunities to decisively pull ahead of one's competitors, and the smart decisions made by management can have

a tremendous positive impact. Industry reports show that contractions dramatically rearrange the pecking order of companies in many industries and that these shake-ups have long-lasting consequences. More than 70% of the companies that made big strides during a contraction preserved their gains during the subsequent boom, whereas fewer than 30% of the companies that lost ground were able to make it up (*Economist* 2009).

Although there are multiple reasons for these dramatic effects, industry analysts have speculated that how companies respond to contractions—in particular, by adjusting their advertising and R&D strategies—plays an important role (American Business Media 1993, *Economist* 2009). However, despite the intriguing conjectures, we know little about whether, why, and how much the effectiveness of advertising and R&D differs systematically between contractions and expansions. The purpose of this paper is to attempt to fill this gap.

1.1. Related Literature

Our study primarily builds on three important studies that have examined how advertising effectiveness depends on the business cycle: Deleersnyder et al. (2009), Srinivasan et al. (2005), and Frankenberger and Graham (2003). We briefly review each of these papers and discuss how we build on their work.

The main focus of Deleersnyder et al. (2009) is on the cyclical sensitivity of aggregate (country-level) advertising expenditure to the business cycle. They find that advertising is considerably more sensitive to business cycle fluctuations than the economy as a whole. In a supplementary cross-sectional analysis on 26 large companies, they find that the more procyclical a firm's advertising expenditure is, the worse its long-run stock price performance. A major contribution of the Deleersnyder et al. (2009) study is that it reveals that the preponderant reaction of firms to difficult times is to cut advertising spending and that, furthermore, it is a global phenomenon. Another important contribution is that they establish the causal sequence between economic contractions and advertising spending. They show that economic contractions lead to a decline in advertising expenditure rather than the other way around. We will use these insights in our work. We also use their econometric filtering procedure to derive the occurrence and depth of contraction periods.

Srinivasan et al. (2005) introduce the construct of proactive marketing in a recession, which is the firm's interpretation of the recession as an opportunity to develop and execute a response in order to capitalize on the perceived opportunity created by the change. They develop a model of the antecedents and consequences of proactive marketing, and they test the model using cross-sectional survey data among managers. Of particular importance for our work is their finding that firms exhibit large variation in responses to the construct of proactive marketing. It shows that there are firms that use contractions as opportunities to boost performance. We will use their insight that not all firms follow the dominant pattern of cutting back marketing efforts in contractions in our simulation analysis, showing that there are benefits in going against the grain.

Whereas the previous two studies are cross-sectional, Frankenberger and Graham (2003) use panel data. They estimate the effects of contemporaneous advertising expenditure and past year-on-year changes in advertising expenditure in expansions versus recessions on firm-operating earnings. They find a positive contemporaneous effect for increasing advertising during a recession but negative effects for two- and three-year lagged advertising. Frankenberger and Graham (2003, p. 81) further conclude that "recessionary decreases in advertising indicate few incremental effects," suggesting that firms need not be overly concerned if they have to reduce advertising during a recession. Their study pioneered extensive longitudinal analyses of business cycle effects on advertising effectiveness for large cross sections of firms. Following their lead, we will also use panel data and study contemporaneous and lagged effects of advertising.

1.2. Contribution

The previous discussion shows how we build on the relevant literature. We add to the literature in four major ways. First, we propose a *conceptual framework* to explain *why* marketing-mix effectiveness differs between contractions and expansions, taking multiple supply- and demand-side factors into account. We operationalize the framework for advertising and R&D. However, because our framework is derived from an understanding of supply- and demand-side effects of economic contractions, it can also serve as an organizing framework to make predictions about the differential effectiveness of other marketing-mix instruments in contractions.

Second, we add to previous research by not only studying the effectiveness of advertising but also of *R&D* across the business cycle.

Third, we introduce the construct of *industry cyclicality* to explain differences in advertising effectiveness, in general, and in contractions, in particular. Frankenberger and Graham (2003) find some differences in advertising effectiveness in contractions between different types of industries (e.g., consumer, industrial, service industries), but it is unclear what gives rise to these differences. We argue that different industries are not equally affected by economic downturns and that we need to take the degree to which

individual industries are affected by the macroeconomic cycle ("industry cyclicality") into account. We will show that the carryover effects of advertising are very dependent on the cyclicality of the industry in which the firm operates and that the effect of industry cyclicality on advertising effectiveness is especially pronounced in contractions.

Fourth, we contribute to previous work in terms of the *execution of the empirical study*. In terms of operational measures, advertising and R&D are measured as share relative to competitors (Reibstein and Wittink 2005), and our contraction measure accounts for the severity of the contraction. Furthermore, we use rigorous panel estimation procedures in which we test and correct for a host of confounding factors, which can seriously bias the parameter estimates of interest (Boulding and Staelin 1993, 1995). Finally, we conduct validation analyses to examine the validity of our findings. Collectively, these empirical refinements increase confidence in the validity of our findings and will help us avoid some of the quizzical results reported in previous research.[1] Our empirical contributions are based on a carefully assembled sample of 1,175 U.S. firms representing a variety of business-to-business (B2B) and business-to-consumer (B2C) industries, covering a 35-year period (1971–2005).

As a result of these contributions, our study responds to Bradlow's (2009, p. 201) call to conduct research on the impact of "down economic times" on the effectiveness of marketing strategies, rather than to just "sit on the sidelines."

1.3. Caveat

We should note one caveat of our study up front. Like previous research, our focus is on aggregate (advertising and R&D) spending. We have no information on the type of advertising used by firms (e.g., price-oriented versus differentiation-focused advertising). Likewise, we have no information on the type of R&D projects (e.g., process versus product innovation). This kind of information is not available for a large number of firms across the 35-year period considered. In the final section, we will discuss how future research can enrich and expand upon our findings by studying whether the type of R&D projects funded and advertising used varies across the business cycle.

[1] Frankenberger and Graham's (2003) model includes contemporaneous advertising expenditure and past year-on-year changes in advertising expenditure. If we rewrite their model in levels, it reveals that lagged advertising expenditure has a negative effect on contemporary operating income, which goes against conventional wisdom. They also find three-year lagged effects for advertising, which is considerably longer than suggested in the literature (Erickson and Jacobson 1992, p. 1269).

The remainder of this paper is organized as follows. We begin by developing a framework for understanding why the effects of R&D and advertising are expected to be different in contractions versus expansions and use it to formulate hypotheses. We then describe our data and modeling procedure and report the results. We conclude with a discussion of managerial implications, limitations, and opportunities for further research.

2. Conceptual Framework and Hypotheses

We begin by describing supply- and demand-side effects of economic contractions. We use these insights as an organizing framework to develop hypotheses as to how contractions systematically moderate the effects of advertising and R&D on firm performance. Finally, we consider the role of the degree of industry cyclicality because different industries are not equally affected by general economic conditions.

In our conceptualization and measurement of advertising and R&D, we are guided by Reibstein and Wittink (2005), who advocate the use of measures *relative* to that of competitors. In this paper, rather than using absolute dollar expenditure, we use "advertising share" (called "share of voice" in the advertising literature) and "R&D share." The intensity of these instruments, both in dollar terms and as a percentage of sales, differs dramatically across industries.[2] Consequently, relative measures for R&D and advertising (as opposed to absolute measures) are more comparable across industries and managerially more meaningful. Moreover, our theorizing is based on R&D/advertising activity relative to competitors. Reibstein and Wittink (2005) further argue that relative marketing metrics are more useful than absolute measures over changing economic conditions. They maintain that the important question to ask is, "How are we doing relative to our competitors who operated under the same economic conditions" (Reibstein and Wittink 2005, p. 8). This point of view is shared by practitioners. For example, industry analyst Tubbs (2007, p. 23) maintains that "a company that underinvests in R&D relative to its principal sector competitors will see a decline in its relative competitiveness of its products and services and this will soon be reflected in its business performance."

2.1. Conceptual Framework for Hypothesis Development

Business cycles consist of periods of expansion, alternating with periods of contraction, and they last

[2] For example, R&D spending as a percentage of sales is approximately 20% in the pharmaceutical industry versus less than 3% in the packaged goods industry (Hartmann et al. 2006). Differences in advertising intensity are equally dramatic (Pepall et al. 2008).

between 1.5 and 8 years (Christiano and Fitzgerald 1998). Economists have examined the relationship between business cycles and various macroeconomic indicators such as unemployment, inflation, interest rates, and consumption. The general finding is that the business cycle has profound effects on supply and demand (Bodman 2001, Razzak 2001). In this paper, we focus on those supply- and demand-side factors that are directly relevant for understanding how R&D and advertising effectiveness may differ between expansions and contractions. Consistent with the positioning of the paper, our focus is on how specific supply- and demand-side factors change in contractions, using the expansionary period as a benchmark.

