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Survival of Manufacturing Firms in *Fortune* 500: The Roles of Marketing Capital and R&D Capital

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Report Summary

It's impossible to overstate the importance of *Fortune* 500 firms—that is, the top 500 U.S. firms as determined by annual sales revenues. Their combined revenues accounted for 73% of U.S. GDP in 2008; if they were a country, that country would be the second-largest economy in the world. But membership in the *Fortune* 500 is by no means permanent: only 84 of the firms that comprised the initial *Fortune* 500 remained on the roll in 2006. Manufacturing firms have a particularly hard time retaining their position on the *Fortune* 500 list due to such economic challenges as global competition, deregulation, and the rapid growth of the service sector.

In this report, Gautham Vadakkepatt, Venkatesh Shankar, and Rajan Varadarajan examine how two factors—marketing capital and R&D capital—affect a *Fortune* 500 manufacturing firm's chances of remaining on the list. Guided by the resource-based view of the firm (RBV) and the structure-conduct-performance paradigm (SCP), they analyze a uniquely compiled data set (143 *Fortune* 500 firms from 18 manufacturing industries) from 1981 through 2006.

They find that both marketing capital and R&D capital have a direct positive effect on a manufacturing firm's survival as a member of the *Fortune* 500. Indeed, if a *Fortune* 500 manufacturing firm were to incrementally spend 1% of its average sales revenues on marketing and another 1% on R&D for five years, that investment would reduce its risk of leaving the list by 27.8%.

Industry growth has an interesting asymmetric moderating effect on the influence of marketing capital and R&D capital: in fast-growing industries, greater marketing capital boosts revenue growth relative to other firms in the *Fortune* 500, but in slow-growing industries, greater R&D capital boosts revenue growth. Certain company- and firm-specific variables also affect *Fortune* 500 staying power: the researchers found that (as might be expected) firm profitability was positively associated with remaining on the list, as was sales momentum. At the industry level, operating in a highly concentrated industry or in a large industry increased a firm's likelihood of remaining on the *Fortune* 500. The researchers also found that firms operating in industries with high R&D intensity have a greater risk of leaving the list.

Several other firm- and industry-specific factors that the researchers investigated, including financial leverage and diversification (firm-specific factors) and demand volatility and industry advertising intensity (industry-specific factors), do not have a significant effect on survival on the *Fortune* 500.

These findings have significant managerial implications for *Fortune* 500 manufacturers. Foremost, they underscore the importance of sustained investment in marketing and R&D. All other things being equal, *Fortune* 500 manufacturers should continue investing in marketing and R&D. The moderating effect of industry growth suggests that in high-growth industries, managers should be allocating more resources to marketing, whereas in stagnant or low-growth industries, they should be giving more resources to R&D. The sobering finding on firms operating in R&D-intense industries should lead managers in those industries to balance their worthwhile investment in R&D with protective measures.

In 1995, the *Fortune* 500 opened its list to service firms, which generally spend less on R&D than manufacturing firms do. Future research might fruitfully investigate what effect marketing and R&D capital have on service firms' survival on the list. Other avenues of future research include examination of the quality of R&D investment, the growth rate of *Fortune* 500 firms, and the role of the CEO in a firm's survival on the list.

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Since 1955, the *Fortune* magazine has published annually the *Fortune* 500 list or the list of the top 500 United States (U.S.) firms ranked by annual sales revenues. "Included in the survey (list) are companies that are incorporated in the U.S. and operate in the U.S., and file financial statements with a government agency. This includes private companies and cooperatives that file a 10-K or a comparable financial statement with a government agency, and mutual insurance companies that file with state regulators. It also includes companies that file with a government agency but are owned by private companies, domestic or foreign, that do not file such financial statements." (http://money.cnn.com/magazines/fortune/fortune500/2010/faq/).

Fortune 500 firms are the engine of the United States (U.S.) economy with their combined revenues accounting for 73% of the U.S. GDP in 2008. To put the importance of *Fortune* 500 firms in perspective, if we were to view them as a separate country, then they would be the second largest economy in the world (Labor Research Foundation 2006). Furthermore, over two-thirds of the Marketing Science Institute (MSI) member firms are *Fortune* 500 firms.

Fortune 500 firms enjoy a number of pecuniary and non-pecuniary benefits. First, they benefit from size advantages such as: (1) the ability to force customers and suppliers to be price-takers (e.g., Dobrev and Carroll 2003), (2) the ability to achieve market shares disproportionate to their sizes due to factors like reputation, information spillover and customer preference (e.g., Borenstein 1991), and (3) the capability to attract and retain the best talents (e.g., Doorley and Donavan 1999).

Second, being listed as a *Fortune* 500 firm generates high awareness about the firm in the investor community. This heightened awareness typically boosts the share price of the firm (e.g., Chen, Noronha, and Singhal 2004).

Finally, stature as a *Fortune* 500 firm engenders favorable perceptions about the future prospects of the firm. Specifically, the common view that *Fortune* 500 firms are less prone to failure can provide specific additional benefits like lower cost of capital and increased sales (Pathania and Pope 2007). The outperformance of the S&P 500 Index by the *Fortune* 500 Index (Carty and Blank 2002) strengthens investor perceptions about the superior performance of these firms. Some people go so far as to invest only in *Fortune* 500 firms (Navellier 2009). Potentially due to reasons discussed thus far, *Fortune* 500 firms enjoy increases in their share prices specifically associated with their entry into this list (Pathania and Pope 2007).

While many *Fortune* 500 firms continue to retain their position on the *Fortune* 500 list year after year, others fall off this prestigious list. A fall from the list can be precursor to adverse corporate outcomes such as bankruptcy and hostile takeover. For example, Outboard Marine fell off the list in 1994, eventually going out of business in 2000. Likewise, Zenith Electronics fell off the list in 1994 and ended up declaring bankruptcy in 2000. These examples highlight the importance to firms of retaining the *Fortune* 500 firm stature once they achieve it.

Maintaining the *Fortune* 500 firm standing is quite challenging. Of the inaugural *Fortune* 500 firms published in 1955, only 84 firms retained the distinction in 2006. These observations raise important questions: What explains the survival of some firms as *Fortune* 500 firms and the non-survival of others as part of this prestigious cohort? How critical are investments in value creation (research and development [R&D]) and value appropriation (marketing) activities to survival as a *Fortune* 500 firm?

Research focusing on the broader phenomenon of survival and failure of firms sheds some light into this issue. However, the *determinants of survival as a Fortune 500 firm* differ from the *determinants of survival as an ongoing firm, per se* (i.e., staying in business). For

example, while a firm that achieves the stature of a *Fortune* 500 firm can be profitable and survive as a business in a particular industry, its survival on the *Fortune* 500 list may depend on whether its sales growth is comparable to, or higher than, those of firms in other industries. This possibility suggests that the role of industry factors such as industry growth in the survival of firms as *Fortune* 500 firms may be more nuanced than their role in the context of survival as a firm, per se. Furthermore, given the size of *Fortune* 500 firms, the effects of marketing and R&D investments on the sales revenues for *Fortune* 500 firms can be different from those for other firms. This possibility suggests that the roles of firm-specific determinants on survival as a *Fortune* 500 firm will also differ from those in the context of survival as a firm, per se.

While survival as a *Fortune* 500 firm is difficult for all firms, it is particularly challenging for firms operating in the manufacturing sector. A review of the firms populating the *Fortune* 500 lists over the years lends support to this observation. For example, the primary metals industry, once home to a number of *Fortune* 500 firms, now finds scarce representation on the list. Rising global competition, deregulation, and rapid growth of the service sector (Sharma, Krishnan, and Grewal 2001) are some of the factors fuelling the decline of manufacturing firms on the *Fortune* 500 list. While some manufacturing industries may be impacted more than others, within industry heterogeneity in survival probabilities is also high. For example, although both Nalco and PPG Industries, two firms operating in the chemicals industry, were able to achieve the prestigious status of being a *Fortune* 500 firm, Nalco fell from the *Fortune* 500 list in 1994, while PPG Industries continues to remain as a *Fortune* 500 firm.

While many firm-specific factors can impact survival as a *Fortune* 500 firm, we focus on two strategic variables: R&D capital and marketing capital, which represent value-creating (innovation) asset and value-extracting asset, respectively. R&D capital can be viewed as the

stock of R&D expenditures, whereas marketing capital can be regarded as the stock of marketing expenditures. At the highest level of decision-making, these variables are critical to a firm's allocation of resources (Shankar 2008). By gaining insights into the nature and relative magnitudes of the effects of marketing and R&D capitals on survival as a *Fortune* 500 firm, firms can better plan their marketing and R&D investments.