2.1.1. Supply-Side Effects. In a contraction, firms feel a strong urge to cut discretionary costs as fast as possible. The reason is that in a contraction, demand typically falls faster than supply, and fast action is needed in order to survive the difficult times. Expenditures on marketing activities are among the first to be cut in adverse conditions (Deleersnyder et al. 2009, Mizik and Jacobson 2007). This reduces the *competitive interference*, or "clutter," in the marketplace. Competitive interference arises from marketing activities (e.g., advertising) that are delivered simultaneously by competing companies at or near the same time and place as the focal company (Danaher et al. 2008, p. 212). In contractions, as many companies cut back on their marketing expenditure, clutter will be reduced.

Moreover, the pressure to cut marketing expenditure exerts a downward pressure on *production costs*, broadly defined as the costs of achieving a particular output (e.g., an advertising campaign) (Kamber 2002). Because demand for such output is scarcer, the firm is able to negotiate more favorable purchase conditions. A third supply-side effect concerns the *quality of production* (Barlevy 2007). Whether sourced internally (as is often the case for R&D) or externally (typically the case for advertising), there is more pressure to perform as job security is lower.

2.1.2. Demand-Side Effects. A defining characteristic of a contraction is a *decline in demand* for the firm's goods. The ability and willingness of the firm's customers to buy its products decrease during contractions. They need to economize on their expenditures by reducing the quantity bought or by postponing their purchases altogether until the economy improves (Katona 1975). Also, tighter budgets and the general uncertainty pervading the economy make people more *price sensitive* (Estelami et al. 2001). Finally, it has been shown that adverse economic conditions make people more *risk averse* (Bollerslev et al. 2011).

In sum, the literature indicates that in a contraction, competitive interference and the costs of producing the activity are likely to be lower, whereas the quality of the marketing activities is higher (supply-side effects). Furthermore, market demand for the firm's output is likely to be lower, whereas the price sensitivity and risk aversion of the firm's customers will be higher (demand-side effects).

We use the specific supply and demand effects as an organizing framework for developing hypotheses as to why the effectiveness of advertising and R&D is different in contractions versus expansions. Note that our focus is *not* on testing individual supply or demand effects separately (for which data are typically not available over such a long time period). Instead, the goal is to consider in a systematical fashion how each supply- and demand-side factor affects the effectiveness of advertising or R&D in contractions. By organizing these different effects using this framework, we keep the discussion tractable. Based on this conceptual analysis, we derive hypotheses about the overall net effect of R&D share and of advertising share in a contraction versus an expansion. These resulting hypotheses will be tested in our empirical study (see, e.g., Narasimhan et al. 1996, Ailawadi et al. 2010 for a similar approach).

Table 1 summarizes our predictions. A plus sign signifies that we expect that the supply- or demand-side factor in question leads to an increase in advertising/R&D effectiveness in a contraction (versus an expansion), a minus sign signifies a negative impact, and a blank space means that we have no compelling reason to expect a strong impact in either direction (see Narasimhan et al. 1996). Below, we will discuss the rationale for our expectations.

2.2. Advertising Effectiveness in Contractions

There is widespread agreement that the duration of advertising's effects tends to be relatively short. Erickson and Jacobson (1992, p. 1269) conclude that "[m]ost studies of the carryover effects of advertising conclude that the primary effects do not last beyond one year." Advertising may yield long-term effects, such as brand equity, yet if these benefits do not emerge in the short run, there is little room for them to emerge later. Memory decay processes can explain this situation (Naik et al. 1998). There is no compelling reason to expect that the duration interval is longer in contractions as there is no evidence that memory decay processes operate differently in contractions. However, we will empirically test whether advertising in contractions has longer-lasting effects. Although we do not anticipate differential duration effects, we do expect that advertising's effectiveness within this duration interval will be greater in contractions than in expansions because of several supply- and demand-side effects.

Table 1 Framework for Developing Hypotheses: Changes in Effectiveness of Advertising and R&D Share in Contractions

	Supply side			Demand side			Net effect	
	Reduced competitive inference	Lower cost production	Higher quality of production	Reduced demand	Higher price sensitivity	Higher risk aversion	Market share	Profit
Advertising share	+[a]	+		+	+	+	+	+
R&D share	+	+	+	−		−	+	+

[a]To be read: Reduced competitive interference in contractions (versus expansions) increases the effectiveness of advertising share in contractions.

2.2.1. Supply-Side Effects. Deleersnyder et al. (2009) have shown that every time the economy enters a downturn, advertising budgets are among the first to be cut. Many firms view advertising as a discretionary expense that can be reduced easily during harsh economic times. Companies can easily postpone advertising activities during an economic contraction, and advertising can easily be ramped up again when the economy improves. Lower advertising activity by firms reduces competitive interference in the category. Consumer researchers have documented that intensive exposure to ads for competing brands results in the retention of overlapping memory traces of content. This overlap inhibits retrieval of distinctive ad information when sought elements become inaccessible or are confused with information stored in memory. This results in lower ad recall and recognition, and therefore less favorable brand evaluations (Burke and Srull 1988) as well as lower sales (Danaher et al. 2008). As advertising activity falls in contractions, clutter will be reduced. Consequently, a firm that increases its level of advertising activity relative to competitors (i.e., increases its share of voice) in tough times can expect a larger effect on firm performance compared to when it would increase its share of voice in good times. This notion is widely shared by advertising agencies. They have long maintained that contractions "provide companies with rare opportunities to boost market share and long-term profitability by taking advantage of the increased share of voice available to advertisers who increase their media expenditures during periods when competitors are forced to cut back" (Kamber 2002, p. 106).

Industry evidence indicates that the general decline in advertising expenditure in a contraction gives firms the opportunity to negotiate better deals with ad agencies and networks. Consequently, one can expect that firms that increase their advertising share in contractions will be able "to get better deals in light of the rapidly declining ad markets and the wholesale retreat of entire sectors of advertisers" (Parekh 2009, p. 7). There is little specific evidence on the quality of advertising campaigns in contractions versus expansions. Hence, we refrain from making a prediction, but it is plausible that only the best creative talent will be retained by advertising agencies in a contraction with commensurate positive effects on the quality of campaigns.

2.2.2. Demand-Side Effects. Reduced market demand in contractions will intensify the competition in the industry. With increased competition, advertising becomes even more important to retain existing customers and to attract new customers from competitors (Gatignon 1984). Firms that increase their advertising relative to their competitors, therefore, should see a stronger positive effect on firm performance.

To understand how higher price sensitivity in contractions may affect advertising effectiveness, we must distinguish between price-oriented and differentiation-focused advertising. The effectiveness of price-focused advertising is likely to be higher in contractions as the advertising message resonates more closely with what is on the mind of the firm's customers. On the other hand, differentiation-focused advertising could be less effective in contractions. It may turn customers away from highly advertised products, which may be perceived to be more expensive than less advertised products. To the extent that advertising content changes from differentiation-focused to price-oriented advertising, we may expect that this has a positive effect on advertising effectiveness in contractions.[3]

Finally, Wiggins and Lane (1983) demonstrate analytically that high advertising effort signals lower quality risk to customers. These authors conclude that risk-averse consumers should purchase highly advertised products. In contractions, risk aversion is higher, so firms that increase their advertising efforts relative to their competitors should attract more customers.

Our discussion of the supply- and demand-side factors, summarized in Table 1, suggests the following hypotheses.

Hypothesis 1A (H1A). *Increasing advertising share has a positive effect on market share and profits.*

Hypothesis 1B (H1B). *Increasing advertising share in contractions has a greater effect on market share and profits in contractions than in expansions.*

[3] We thank an anonymous reviewer for this insight.

2.3. R&D Effectiveness in Contractions

There is general agreement that the duration interval for R&D is considerably longer than the duration interval for advertising, but there is less agreement on the length of the R&D lag structure (Boulding and Staelin 1995, Ravenscraft and Scherer 1982). In this paper, we are guided by Erickson and Jacobson (1992), according to whom a three-year lagged structure captures approximately 80% of the total effect of R&D. There is no compelling reason to expect that the duration interval would systematically vary across the business cycle. However, we will empirically test whether R&D in contractions has longer-lasting effects.[4]

When considering R&D activities, it is common to distinguish between process and product innovations. Process innovations are discoveries of new, typically cheaper methods for producing existing products, whereas product innovations concern the creation of new goods and services (Pepall et al. 2008, p. 576). Process innovations can contribute to firm profit by lowering production costs as well as to market share by allowing the firm to remain price competitive, a result of greater production efficiency. Product innovations contribute to market share and profit by meeting existing demand and/or creating new demand. Supply-side effects play a role for both types of innovations, whereas demand-side effects primarily apply to new product development (NPD)-focused R&D.[5]

2.3.1. Supply-Side Effects. The need to cut costs in contractions will not be limited to advertising. Barlevy (2007) reviews a wealth of evidence showing that firms' R&D expenditures behave procyclically as well. The labor market for top technical talent is fiercely competitive (Tabrizi and Chaudhuri 1999). Firms that maintain or even increase their R&D efforts while other firms cut back can use the contraction as an opportunity to lure star employees away from competitors (Barlevy 2007). Thus, in contractions, we can expect a higher quality of R&D production.

Although firms may be reluctant to cut the wages of their employees, new hires may receive lower wages because of a relative oversupply of technical workers' asymmetry in the job market in contractions. Moreover, in contractions, hardware might be procured at lower prices because demand has fallen. Reduced competitive clutter also plays a role, but only for NPD-focused R&D and only in the longer run. Shleifer (1986) points out that firms find it in their best interest to introduce new products in expansionary periods. However, this does not imply that R&D activity underlying these innovations should occur in economic booms. In fact, Francois and Lloyd-Ellis (2003) show that it is optimal for firms to engage in NPD-focused R&D during contractions when it conflicts less with production—and wait until economic conditions improve before introducing them. In the longer run, as the economy improves, the company that maintained R&D share will have new products "shelf ready." These innovations are introduced in a marketplace where demand is rising again but that is less cluttered because the firm's competitors are struggling to ramp up their R&D (Francois and Lloyd-Ellis 2003).

2.3.2. Demand-Side Effects. The reduced market demand that characterizes contractions will also reduce demand for the output of NPD-focused R&D, at least in the short term until demand picks up again. Furthermore, new products are typically perceived to be riskier than established products because there is no track record of their performance. In tight economic times, there is an urge to play it safe because the (financial) margin of error is less. Higher risk aversion in contractions is thus likely to hurt the effectiveness of NPD-focused R&D in the short run.

In sum, our discussion indicates that a strategy of increasing R&D share in contractions will be associated with higher firm performance. Although there is some potential for a short-run effect on firm profit, via process innovations, the positive effect of increasing R&D share in contractions is likely to emerge only in subsequent years.

Hypothesis 2A (H2A). *Increasing R&D share has a positive effect on market share and profit.*

Hypothesis 2B (H2B). *Increasing R&D share has a greater effect on market share and profit in contractions than in expansions.*

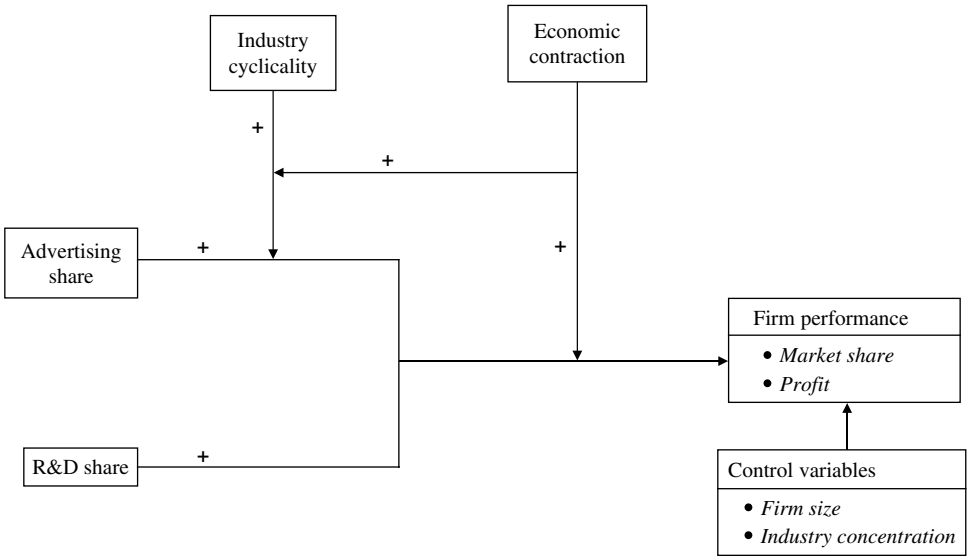
2.4. Moderating Role of Industry Cyclicality

Although business cycles affect the entire economy, not all industries are equally effected (Deleersnyder et al. 2004). We propose that advertising effectiveness will be larger in strongly cyclical industries than in less cyclical industries. Less cyclical industries exhibit a greater amount of temporal inertia, which offers less scope for strong advertising effects. Conversely, in strongly cyclical industries, sales fall sharply in contractions, meaning that many customers will be lost. If better economic times arrive again, these lost customers will return to the market. Advertising helps these new entrants to update their product knowledge. There is some indirect evidence for

[4] It is possible that in contractions, firms shift resources from radical to incremental innovations, which may offer more revenues in the short term (but less in the long term). However, we are not aware of "hard" evidence to support this proposition. In fact, economists have argued that contractions offer opportunities for firms to work on breakthrough innovations as there is less interference with production (Barlevy 2007, Francois and Lloyd-Ellis 2003). We will revisit this issue in the final section of the paper.

[5] We thank an anonymous reviewer for this insight.

Figure 1 The Effect of Advertising and R&D on Firm Performance Moderated by Economic Contraction and Industry Cyclicality



Note. The plus sign refers to the direction of the hypothesized effect.

our expectation. Previous work has found that advertising effectiveness is greater for new products (which require new information and have the potential to bring people out of inertia) (Lodish et al. 1995) and for (relatively cyclical) durables than for (less cyclical) nondurables (Vakratsas and Ambler 1999).

Furthermore, following the logic that advertising is more effective in contractions than in expansions, we submit that the difference in advertising effectiveness between more versus less cyclical industries is especially pronounced in contractions. We do not have strong reasons to expect that industry cyclicality affects the effectiveness of R&D, given the long-term orientation of R&D investments.[6] Hence, we propose the following.

Hypothesis 3A (H3A). *Increasing advertising share of advertising expenditure has a greater effect on market share and profit in more cyclical industries than in less cyclical industries.*

Hypothesis 3B (H3B). *The difference in advertising effectiveness between more and less cyclical industries is stronger in contractions than in expansions.*

2.5. Control Variables

We include several control variables in our research model to allow for a more precise test of our hypotheses. In any study on firm performance, it is important to account for firm size. Larger firms have more market power, which is likely reflected in market share and profitability (Boulding and Staelin 1990). We control for the degree of concentration in the primary industry in which the firm is active (Lipczynski et al. 2005). Furthermore, we control for the positive effect of market share on profitability found in previous research (Szymanski et al. 1993).

Figure 1 provides a schematic overview of our predictions. The remainder of this paper is devoted to testing our hypotheses.

3. Method

3.1. Data

Our research setting is publicly traded U.S. firms from a broad range of industries for the period 1971–2005. We obtained data from the COMPUSTAT industry annual database and the COMPUSTAT business segment database. We did not use the COMPUSTAT quarterly database because some key variables such as advertising expenditure are not available on a quarterly basis. The COMPUSTAT databases are heavily dominated by B2B. To avoid a skew in our results toward B2B firms, we randomly selected 600 firms from B2B industries. We combined this set of companies with 575 firms from B2C industries for a total sample of 1,175 firms. Table 2 lists the distribution of the firms in our sample across industries.

3.2. Measurement

3.2.1. Extracting the Business Cycle Component. Data on annual real U.S. gross domestic product (GDP) are used as a proxy for the GDP general economic activity. Business cycle fluctuations across

[6] In our empirical study, we examined whether industry cyclicality moderated the effectiveness of R&D share. None of the interactions was significant.