A number of considerations underscore the importance of a firm's marketing capital to survival as a *Fortune* 500 firm. For instance, some researchers argue that the failure of leading firms, such as *Fortune* 500 firms, may be due to inertia in target marketing (e.g., Christensen and Bower 1996; Slater and Narver 1998). Other research provides extensive evidence of the positive effect of a firm's marketing effort or its specific components on various measures of firm performance, including sales (e.g., Dekimpe and Hanssens 1995), market value (e.g., Joshi and Hanssens 2010) and systematic risk (e.g., McAlister, Srinivasan, and Kim 2007). However, there is a paucity of research that investigates the effect of a firm's marketing capital on its survival as a *Fortune* 500 firm.

The importance of R&D capital is highlighted by a number of considerations such as the growing emphasis on innovation (e.g., Srinivasan, Haunschild, and Grewal 2007) and the associated increase in R&D spending by firms (e.g., Jaruzelski and Dehoff 2007; Taub 2004). Some prior research (e.g., Hall 1987) suggests a positive relationship between R&D expenditures and sales growth. However, increased R&D capital may not directly translate into improved firm performance. For instance, the 2007 Global Innovation 1000 Survey (Jaruzelski and Dehoff 2007) finds no statistically significant relationship between the levels of R&D investment and the financial performance of the top spenders on R&D. This begs the question of how, after controlling for other firm- and industry-specific factors, R&D capital impacts its survival as a

Fortune 500 firm. To our knowledge, no research has explicitly examined the link between R&D capital and survival as a *Fortune* 500 firm.

In this regard, the strategic fit perspective argues that it is not merely the strategic choices of the firm, but how the strategic choices of the firm fit with the contingencies surrounding the firm, that determine the impact of these actions. This viewpoint highlights the role of environmental or industry-specific contingency factors. An industry-specific moderating factor particularly relevant to survival as a *Fortune* 500 firm is industry growth. Consider for instance, the industry composition for the top 100 leading manufacturing firms in the years 1919 and 1964 as identified by Boyle and Sorensen (1971). While in 1919, 52 firms from six industries that were identified as declining industries were part of the leading firm cohort, only 29 firms from these six industries were part of the cohort in 1964. On the flip side, seven industries that were identified as growth industries in 1919 accounted for 60 of the top 100 leading manufacturing firms in 1964, an increase from the 45 firms that represented these industries in 1919. While these statistics highlight the importance of industry growth to survival as a *Fortune* 500 firm, there is a dearth of research that examines the moderating effects of industry growth on the relationships between marketing capital and survival as a *Fortune* 500 firm and between R&D capital and survival as a *Fortune* 500 firm.

Our research fills this void by examining the moderating effects of industry growth in addition to the main effects of marketing and R&D capitals on survival as a *Fortune* 500 firm. We develop a conceptual framework and hypotheses related to the above and test the hypotheses using a survival analysis on a uniquely compiled large dataset of 143 U.S. manufacturing firms from the 1981 *Fortune* 500 list.

Our empirical analysis reveals several important and interesting findings. The effects of marketing and R&D capital on survival as a *Fortune* 500 firm are asymmetric. While both R&D capital and marketing capital show a significant and direct positive association with survival as a *Fortune* 500 firm, the moderating effects of industry growth on the relationships between marketing capital and survival as a *Fortune* 500 firm and R&D capital and survival as a *Fortune* 500 firm is asymmetric. Specifically, we find that marketing capital also indirectly improves survival as a *Fortune* 500 firm through the positive moderating effects of industry growth. In contrast, R&D capital indirectly undermines survival as a *Fortune* 500 firm due to the negative moderating effect of industry growth. Thus, to retain firms' positions in the *Fortune* 500 list, managers may want to consider investing more in marketing (R&D) when industry growth is high (low).

Conceptual Framework and Hypotheses

Figure 1 (following References) presents a conceptual model delineating the relationships between a firm's marketing capital and survival as a *Fortune* 500 firm and between R&D capital and survival as a *Fortune* 500 firm. As shown in Figure 1, we posit that industry growth (an environmental contingency variable) moderates these relationships. Figure 1 also shows a number of firm-specific and industry-specific control variables that affect firm survival. The resource-based view (RBV) of the firm and the structure-conduct-performance (SCP) paradigm provide the theoretical underpinnings for this conceptual model.