Table 2 Distribution of Firms Across Industries

Industry	No. of firms	Percentage
Apparel	42	4
Computer software	65	6
Electronic equipment	116	10
Electronic computers	79	7
Food products	59	5
Industrial chemicals	167	14
Industry equipment	177	15
Pharmaceutical drugs	79	7
Professional equipment	156	13
Textiles	56	5
Transport equipment	67	6
Others	112	10
Overall	**1,175**	**100**

many sectors are reflected in aggregate output, making the cyclical component of GDP a good indicator for the overall economic cycle (Stock and Watson 1999). However, not all overtime variation present in the GDP series can be attributed to business cycle movements. In line with previous research (e.g., Deleersnyder et al. 2009, Lamey et al. 2007), we apply the well-known Hodrick and Prescott (1997) filter (hereafter, the HP filter) to extract from the aggregate GDP series those fluctuations that occur at business cycle periodicities. The HP filter decomposes a time series, GDP_t, into a trend component, GDP_t^l, which varies smoothly over time, and a cyclical component, GDP_t^c, by fitting a smooth curve through a set of data points. To identify both components, one minimizes the variance of the cyclical component subject to a penalty for variation in the second difference of the trend component. The cyclical component, which fluctuates around that trend, is then obtained by subtracting the long-term trend from GDP_t; i.e., $GDP_t^c = GDP_t - GDP_t^l$ (Hodrick and Prescott 1997). The HP filter obtains GDP_t^l by minimizing

$$\sum_{t=1}^{T}(GDP_t - GDP_t^l)^2 + \lambda \sum_{t=2}^{T-1}\big((GDP_{t+1}^l - GDP_t^l) - (GDP_t^l - GDP_{t-1}^l)\big)^2, \quad (1)$$

where GDP_t is the log-transformed GDP series at year t. The log transformation ensures that the units of GDP_t^c, when multiplied by 100, represent percentage deviations from the economy's long-term growth path (Stock and Watson 1999). Penalty parameter λ determines the degree of smoothing, with larger values resulting in a smoother growth component. As business cycles exhibit cycles of varying length that tend to last no longer than eight years in duration (Christiano and Fitzgerald 1998), our smoothing constant is chosen to generate a trend accounting for all fluctuations longer than eight years. We follow Baxter and King (1999), who recommend a value of λ equal to 10 for annual series (see Deleersnyder et al. 2009, Lamey et al. 2007 for similar practices). This value produces a good correspondence between the HP filter and an ideal bandpass filter that passes through cycles between two and eight years.

Following established practice in business cycle economics (Baxter and King 1999, Deleersnyder et al. 2009, Hodrick and Prescott 1997, Lamey et al. 2007), the economy is in contraction when there is a decrease in the cyclical component of GDP (GDP_t^c)—that is, when the economy in year t grows less than its long-term trend (i.e., when $GDP_t^l > GDP_t$). To quantify the *magnitude* of the contraction in any given contraction year, we follow Lamey et al. (2007) and specify the following asymmetric growth model:

$$contr_t = \begin{cases} 0 & \text{if } \Delta gdp_t^c c > 0, \\ (\textit{prior peak in } gdpc^c) - gdpc_t^c & \\ \qquad \text{if } \Delta gdp_t^c c \le 0. & \end{cases} \quad (2)$$

The variable $contr_t$ is expressed as a percentage.[7] If $contr_t = 0$, the economy is growing at or above its long-term trend. Thus, the effects of contraction will be tested against the benchmark of economic expansion.[8]

3.2.2. Firm Performance. We obtained firm profit data, expressed in millions of dollars, from COMPUSTAT's industrial annual net income (data#13). Market share is expressed as a fraction and is calculated as the firm's sales revenue divided by the sales of all firms in the same industry (i.e., the same four-digit standardized industry classification (SIC) code), which we gathered from the COMPUSTAT segment database. For a firm that operates in multiple industries, we obtained sales revenues in all the industries in which it is active using the corresponding four-digit SIC codes. Four-digit SIC codes represent the most disaggregate level in COMPUSTAT. We aggregated the sales of all firms in these four-digit SIC codes to arrive at industry sales. Finally, we calculated a firm's overall market share as the sales-revenue-weighted average of its market share across its different business segments.

3.2.3. Advertising and R&D Share. Data on companies' advertising and R&D expenditures came from COMPUSTAT advertising expenses (data#45) and R&D expenses (data#46), respectively. Advertising

[7] Through this operationalization, $contr_t$ will always be nonnegative.

[8] In 13 years of the 35-year period considered in our study, the U.S. economy was growing below its long-term trend, i.e., was in contraction. In the other 22 years, the economy was growing above its long-term trend.

(R&D) share is expressed as a fraction and is calculated as the firm's advertising (R&D) expenditure divided by those of all firms in the same industry (i.e., the same four-digit SIC code). The information was obtained from the COMPUSTAT segment database. For a firm that operates in multiple industries, we gathered advertising and R&D expenditure in all the industries in which it is active, using the corresponding four-digit SIC codes. We aggregated the advertising and R&D expenditure of all firms in these four-digit SIC codes to arrive at industry overall advertising and R&D expenditure. Finally, we calculated a firm's overall advertising and R&D share as the revenue-weighted average of its advertising and R&D shares across its different business segments.

3.2.4. Industry Cyclicality. To quantify the extent of cyclical sensitivity in an industry over the period 1971–2005, we followed the procedure outlined by Braun and Larrain (2005). For each four-digit SIC code industry, we applied the HP filter to the time series of the log industry annual sales adjusted for inflation to extract the cyclical component. We regressed the cyclical component of industry j's sales $IS^c_{j,t}$ on the cyclical component of the GDP as derived in Equation (1):

$$IS^c_{j,t} = \beta_j GDP^c_{j,t} + \varepsilon_{j,t}, \tag{3}$$

where β_j is the measure of the cyclicality in industry j (Braun and Larrain 2005). Because we worked in the log-log space, β is an elasticity where higher values indicate higher industry cyclicality. We mean-centered industry cyclicality for ease of interpretability (Cohen et al. 2003). For a firm that operates in multiple industries, we calculated a firm's overall cyclicality as the revenue-weighted average of the industry cyclicality across its different business segments.

3.2.5. Control Variables. Firm size is operationalized as the log of firm total assets measured in millions of dollars. The firm's primary industry is identified by its primary four-digit SIC code in the COMPUSTAT database. The degree of concentration of the firm's primary industry (based on its primary four-digit SIC code in the COMPUSTAT database) is operationalized by the Herfindahl index, where larger values indicate a more highly concentrated industry.

3.3. Model Setup

Following Boulding and Staelin (1995), we postulated a multiplicative performance model:

$$Y_{i,t} = \prod_{a=0}^{1} (ADV_{i,t-a})^{\beta_{i,t-a}} \times \prod_{b=0}^{3} (R\&D_{i,t-b})^{\gamma_{t-b}} \times \prod_{c=0}^{C} (CONTR_{t-c})^{\delta_{t-c}} \times e^{\theta_{i,t}} \tag{4}$$

with

$$\beta_{i,t-a} = \beta_{0,t-a} + \beta_{1,t-a} CONTR_{t-a} + \beta_{2,t-a} CYC_i + \beta_{3,t-a} CONTR_{t-a} \times CYC_i \quad \text{for } a = 0, 1, \tag{5}$$

$$\gamma_{t-b} = \gamma_{0,t-b} + \gamma_{1,t-b} CONTR_{t-b} \quad \text{for } b = 0, 3, \tag{6}$$

$$\theta_{i,t} = \theta_0 + \theta_1 Size_{i,t} + \theta_2 InduCon_{i,t} + \theta_3 CYC_i + \theta_i + \varepsilon_{i,t}, \tag{7}$$

$$\varepsilon_{i,t} = \rho \varepsilon_{i,t-1} + \mu_{i,t}, \tag{8}$$

where i stands for firm i and t for year t. Firm performance (market share or profit) is Y, and R&D (advertising) share is $R\&D$ (ADV). $CONTR$ is the magnitude of the economic contraction as calculated in Equation (2). We multiplied $CONTR$ by 10 to arrive at more easily interpretable parameter estimates. CYC is industry cyclicality, $Size$ is (log) firm size, and $InduCon$ is the degree of concentration in the primary industry in which the firm is active.

Equation (4) models contemporary and carryover effects using the well-known finite distributed lag (FDL[K_{ADV}, $K_{R\&D}$, K_{CONTR}]) model (Hanssens et al. 2001, p. 142), where K indicates the number of lags. Based on our literature review, we specify $K_{ADV} = 1$ and $K_{R\&D} = 3$. There is no literature to guide us on the number of lags to be expected for $CONTR$. Therefore, we specify $K_{CONTR} = C$. We will empirically assess the appropriateness of our FDL[1, 3, C] structure (see Boulding and Staelin 1995 for similar practice).

The intercepts $\beta_{0,t-a}$ represent the distributed-lag effects of advertising share for a firm in an industry of average cyclicality when the economy is in expansion. The coefficients $\beta_{1,t-a}$ are the change in advertising effectiveness for this firm when the economy is in a contraction. The magnitude of the effect depends on the deepness of the contraction. Similarly, the coefficients $\gamma_{0,t-b}$ represent the distributed-lag effects of R&D share when the economy is in an expansion, and the coefficients $\gamma_{1,t-a}$ represent the change in the effectiveness of R&D when the economy is in a contraction. Coefficients $\beta_{2,t-a}$ and $\beta_{3,t-a}$ represent the moderating effects of industry cyclicality on the effectiveness of advertising in expansions and contractions, respectively.