At its essence, the RBV posits that the bundle of valuable, rare, inimitable, and non-substitutable resources at a firm's disposal is its source of competitive advantage (Barney 1991).

A firm's marketing and R&D capitals represent firm-specific resource bundles that exhibit these characteristics. Marketing capital produces sustained competitive advantage through the creation and strengthening of market-based relational assets (e.g., brand equity, customer equity, and channel equity) and market-based intellectual assets (i.e., market knowledge and marketing knowledge), both of which are valuable, difficult to imitate and idiosyncratic to the firm (e.g., Srivastava, Fahey, and Christensen 2001). Similarly, it has been argued that R&D capital creates sustained competitive advantage through the mechanisms of organizational knowledge (e.g., Cohen and Levinthal 1989) and innovation capability (e.g., Geroski, Machin, and Reenan 1993), which are hard-to-imitate and valuable resources.

The SCP paradigm postulates that certain industry structural characteristics (e.g., growth, entry barriers, and industry concentration), by virtue of their effect on the behavior of firms in the industry, impact their profitability (e.g., Bain 1956). Prior research suggests that industry growth moderates the relationship between strategic variables and various measures of firm performance (e.g., Gatignon and Xuereb 1997). Building on these streams of research, we posit industry growth as a moderator of the relationships between marketing capital and survival as a *Fortune* 500 firm and between R&D capital and survival as a *Fortune* 500 firm. A detailed discussion of the hypothesized linkages follows.

Main effect of marketing capital

A firm's marketing capital comprises of investments in marketing variables such as advertising, sales force, and sales promotions (Shankar 2008). We expect that a *Fortune* 500 firm's marketing capital will enhance its probability of survival in the *Fortune* 500 firm cohort in at least two ways. First, marketing capital can influence key measures of firm performance

directly and hence improve the probability of survival as *Fortune* 500 firm. Second, it can create market-based assets that serve as a source of sustained competitive advantage, further improving the probability of survival as a *Fortune* 500 firm.

Expenditures on marketing variables have a positive effect on the different dimensions of firm performance. For instance, advertising spending has a direct effect on sales (Dekimpe and Hanssens 1995), profit (Erickson and Jacobson 1992), firm value (Joshi and Hanssens 2010), and systematic risk (McAlister, Srinivasan, and Kim 2007). Investments in sales force activities also have a direct effect on firm performance (Narayanan, Desiraju, and Chintagunta 2004). Investments in sales promotions also generate a short term boost in sales with market leaders enjoying the largest surge (Dekimpe, Hanssens, and Silva-Risso 1999).

Consistent with the RBV of the firm, marketing capital can also impact survival as a *Fortune* 500 firm through the creation of market-based relational or intellectual assets (Srivastava, Fahey, and Christensen 2001). Brand equity is a market-based relational asset with the potential to insulate a firm's fortunes from its competitors' actions and macroeconomic changes (Leone et al. 2006) through mechanisms such as decreasing customer price sensitivity (e.g., Kalra and Goodstein 1998) and increasing the ability to charge a premium relative to its competitors (Shankar, Azar, and Fuller 2008). Customer equity, another market based asset, also impacts market capitalization (Kumar and Shah 2009). Finally a firm's market-focused intelligence generation related activities (Kohli and Jaworski 1990; Slater and Narver 2000) facilitate the creation of market based intellectual assets that can enhance its survival as a *Fortune* 500 firm. For these reasons, we posit that:

> H_1: The greater the marketing capital of a *Fortune* 500 firm, the higher its probability of survival as a *Fortune* 500 firm.

Main effect of R&D capital

In scholarly business literature as well as in the business press, innovation has been widely heralded as the cure-all for organizations. The importance of innovation stems from its positive impact on firm profits (Bayus, Erickson, and Jacobson 2003), market value (Chaney, Devinney, and Winer 1991), and market-expansion ability (Nijs et al. 2001). There is, however, a paucity of research that examines the impact of R&D capital on firm survival and virtually no research examines the effect of R&D capital on survival as a *Fortune* 500 firm.