The coefficients δ_{t-c} capture the distributed-lag effects of the economic contraction on firm performance. Although these main effects are not of substantive interest for the purposes of this study, we need to control for them to interpret the interactions (Cohen et al. 2003). Coefficients θ_1 and θ_2 are the effects of the control variables' firm size and concentration, respectively, in the firm's primary industry, and θ_3 captures the (time-invariant) main effect of industry cyclicality. For models with firm profit as

the dependent variable, we also included contemporary market share as a predictor. Its coefficient (θ_4) captures the possible effect of market share on firm profit. Coefficient θ_i captures unobserved, fixed firm-specific factors. Finally, with our specification for the error term ε, we control for random contemporaneous and first-order autoregressive unobserved factors.

When we substitute Equations (5)–(8) in Equation (4) and take logs, we obtain the following theoretical model specification that we set out to test in our empirical study:

$$\begin{aligned}\ln Y_{i,t} = \theta_0 &+ \sum_{a=0}^{1}[(\beta_{0,t-a}+\beta_{1,t-a}CONTR_{t-a}+\beta_{2,t-a}CYC_i \\ &+ \beta_{3,t-a}CONTR_{t-a}\times CYC_i)\times \ln ADV_{i,t-a}] \\ &+ \sum_{b=0}^{3}[(\gamma_{0,t-b}+\gamma_{1,t-b}CONTR_{t-b})\times \ln R\&D_{i,t-b}] \\ &+ \sum_{c=0}^{C}\delta_{t-c}\ln CONTR_{t-c} + \theta_1 Size_t + \theta_2 InduCon_t \\ &+ \theta_3 CYC_i + \theta_i + \rho\varepsilon_{i,t-1} + \mu_{i,t}. \qquad (9)\end{aligned}$$

3.4. Model Estimation

Before we can estimate our theoretical model, we need to check the following aspects: (1) appropriateness of our distributed-lag specification; (2) direction of causality; (3) absence of unobserved, firm-specific fixed effects; (4) stationarity in the time series; (5) absence of serial correlation between error terms; and (6) independence of advertising and R&D share from contemporaneous random events (Boulding and Staelin 1993, 1995; Dekimpe et al. 1999).

3.4.1. Number of Lags. To empirically test the lag specification of our FDL[1, 3, C] model, we used the procedure outlined by Tellis et al. (2000). We specified a series of autoregressive distributed-lag models to determine how many lags we needed for each variable:

$$\begin{aligned}\ln Y_t = a_0 &+ b_1\times\ln(ADV)_t + b_2\times\ln(ADV)_{t-1}+\cdots+c_1 \\ &\times\ln(R\&D)_t + c_2\times\ln(R\&D)_{t-1}+\cdots+d_1 \\ &\times\ln(CONTR)_t + d_2 \\ &\times\ln(CONTR)_{t-1}+\cdots+e_t. \qquad (10)\end{aligned}$$

We used the Akaike information criteria and Bayesian information criterion to determine the number of lags (see Osinga et al. 2010 for similar practice). For both performance variables, the information criteria pointed to a model with three lags for R&D, one lag for advertising, and no lags for contraction. We also conducted *F*-tests on additional lags that indicated that additional lags did not significantly improve model fit.

3.4.2. Direction of Causality. We performed pairwise Granger causality tests to examine whether performance "Granger causes" advertising or R&D.[9] None of the *F*-tests was significant ($p > 0.05$). Thus, we find no evidence for reverse causality.[10]

3.4.3. Test for Unobserved Firm-Specific Effects. We tested for unobserved, fixed firm-specific effects (θ_i) using the Hausman test (Baltagi 2005). For both models, the chi-square statistic was significant (market share model: $\chi^2_{(23)} = 63.85$, $p < 0.01$; profit model: $\chi^2_{(23)} = 76.69$, $p < 0.01$). To eliminate the biasing influence of these fixed effects, Boulding and Staelin (1995) recommend first-differencing.

3.4.4. Stationarity in Time Series. If our panel data are nonstationary, this may produce spurious results, and inferences based on *t*-values can be highly misleading (Hanssens et al. 2001). The Levin-Lin-Chu panel unit root test (Baltagi 2005) on the undifferenced data indicates that the null hypothesis of the presence of a unit root cannot be rejected (market share: *t*-statistic = −1.46, N.S.; profit: *t*-statistic = −1.32, N.S.). However, after first differencing, the data are stationary (market share: *t*-statistic = −4.56, $p < 0.01$; profit: *t*-statistic = −3.69, $p < 0.01$).

3.4.5. Test for Serial Correlation. We tested for serially correlated errors ($\rho\varepsilon_{it-1}$) using the Durbin-Watson test for panel data (Baltagi 2005). We find that serial correlation is indeed present in our data. The panel Durbin-Watson statistic is 1.10 ($p < 0.05$) for market share and 1.23 ($p < 0.05$) for firm profit. ρ-Differencing is recommended to remove the autoregressive error from the data (Boulding and Staelin 1993).

3.4.6. Test for Endogeneity. We used the Hausman-Wu endogeneity test (Baum et al. 2003) to test whether advertising and R&D share are independented from remaining contemporaneous random events $\mu_{i,t}$. We implemented the test using

[9] We first regressed contemporaneous advertising (R&D) share on lagged advertising (R&D): $\ln ADV_t(R\&D_t) = a_0 + b_1 \times \ln ADV_{t-1}$ $(\ln R\&D_{t-1}) + \cdots + e_t$. Next, we added lagged firm performance (market share or profit): $\ln ADV_t(R\&D_t) = a_0 + b_1 \times \ln ADV_{t-1}(\ln R\&D_{t-1}) + \cdots + c_1 \ln(Y)_{t-1} + \cdots + e_t$. If the *F*-test on improvement of model fit was significant, that indicated that firm performance "Granger causes" advertising (R&D share; Hanssens et al. 2001, p. 310). We performed this test for a number of lag structures, ranging from one to three lags. In none of the cases was the *F*-test significant.

[10] We also tested whether contractions directly affect a firm's advertising and R&D share. Because advertising and R&D are expressed in relative terms, the presence of such an effect suggests that the firms in our sample are disproportionately affected by contractions. We regressed advertising and R&D share on economic contractions and our control variables. No significant effects for contraction were found.

instruments that are lagged one period beyond the error term. For both models, the F-statistic was not significant (market share model: $F_{2,3,203} = 2.43$, $p > 0.05$; profit model: $F_{2,3,652} = 2.57$, $p > 0.05$). This indicates that advertising and R&D share are not correlated with remaining contemporaneous random events $\mu_{i,t}$. Therefore, we do not need to use instruments.[11]

In sum, we find that the appropriate lag structure is FDL[1, 3, 0], with no evidence for reverse causality or contemporaneous correlation between R&D/advertising and the random error term. However, first-differencing is necessary to remove unobserved, fixed firm-specific effects and to render the data stationary, whereas ρ-differencing is necessary to remove serial correlation. Implementing these steps leads to the following estimation equation:[12]

$$
\begin{aligned}
&\ln Y_{i,t} - \ln Y_{i,t-1} \\
&= \rho(\ln Y_{i,t-1} - \ln Y_{i,t-2}) + \sum_{a=0}^{1}\Big[(\beta_{0,t-a} + \beta_{1,t-a}CONTR_{t-a} \\
&\quad + \beta_{2,t-a}CYC_i + \beta_{3,t-a}CONTR_{t-a} \times CYC_i) \\
&\quad \times [(\ln ADV_{i,t-a} - \ln ADV_{i,t-a-1}) \\
&\quad - \rho(\ln ADV_{i,t-a-1} - \ln ADV_{i,t-a-2})]\Big] \\
&\quad + \sum_{b=0}^{3}\Big[(\gamma_{0,t-b} + \gamma_{1,t-b}CONTR_{t-b}) \\
&\quad \times [(\ln R\&D_{i,t-b} - \ln R\&D_{i,t-b-1}) \\
&\quad - \rho(\ln R\&D_{i,t-b-1} - \ln R\&D_{i,t-b-2})] \\
&\quad + \sum_{c=0}^{3}\delta_{t-c} \times [(\ln CONTR_{t-c} - \ln CONTR_{t-c-1}) \\
&\quad - \rho(\ln CONTR_{t-c-1} - \ln CONTR_{t-c-2})\Big] \\
&\quad + \theta_1 \times [(Size_t - Size_{t-1}) - \rho(Size_{t-1} - Size_{t-2})] \\
&\quad + \theta_2 \times [(InduCon_t - InduCon_{t-1}) \\
&\quad - \rho(InduCon_{t-1} - InduCon_{t-2})] + \mu_{i,t} - \mu_{i,t-1}. \qquad (11)
\end{aligned}
$$

[11] We also performed the Hausman-Wu test using instruments that are lagged two periods beyond the error term and instruments lagged one and two periods. In all cases the F statistic was not significant.