We posit that a *Fortune* 500 firm's R&D capital will be positively associated with survival as a *Fortune* 500 firm, based on the following considerations. First, absolute R&D expenditures are positively associated with firm size (Cohen and Klepper 1996), a key variable determining *Fortune* 500 ranking. Thus, *Fortune* 500 firms typically have the largest investments in R&D within their industries. Second, there is a positive relationship between R&D investment and innovation output (e.g., Mansfield 1968). Taken together, these arguments suggest that firms with high R&D capital will have high innovation outputs, and because innovation is positively linked to market expansion abilities (Nijs et al. 2001), these firms are in a strong position to retain membership in the *Fortune* 500 firm cohort. Sustained innovations, even those that are incremental, can help *Fortune* 500 firms retain their status as a *Fortune* 500 firm through their positive effect on market shares (e.g., Banbury and Mitchell 1995).

Second, R&D capital can impact survival through the creation of intangible, difficult to imitate assets that serve as a source of sustained competitive advantage. R&D capital can create these assets in at least two ways. It can improve a firm's absorptive capacity (Cohen and Levinthal 1989), which in turn allows it to more easily adapt to or adopt technological changes introduced by competition. It can also lead to an improved innovation process (Geroski, Machin,

and Reenan 1993), potentially allowing the firm to renew its capabilities. For these reasons, we posit:

> H_2: The greater the R&D capital of a *Fortune* 500 firm, the higher its probability of survival as a *Fortune* 500 firm.

Main effect of industry growth

A firm is said to be operating in a munificent environment if adequate resources are available in the environment to sustain its growth (Bahadir, Bharadwaj, and Parzen 2009; Dess and Beard 1984). Munificent operating environments reduce the motivation of firms to engage in competitive retaliation and also provide the focal firm with the many strategic options (Castrogiovanni 1991).

Typically, high growth industries are associated with high environmental munificence. In contrast, low growth industries create an environment that results in fierce competition among firms within an industry (Dess and Beard 1984). This increased competition among firms may be one reason why Boyle and Sorenson (1971) observe that leading manufacturing firms operating in low growth industries are more likely to exit the leading firm cohort than those operating in high growth industries. Another reason is that low growth industries impose a natural limit on the growth of these firms. In contrast, firms that operate in high growth industries have a greater probability of retaining their leadership position than others because in high growth industries, firms can focus on gaining new customers rather than on poaching customers away from competition. Furthermore, it is likely that under conditions of high industry growth, a *Fortune* 500 firm is able to grow by leveraging factors like reputation, information spillovers and network effects. The above line of reasoning leads us to postulate that:

H_3: The greater the rate of growth of the primary industry in which a *Fortune* 500 firm operates, the higher its probability of survival as a *Fortune* 500 firm.

Moderating effects of industry growth

Moderating effect on the link between marketing capital and survival as a Fortune 500 firm:[i] In low-growth industries, customers' needs and preferences are relatively stable and predictable. Although the absolute number of new customers is a function of the size of the market, for a given market size, low industry growth rate implies a relatively small number of new customers. To sustain firm growth in such an environment, a firm is faced with the need to attract customers away from its competitors. Enticing competitors' customers to switch will require a greater investment in marketing activities such as sales promotion. Furthermore, and as a consequence of having to expend a greater level of effort toward understanding the needs of the customers, firms operating in low-growth industries will require greater marketing effort than those operating in high-growth industries (Kohli and Jaworski 1990).

In contrast to firms operating in low-growth industries, firms operating in high-growth industries need to expend less effort in acquiring new customers (Dess and Beard 1984). In addition, operating in high-growth markets is advantageous to *Fortune* 500 firms because high-growth markets are associated with evolving customer preferences (Gatignon and Xuereb 1997) and a *Fortune* 500 firm, through its marketing activities and reputation, can influence and shape customers' preference formation. For these reasons, we hypothesize that:

H_4: Industry growth moderates the positive effect of marketing capital on survival as a *Fortune* 500 firm such that at higher levels of industry growth, the effect of marketing capital on probability of survival as a *Fortune* 500 firm is greater.

Moderating effect on the relationship between R&D capital and survival as a Fortune 500 firm. We expect R&D capital to have a weaker effect on survival as a *Fortune* 500 firm for

firms that operate in high-growth industries than in low-growth industries. This is because high-growth industries attract and sustain a larger number of entrants than do low-growth industries (Dess and Beard 1984). Furthermore, in high-growth industries, new entrants engage in more innovative activities and are typically larger in size than those in low-growth industries (e.g., McDougall et al. 1994). The increase in competition and the increased innovative activities of new entrants have the potential to decrease the effect of the *Fortune* 500 firm's R&D capital on its survival as a *Fortune* 500 firm. In particular, in high-growth industries, because of the greater innovative activities of new entrants, the possibility that the next innovation will be introduced by a rival is higher. In low-growth industries, the need for innovation is high, so greater R&D capital will likely be associated with higher sales revenues. Given the importance of innovation to sustained membership in the *Fortune* 500 firm cohort, we posit that:

> H_5: Industry growth moderates the positive effect of R&D capital on survival as a *Fortune* 500 firm such that at higher levels of industry growth, the effect of R&D capital on probability of survival as a *Fortune* 500 firm is smaller.

Firm-specific control variables

Momentum. We define momentum as the change in sales revenues between the current and immediate past time periods. We expect that the greater the momentum, the higher is the probability of survival as a *Fortune* 500 firm.

Profitability. Because firms cannot spend their way to high sales and maintain their *Fortune* 500 membership without regard to profits, we control for profitability. Jacquemin and Berry (1979) observe that the initial profitability of a firm has a positive impact on its subsequent growth rate. Similarly, Coad (2007) finds a positive effect of second and third period lags of

profits on firm growth rates. Thus, we expect the probability of survival as a *Fortune* 500 firm to increase with firm profitability.

Diversification. Jacquemin and Berry (1979) show that both diversification within the two-digit SIC code in which a firm currently operates (related diversification) and diversification into industries in other two-digit SIC codes (unrelated diversification) resulted in positive growth rates for 460 *Fortune* 500 firms in 1960. Therefore, we expect an increase in the probability of survival as a *Fortune* 500 firm with increasing diversification.

Strategic Shift in Emphasis. A shift in emphasis between marketing and R&D spending at appropriate times in the firm's life can influence a firm's survival as a *Fortune* 500 firm. Spending more (less) on R&D than on marketing implies firms placing a strategic emphasis on value creation (value appropriation) and stock markets reward companies for a strategic shift to value appropriation (Mizik and Jacobson 2003). Furthermore, marketing capability may be more valuable to a firm than R&D capability (Krasnikov and Jayachandran 2008). Therefore, we expect that the greater the strategic shift toward marketing from R&D, the higher is the probability of survival as a *Fortune* 500 firm.

Financial leverage. Financial leverage refers to a firm's debt to asset ratio. Debt financing involves a trade-off that pits its advantages, namely, interest tax shields and lower need for capital (Ross, Westerfield, and Jordan 2007) against its disadvantages, namely, managerial loss of control rights and increased probability of bankruptcy (e.g., Hillegeist et al. 2004; Shumway 2001). Financial leverage may be positively related to the probability of bankruptcy due to two main reasons. First, greater leverage is associated with increased probability of defaulting on payments. Second, an increased diversion of internal finance into servicing debt detracts from the firm's ability to invest in future growth opportunities (Lang,

Ofek, and Stulz 1996; Zingales 1998). Based on this reasoning, we expect the link between financial leverage and survival as a *Fortune* 500 firm to be negative.

Industry-specific control variables

Industry concentration. Industries with high concentration are conducive to *Fortune* 500 firms controlling their level of output by tacitly colluding with other firms in the industry. In the limit, the abilities of the largest firm in a highly concentrated industry can be tantamount to monopoly power. Often, in highly concentrated industries, customers are price takers and suppliers are faced with the imperative to accept the terms set by the largest firms. These considerations suggest that the probability of survival as a *Fortune* 500 firm increases with increasing concentration.

Industry demand volatility. Companies that operate in environments characterized by greater demand uncertainty have a higher hazard of failure (Anderson and Tushman 2001). Fluctuations in industry revenues are likely to decrease the probability of survival as a *Fortune* 500 firm because volatility may be negatively associated growth.

Industry Size. We expect the size of the primary industry in which a *Fortune* 500 firm operates to have a positive impact on its survival as a *Fortune* 500 firm.