[12] First-differencing also removes the time-invariant effect of industry cyclicality. Although our analysis of the appropriate lag structure indicates that no lags are necessary for contractions, we need to include three lags because our model specifies a three-year distributed-lag structure for R&D. Proper interpretation of the interaction terms involving R&D and contraction require inclusion of the lagged main effects for contraction (Cohen et al. 2003). Our substantive results remain the same when we exclude the lagged contractions terms.

As mentioned earlier, we included contemporary market share as a predictor in the profit model. We estimate the models using generalized least squares.

4. Results

The results are presented in Table 3. Reported are unstandardized regression coefficients. All variance inflation factors are below 10. This indicates that multicollinearity is not a serious issue (Cohen et al. 2003).

4.1. Advertising Effectiveness in Expansions and Contractions

We find that in expansionary periods, advertising share has a positive contemporaneous effect on market share ($\beta_{0,\text{year}(t)} = 0.0710$, $p < 0.01$) as well as a significant one-year carryover effect ($\beta_{0,\text{year}(t-1)} = 0.0529$, $p < 0.05$). Advertising also has a significant direct effect on contemporaneous profit ($\beta_{0,\text{year}(t)} = 0.1459$, $p < 0.05$), as well as an indirect effect via market share ($\beta = 0.0137$, $p < 0.05$) for a total contemporaneous effect of advertising on profit of 0.1596.[13] These findings support H1A for both performance measures. It clearly pays to advertise.

How is this picture modified when the economy is in contraction? We find that contractions offer courageous companies that maintain their advertising while others cut back (thus increasing their share) a unique opportunity to strengthen their market position. Advertising effectiveness increases in contractions, both for building market share ($\beta_{1,\text{year}(t)} = 0.0024$, $p < 0.01$) and profit ($\beta_{1,\text{year}(t)} = 0.0059$, $p < 0.05$). To get a sense of the magnitude of the effect, consider that year t was a typical contraction year, experiencing a median decline of 2.74%. Consistent with our model estimation, this median value is multiplied by 10. In a typical contraction year, the contemporaneous effect of advertising on market share is calculated as $0.1368 (= 0.0710 + 27.4 \times 0.0024)$ ($p < 0.01$). This is nearly twice as high as the effect of advertising in an expansion year. Advertising's direct effect on contemporary profit in a typical contraction year (0.3076) is also considerably larger than advertising's effect in an expansion year (0.1459). Thus, H1B is supported. Advertising in contractions is significantly more effective than advertising in expansions in building market share and profit. Furthermore, we find that this increased effectiveness emerges in the same year in which the firm advertises.

[13] Significance of the indirect effect is derived using the Aroian version of the Sobel test (Baron and Kenny 1986). If a is the regression coefficient of the effect of advertising on market share and b is the regression coefficient of the effect of market share on profit, and s_a and s_b are their standard errors, the Z-statistic for the indirect effect of advertising on profit is given by $(a \times b)/\sqrt{v}(b^2 \times s_a^2 + a^2 \times s_b^2 + s_a^2 \times s_b^2)$.

Table 3 The Effects of Advertising and R&D on Performance Across the Business Cycle

Predictors	*Market share*$_t$	*Firm profit*$_t$
Intercept	0.1859 (0.1423)	−0.3421 (0.3958)
Advertising effectiveness in expansions		
Advertising share$_t$	0.0710 (0.0224)**	0.1459 (0.0716)*
Advertising share$_{t-1}$	0.0529 (0.0234)*	0.1201 (0.0722)
Industry cyclicality × *Advertising share*$_t$	0.0027 (0.0146)	0.0620 (0.0759)
Industry cyclicality × *Advertising share*$_{t-1}$	0.0371 (0.0162)*	0.1750 (0.0817)*
Changes in advertising effectiveness because of contractions		
Contraction$_t$ × *Advertising share*$_t$	0.0024 (0.0009)**	0.0059 (0.0026)*
Contraction$_{t-1}$ × *Advertising share*$_{t-1}$	0.0012 (0.0010)	0.0056 (0.0030)
Industry cyclicality × *Contraction*$_t$ × *Advertising share*$_t$	0.0012 (0.0007)	0.0040 (0.0022)
Industry cyclicality × *Contraction*$_{t-1}$ × *Advertising share*$_{t-1}$	0.0020 (0.0007)**	0.0058 (0.0022)**
R&D effectiveness in expansions		
R&D share$_t$	−0.0021 (0.0240)	0.1301 (0.0625)*
R&D share$_{t-1}$	0.0689 (0.0227)**	0.0814 (0.0803)
R&D share$_{t-2}$	0.0613 (0.0257*	0.1789 (0.0823)*
R&D share$_{t-3}$	0.0589 (0.0278)*	0.1404 (0.0957)
Changes in R&D effectiveness because of contractions		
Contraction$_t$ × *R&D share*$_t$	0.0009 (0.0007)	0.0018 (0.0022)
Contraction$_{t-1}$ × *R&D share*$_{t-1}$	0.0024 (0.0011)*	0.0079 (0.0025)**
Contraction$_{t-2}$ × *R&D share*$_{t-2}$	0.0024 (0.0012)*	0.0033 (0.0030)
Contraction$_{t-3}$ × *R&D share*$_{t-3}$	0.0006 (0.0014)	0.0064 (0.0031)*
Control variables		
Market share$_t$	—	−0.1924 (0.0509)**
Firm size$_t$	0.0810 (0.0122)**	0.2013 (0.0729)**
Industry concentration$_t$	0.0113 (0.1189)	−0.0619 (0.0287)*
Contraction$_t$	0.0060 (0.0436)	−0.3215 (0.1541)*
Contraction$_{t-1}$	−0.0023 (0.0598)	−0.1658 (0.1895)
Contraction$_{t-2}$	−0.0019 (0.0654)	−0.0897 (0.2015)
Contraction$_{t-3}$	0.0003 (0.0723)	−0.0658 (0.2368)
F-Value	63.58**	67.93**

*$p < 0.05$; **$p < 0.01$ (two-sided).

4.2. R&D Effectiveness in Expansions and Contractions

In expansionary periods, R&D share has a positive effect on market share, which carries over for three years: $\gamma_{0,\,\mathrm{year}(t-1)} = 0.0689$ ($p < 0.01$), $\gamma_{0,\,\mathrm{year}(t-2)} = 0.0613$ ($p < 0.05$), and $\gamma_{0,\,\mathrm{year}(t-3)} = 0.0589$ ($p < 0.05$). The contemporaneous effect is not significant. This is consistent with earlier work that suggests that firms expect a lag of at least one year before revenue returns to R&D spending start to emerge (Pakes and Schankerman 1984). We further find that R&D has a positive contemporaneous effect on profit ($\gamma_{0,\,\mathrm{year}(t)} = 0.1301$, $p < 0.05$), as well as a two-year lagged effect ($\gamma_{0,\,\mathrm{year}(t-2)} = 0.1789$, $p < 0.05$). The effect for year $t-1$ is also positive but is not significant. These findings support H2A.

It is interesting to see that R&D has an immediate effect on profit but not on market share. R&D activities can have a short-term effect on firm profit (through cost-reducing process innovation), but their effect on sales (through product innovation) will usually take longer to materialize because it takes time before new products gain market acceptance.

R&D effectiveness is systematically affected by economic contractions. When the economy is in a contraction, we find one- and two-year lagged positive effects on market share: $\gamma_{1,\,\mathrm{year}(t-1)} = 0.0024$ ($p < 0.05$) and $\gamma_{1,\,\mathrm{year}(t-2)} = 0.0024$ ($p < 0.05$). To illustrate, if the economy was in a typical contraction in one of those years, it would about double the effect of R&D share for that year on contemporary market share. If the economy was in a typical contraction in both years $t-1$ and $t-2$, the total effect of R&D share (aggregated across the three lagged years) on contemporary market share in expansions would be 0.1891, whereas the effect in a typical contraction for the past two years would be 0.3207, an increase of 70%.[14] Increasing R&D share in contractions is also more effective in building profit than increasing R&D share in expansions. Again, the positive effects take at least one year to materialize: $\gamma_{1,\,\mathrm{year}(t-1)} = 0.0079$ ($p < 0.01$) and $\gamma_{1,\,\mathrm{year}(t-3)} = 0.0064$ ($p < 0.05$). In sum, our findings support H2B. Increasing R&D share has a greater

[14] In this illustration, we assume that R&D share remains constant, which allows us to add the coefficients.

effect on both profit and market share in contractions than in expansions, but these effects emerge only in subsequent years.

4.3. The Moderating Role of Industry Cyclicality

We hypothesized that advertising effectiveness is moderated by the degree of cyclicality of the industry (H3). Advertising share has indeed a greater effect on firm performance in cyclical industries than in less cyclical industries. In expansions, we find an effect (one-year lagged) both for market share ($\beta_{2,\,\mathrm{year}(t-1)} = 0.0371$, $p < 0.05$) and profit ($\beta_{2,\,\mathrm{year}(t-1)} = 0.1750$, $p < 0.05$). These results provide support for H3A.

The effect of cyclicality is strong. In expansions for firms in stable industries, all market share benefits of advertising accrue in the same year, the lagged effect being nonsignificant, for a total effect of 0.0671. In contrast, in industries of average cyclicality, the total effect of advertising on market share is 0.1239, whereas that effect increases to 0.1807 in highly cyclical industries.[15] Thus, in expansionary ("normal") times, advertising effectiveness in highly cyclical industries is approximately three times larger than advertising in stable industries and 50% higher than advertising in industries of average cyclicality. The findings for profit follow the same pattern and are even stronger. The total effect of advertising is 0.1459 in industries of average cyclicality versus 0.4140 in highly cyclical industries. In stable industries, advertising's effect of profit is negligible. Thus, the carryover effects of advertising are very dependent on the cyclicality of the industry in which the firm operates. In relatively stable industries, advertising effects are small and do not go beyond the year the firm advertises.

Consistent with H3B, we find that the effect of industry cyclicality on advertising effectiveness is especially pronounced in contractions (market share: $\beta_{3,\,\mathrm{year}(t-1)} = 0.0020$, $p < 0.01$; profit: $\beta_{3,\,\mathrm{year}(t-1)} = 0.0058$, $p < 0.01$). These results unequivocally demonstrate that advertising is more effective in highly cyclical industries, and this increased effectiveness is even more pronounced in contractions than expansions.

4.4. Validation Analyses

4.4.1. Holdout Sample Validation. The key distinguishing feature of our model is the role of contractions in systematically moderating R&D and advertising effectiveness. A logical benchmark model is a model that does not include any effect of the business cycle. This benchmark FDL[1, 3] model specifies that one needs only information on R&D and advertising share (together with control variables) to explain firm performance. Thus, the benchmark model is nested in our model, in that our model adds eight interactions involving contraction (as well as the contemporaneous and lagged main effects of contraction). To compare the performance of our model versus the benchmark model, we randomly split our sample into an estimation sample of 850 firms (approximately 75% of the sample) and a validation sample comprising the remaining 325 firms.[16] We estimate the two models on the estimation sample and use the validation sample for out-of-sample forecasting.

We performed two model comparison tests. First, we performed an F-test on difference in model fit between the two models using the estimation sample. Our model has significantly better model fit ($F_{12,\,3,486} = 4.82$, $p < 0.001$ for market share; $F_{12,\,3,724} = 5.66$, $p < 0.001$ for firm profit). Second, we use the parameter estimates to predict market shares and profit of the firms in the validation sample. Mean absolute deviation (MAD) and mean squared error (MSE) are used as model comparison measures. We find that our model consistently outperforms the benchmark model in out-of-sample forecasting:

	Our model	Benchmark model	Improvement (%)
Market share			
MAD	0.291	0.338	13.9
MSE ($\times 10^3$)	6.156	9.365	34.3
Firm profit			
MAD	0.182	0.233	21.9
MSE ($\times 10^3$)	3.198	4.320	26.0

4.4.2. Temporal Stability of the Estimates. Because our data span multiple decades, it is possible that our substantive coefficients exhibit temporal variation, for example, because managers are starting to view marketing as a strategic investment.[17] To assess the temporal stability of the parameter estimates, we divided the sample into two time periods: 1971–1988 and 1989–2005. We estimated our model for both periods separately. The Chow test indicates that the null

[15] Following Cohen et al. (2003), high (low) cyclicality is operationalized as one standard deviation (1.532) above (below) the mean. We assume that R&D share remains constant, which allows us to add the coefficients. The total (contemporaneous and one-year lagged) effect of advertising in highly cyclical industries is $0.1807 (= 0.071 + 0.0529 + 1.532 \times 0.0371)$ versus $0.1239 (= 0.071 + 0.0529)$ in industries of average cyclicality and $0.0671 (= 0.071 + 0.0529 - 1.532 \times 0.0371)$ in stable industries, i.e., industries characterized by relatively low cyclicality.

[16] The empirical results reported in §§4.1.–4.3 are based on the full sample so as to present the most complete picture of empirical effects, using all observations. However, the parameter estimates based on the estimation sample are very close to the estimates reported in Table 3, and the conclusions remained substantively the same.

[17] We thank an anonymous reviewer for this suggestion.

hypothesis of no difference in the vectors of parameter estimates cannot be rejected ($F_{23,4,384} = 1.052$, N.S. for market share; $F_{24,4,618} = 1.213$, N.S. for firm profit). Tests on differences between parameter estimates for individual predictors, using the Bonferroni correction with overall $p < 0.05$, yield no significant results for either the market share or firm profit models.

4.4.3. B2C vs. B2B Firms. We examined whether there are systematic effects between B2B and B2C firms. We estimated our model for each group of firms separately. The Chow test is again not significant ($F_{23,4,755} = 0.828$, N.S. for market share; $F_{24,4,851} = 0.962$, N.S. for firm profit). Tests on differences between individual coefficients, using the Bonferroni correction, yield only one significant result for the market share model but none for the firm profit model.

4.4.4. High vs. Low Industry Advertising Intensity. We tested whether the effects of advertising and R&D share are asymmetric between high and low advertising (R&D) industries. For example, in high advertising intensity industries, a firm's advertising share can be low even if its absolute dollar volume is high. Conversely, in low advertising intensity industries, a firm's share can be high even though it does not spend much advertising dollars. We divided the industries into high and low advertising intensity industries, based on a median split on overall industry advertising dollar volume. We estimated our model for each group of firms separately. The Chow test indicates that the null hypothesis of no difference in the vectors of parameter estimates cannot be rejected ($F_{23,4,826} = 1.1065$, N.S. for market share; $F_{24,4,965} = 0.689$, N.S. for firm profit). Tests on differences between individual coefficients, using the Bonferroni correction, yield only one significant result for market share and none for firm profit.

We repeated this procedure with high versus low industry R&D intensity. Again, the Chow tests are not significant ($F_{23,4,619} = 0.975$, N.S. for market share; $F_{24,4,877} = 0.730$, N.S. for firm profit). Tests on differences between individual coefficients, using the Bonferroni correction, yield no significant result for either market share or firm profit model.

4.4.5. Differential Duration of R&D or Advertising Effects in Contractions. We finally investigated whether the duration of advertising and R&D differs between expansions and contractions. It is possible that duration effects last longer when they occur in contractions. To test this idea, we added an additional lag to our model. More specifically, we included the interaction term between *Contraction* and *R&D share*, between *Contraction* and *Advertising*, and between *Contraction* and *Advertising* × *Industry Cyclicality* one period beyond what is specified in the model (i.e., $t-2$ for advertising, $t-4$ for R&D). None of these interaction terms is significant at the 0.10 level or better. This suggests that there is no compelling evidence that the duration effects of advertising or R&D differ between expansions and contractions.

5. Conclusion

5.1. Summary

The critical role of R&D and advertising in the marketing strategy of a firm is well established. Consequently, these instruments have been the focus of considerable research attention. Therefore, it is surprising that little research has been conducted on their effectiveness in relation to the general economic conditions in which the firm operates. After all, companies do not operate in a vacuum but are rather part of our market-based economic system and hence are subject to its fluctuations. In this paper, we have attempted to contribute to filling this void.

We proposed a conceptual framework to explain *why* the effectiveness of marketing instruments differs between contractions and expansions, taking multiple supply- and demand-side factors into account. Using this framework, we developed hypotheses concerning the moderating role of economic contractions on the effectiveness of advertising and R&D. We tested the hypotheses using a sample of 1,175 U.S. firms across a time span of more than three decades. Our time span includes multiple business cycles, with contractions of different duration and severity, that allow for a more precise test of the moderating role of economic contractions. We find that investments in R&D and advertising pay off in expansions but even more so in contractions. Increasing advertising share in contractions has a stronger effect on profit and market share than increasing advertising share in expansion years. Likewise, sustaining investments in R&D in contractions lead to higher gains in market share and profit than R&D investments in expansions, albeit only in subsequent years.

We introduce the construct of industry cyclicality to explain differences across industries in advertising effectiveness, in general, and in contractions, in particular. We argue that different industries are not equally affected by economic downturns and that we need to take this into account to understand advertising effectiveness. We show that the carryover effects of advertising are very dependent on the cyclicality of the industry in which the firm operates. We also find that across the business cycle, advertising effectiveness is between 50% (market share) and 200% (profit) larger in highly cyclical industries than in industries of average cyclicality, whereas advertising has a small effect at best on firm performance in stable industries. Finally, the effect of industry cyclicality on advertising effectiveness is especially pronounced in contractions.

5.2. Managerial Implications

In expansionary years, the higher a firm's advertising or R&D share, the higher its market share and profit. These effects are increased considerably in contractions. To get a sense of the practical magnitude of the effects, we performed two simulation analyses where we consider a "typical" firm in a "typical" industry in an economic expansion versus an economic contraction.[18] In our first simulation, we contrasted the performance outcomes of a strategy of increasing advertising share (AS↑) with a strategy of decreasing advertising share (AS↓). In the former scenario, the firm increases its advertising share by three percentage points per year between years $t-2$ and t. In the latter scenario, the firm decreases its advertising share by two percentage points annually over the same period. Our simulation takes interrelations between predictors into account as well as indirect effects of advertising on profit via market share. We find that the difference between AS↑ and AS↓ in expansions amounts to 58 basis points in market share (0.58 percentage points) and \$3.33 million in additional profit. These are already meaningful outcomes. However, consistent with the results discussed in §4, in contractions the difference between AS↑ and AS↓ becomes even larger: 65 basis points in market share (12.3% higher than in expansions) and \$3.92 million in profit (+17.8%).

We performed a similar simulation for R&D↑ and R&D↓. The R&D↑ is operationalized as an increase in R&D share by three percentage points per year between years $t-4$ and $t-1$, whereas R&D↓ refers to a decline in R&D share by two percentage points annually over the same period. We find that in expansions, R&D↑ leads to an increase of 86 basis points in market share and \$9.56 million in additional profit by year t versus an increase of 103 basis points and \$12.04 million in contractions, a difference of 19.4% and 25.9%, respectively.

We previously examined the effects of changes in advertising share and R&D share separately, keeping the other marketing instrument constant. However, from a resource allocation standpoint, a firm frequently has to make trade-offs between different investments, including R&D and advertising. This is particularly true during contraction periods when resource constraints become a serious issue. To shed light on this issue, we conducted a third simulation study in which we contrasted the strategy of funding R&D at the expense of advertising (i.e., R&D↑ and advertising↓) with a strategy of funding advertising efforts by reducing R&D (i.e., advertising↑ and R&D↓). Again, we contrast contractions versus expansions. We find that in expansions, R&D↑/advertising↓ leads to an increase of 45 basis points in market share and \$5.23 million in additional profit, compared with the strategy of advertising↑/R&D↓. In contractions, R&D↑/advertising↓ leads to an increase of 62 basis in market share and \$8.93 million in additional profit, compared with advertising↑/R&D↓. These results suggest that if the firm faces tight resource constraints, a strategy of emphasizing R&D at the expense of advertising generates higher profits and market share than the opposite strategy, and that this effect is more pronounced in contractions than expansions.

If increasing R&D and advertising share in contractions has such beneficial effects, why is the dominant response of firms to cut back strongly on these activities? Deleersnyder et al. (2009) provide an explanation. They argue that firms' marketing decisions remain subject to social influences. They use "information cascades" theory to show that herding behavior—where individuals rely on signals and information conveyed by the behavior of others—can be rational when gathering information is costly. Herding leads managers to imitate the marketing behavior they observe from or expect of (because of overtime experience) their competitors during contraction and expansion periods. Given the dictum "Better be safe than sorry," potential career sanctions on deviating from others' marketing behavior may induce more managers to decrease advertising and R&D expenditure during tough economic times and to expand expenditure on these activities when most other firms do. As such, they may imitate the heuristics that other firms use (Deleersnyder et al. 2009) instead of conducting a formal and independent analysis. This tendency may be further strengthened by the fact that managers remain in their positions for only a few years. This even applies to the CMO, whose average tenure is 23 months (Welch 2004). Managers may feel that they do not have the "luxury" to take a long-term view.

Next to behavioral reasons, there may also be "financial" reasons why most firms do not use contractions to increase their advertising or R&D efforts relative to competitors. If a firm has not reserved money in good times for the (inevitable) rainy day, it will have to cut costs no matter what, even if the long-term consequences are decidedly negative. The firms may also feel the pressure to meet the quarterly earnings expectations of Wall Street. Discretionary expenses that can be cut relatively quickly are prime candidates to cut if financial targets are not met otherwise.

[18] In our simulations, all other predictors were set at or close to their sample mean. For contraction, we used the median decline of 2.74% for all years. We kept the marketing-mix instrument that is not involved in the simulation in question constant over time.

Understanding why firms exhibit cyclical behavior does not make a wrong right. We hope that this study provides ammunition for executives who want to go against the grain. Our findings indicate that a complacent attitude toward the consequences of cutting back on relative R&D or advertising intensity in contractions is not supported by facts. Our simulation results show that the benefits of R&D and advertising are real and may materialize while the executives are in their current jobs, even if it is only three years or so. By including market share in our study, we show marketing managers that herding behavior may not be in their best interest. Our empirical finding that maintaining R&D and advertising share yields greater returns in contractions than in expansions can be used by senior management as motivation to reserve money in good times to be spent in bad times. Furthermore, by including profit in our study, we show senior and financial managers that strongly cutting back on advertising and R&D in contractions reduces rather than improves financial results. The positive net effects of advertising and R&D in contractions on firm profit can be used as an additional reason to counter Wall Street's pressure to meet quarterly expectations, as it provides a view into future profit.

5.3. Limitations and Future Research

In this study, we focused on aggregate, macrolevel R&D expenditure. We have no microlevel information on the type of R&D activities on which the money is spent and whether the allocation of expenditures on (different subcategories of) NPD-focused R&D versus process-focused R&D projects changes across the business cycle. In contractions, cost cutting and risk aversion are important considerations. This would suggest that in tough times, firms shift R&D resources from product to process innovation, and within product innovations from radically new products to (less risky) incrementally new products.[19] However, it is not obvious that firms actually exhibit this behavior. Economists have argued that contractions are good times for developing major innovations because there is less interference with production (Barlevy 2007, Francois and Lloyd-Ellis 2003). Moreover, if firms would shift resources in contractions from product to process innovations, one would expect that the contemporaneous effect of R&D on firm profit becomes larger in contractions. We find no evidence for this proposition in our study. Thus, the evidence is inconclusive. Future research should examine whether the mix of R&D projects systematically differs across the business cycle and which type of project is most effective in contractions.

[19] See Srinivasan et al. (2009) for a discussion on the importance of distinguishing between incremental and radically new products in the context of R&D and innovation.

We need research on whether advertising content changes over the business cycle. It is plausible that in contractions, firms switch funds from differentiation-focused advertising to price-oriented advertising. Because price sensitivity is greater in contractions, it may further stimulate advertising effectiveness; this is exactly what we find. Future research could also investigate whether the effectiveness of other marketing-mix instruments such as price or sales force is systematically affected by adverse economic conditions. Our conceptual framework of specific supply- and demand-side factors is a good starting point for developing hypotheses.

One might wonder whether the 5% significance level employed in this study is too lenient, given the large number of observations. Although it would obviously be preferable to have even lower p-values, our simulation studies document that our effects are not "merely" statistically significant but also have practical significance. Furthermore, although the power of tests on our main effects is high, this is much less the case for the interactions, which, after all, are the main focus of our study. In a seminal paper, McClelland and Judd (1993) show that a researcher needs about 20 times as many cases in a field study to achieve the same efficiency to detect a two-way interaction as in an optimally designed experiment. Finally, our validation analyses showed that the model with interactions substantially outperforms the benchmark (main-effects-only) model in out-of-sample forecasting.

In our theorizing, we use supply- and demand-side effects as an organizing framework to predict "net effects" for R&D and advertising (see Table 1). However, we do not test the underlying effects per se. Future research could address this limitation. Because information of various demand- and supply-side effects may not be available on a consistent basis for a large number of firms over multiple decades, perhaps a deep case study involving one company, or even one industry, may be the way to implement this idea.

We study the effects of R&D and advertising on market share, but we do not know whether these changes are due to changes in volume or price, or both. Changes may also be due to changes in a firm's own levels of these instruments or of competitors. Future research could attempt to disentangle these effects. Another limitation of our research is that our simulations do not include competitive reactions. If firms observe other firms making smart moves and increasing market share, they may be tempted to follow suit. On the other hand, the cyclical variation in R&D and advertising has by now been observed for multiple decades. As such, it may be that at least in contractions, marketing myopia will still trump marketing acumen for most firms.

In sum, much remains to be studied, and we hope that our paper provides an impetus to other marketing researchers to make business cycles the focus of some of their own work. However, the core message of this paper is clear. Economic downturns offer a great opportunity for courageous firms to pull ahead of competitors. To paraphrase former White House Chief of Staff Rahm Emanuel, you never want a contraction to go to waste.

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