Industry R&D intensity. Industry level R&D intensity is a widely used measure of product differentiation related entry barriers (e.g., Grabowski and Mueller 1978; Waring 1996). The greater the R&D intensity of an industry, the higher the barriers are to enter the industry. In turn, barriers to entry are positively associated with the profitability of incumbents in an industry. Industry R&D intensity has a positive impact on the persistence of profits (e.g., Grabowski and

Mueller 1978; Sutton 2007; Waring 1996). These considerations suggest that the R&D intensity of an industry will be positively associated with survival as a *Fortune* 500 firm.

Industry advertising intensity. Industry level advertising intensity is another widely used measure of product differentiation-related entry barriers (Comanor and Wilson 1967; Davies and Geroski 1997). Comanor and Wilson (1967) observe that industry advertising expenditures have a substantial positive effect on the average profit rates of incumbents in the industry. Therefore, we expect industry advertising intensity to be positively related to survival as a *Fortune* 500 firm.

Methodology

Sample selection

While firms have typically engaged in R&D activities for decades, the focus on R&D and marketing activities as sources of competitive advantage came into sharper focus in the late 1970s (Nakamura 2003). It is also around this time frame that more firms began reporting their marketing and R&D expenditures. For these reasons, the 1981 cohort of *Fortune* 500 firms in the manufacturing sector forms the basis of our empirical analysis.

We arrived at the final list of firms in our data set by adopting the following sample selection procedure. In the first step, we identified the firms in the *Fortune* 500 list for which COMPUSTAT data on the variables in our conceptual model are available. We identified 400 such firms. In the second step, we retained the manufacturing firms, which are firms whose primary operating industry is in the SIC codes 20-39. This reduced the database of potential firms to 324 firms. In the third step, given our focus on marketing capital and R&D capital, we

dropped companies that did not report both sales and general administration (SG&A) expenditures and R&D expenditures, the bases of marketing capital and R&D capital, respectively. We also dropped 13 firms that reported insignificant R&D expenditures as the data on this variable for these firms could have been misreported. This resulted in a final sample of 234 firms.

A possible reason for changes in the list of *Fortune* 500 firms over time is the acquisition of one *Fortune* 500 firm by another and not poor performance. For this reason, we eliminated from our database, those companies whose exit from the *Fortune* 500 firm cohort was due to their being acquired.[ii] This step further reduced the active dataset to 176 firms. Finally, to analyze the uninterrupted longevity of leadership, we omitted 33 firms that had recurrent events, i.e., firms which re-entered the list after dropping out earlier. Thus, the final dataset included 143 firms from 18 different manufacturing industries. Table 1 (following References) describes the SIC industries included in the database and the number of companies by the two digit SIC code in the operating database. The sectors that have more companies on the *Fortune* 500 also have a larger representation in the final database. We did this tracking through multiple archival sources, including LexisNexis and Hoovers.

Variables and data sources

Table 2 (following References) describes the variables, the measures and data sources. We utilize two main sources for data: (1) the 1981 *Fortune* 500 list forms the initial sampling frame and (2) the COMPUSTAT database for the set of firm- and industry-specific measures that we have listed in Table 2.

We discuss the operationalization of only the focal strategic constructs, namely, marketing capital and R&D capital and the variable that involves a new operationalization, namely, shift in strategic emphasis. The operationalizations of the remaining variables are consistent with those in prior research and are described in Table 2.

Marketing capital and R&D capital. We operationalize marketing capital and R&D capital through stock measures that capture the cumulative asset value of marketing expenditures and R&D expenditures, respectively. Consistent with prior research (e.g., Hanssens, Parsons, and Schultz 2003), we use a Koyck structure to compute the lagged effects of R&D and marketing expenditures. Formally, the marketing capital (*MKT*) for period *t* is given by:

$$MKT_t = \sum_{k=1}^{t} \lambda^{t-k} MKTE_{kt} \quad (1)$$

where λ is the retention rate for marketing investment, i.e., the proportion of marketing stock from the previous year that carries over to the present year and *MKTE* is the marketing spending. Similarly, the R&D capital (*RD*) for period *t* is given by:

$$RD_t = \sum_{k=1}^{t} \theta^{t-k} RDE_{kt} \quad (2)$$

where θ is the retention rate for R&D investment and RDE is the R&D spending. Consistent with Mizik and Jacobson (2007) and Luo (2008), we proxy annual marketing expenditures by the difference of SG&A and R&D expenditures, which we obtained from COMPUSTAT. We use this measure and not advertising expenditures as a proxy for marketing expenditures for several reasons. First, because advertising is just one element in a firm's marketing mix, our measure better captures a firm's investment in all marketing activities than does advertising expenditure. For instance, a decline in advertising spending may not reflect a decrease in marketing expenditures, but indicate a shift in spending to other marketing mix elements. Second, many of the firms in our data did not directly report advertising expenditures for the period of our

analysis. Finally, there is a high correlation (.73) between our measure of marketing expenditures and advertising expenditures for the sample of firms in COMPUSTAT that report R&D, advertising and SG&A expenditures during the period 1981-2006.

We estimate the retention rates for each of these variables separately using the Koyck transformation on an equation that regresses sales revenues on the focal strategic variable. Through this procedure, we obtain retention rates of 60% and 84% for marketing capital and R&D capital, respectively. While the rate for R&D capital is consistent with prior research (e.g., Hall, Jaffe, and Trajtenberg 2005), the rate for marketing capital is slightly higher than the average rate for advertising from prior research (50%). A possible reason is that because marketing covers more elements than advertising, the retention rate for marketing capital will likely be higher than that for advertising capital. We calculate the initial marketing capital and R&D capital by using appropriate back year data.

Strategic shift in emphasis. We use a modified form of the strategic shift in emphasis variable used by Mizik and Jacobson (2003). We operationalize shift in strategic emphasis as the difference of the annual change in marketing expenditures and the annual change in R&D expenditures because our focus is on membership in the *Fortune* 500 list, which is based on absolute sales revenues. In addition, our measure captures the broad set of marketing activities.

Year of services firms introduction. In 1995, the *Fortune* 500 list was extended to include services firms, many of which displaced several manufacturing firms from the 1994 list. To account for this onetime event reason for exit from the *Fortune* 500 list, we use a dummy variable to represent those firms that exit the list in 1995.

Data

The constructed database contains new entrants as well as firms that have been in existence since the inaugural *Fortune* 500. Table 3 (following References) presents the descriptive statistics for key variables used in the analysis. There are a few notable characteristics of the database. There is considerable heterogeneity in firm-specific factors. The marketing capital and R&D capital of these *Fortune* 500 firms also exhibit a wide range of values. Marketing capital ranges between $92.118 million to $45,813 million and R&D capital ranges from $4.28 million to $39,321 million. Measures of financial leverage differ widely with some *Fortune* 500 firms being debt-free and other firms being highly leveraged.

Table 4 (following References) presents the correlations among the explanatory variables.[iii] The variance inflation factors (VIFs) and condition indices are much lower than 10 and 30, respectively, suggesting that multicollinearity is not an issue (Belsey, Kuh, and Welsch 1980).

Figure 2 (following References) shows the Kaplan-Meier estimate of survival as a *Fortune* 500 firm for the data. Exits from the *Fortune* 500 firm cohort occur in every year except 2006. The most number of exits occur at the end of Year 1994. As mentioned earlier, service sector firms were first introduced in the *Fortune* 500 list in 1995.

Model formulation

The time to exit from the *Fortune* 500 firm cohort is censored at the end of the observation period, that is, Year 2006. This condition requires us to use a duration model because standard regression techniques would result in biased results. The hazard function is the distinguishing idea behind survival models and can be defined as the instantaneous probability of

an event occurring given that the event has not occurred until that point of time. Thus, the hazard $h_i(t)$ of failure or dropping off the *Fortune* 500 list for a firm *i* with event time T_i at time *t* can be written as:

$$h_i(t|X_i) = \underset{\Delta t \to 0}{Lim} \frac{\Pr_i[t < T_i \leq t + \Delta t | T_i > t, X_i]}{\Delta t} = \frac{f_i(t)}{S_i(t)} \quad (3)$$

where X_i is a vector of covariates, Pr_i is probability, $f_i(t)$ is the probability density function and $S_i(t)$ is the survival function, all relating to firm *i*, and Δt is small incremental time. The Cox proportional hazards model (PHM) is the most popular model used in survival analysis. Two key advantages of this model are: it does not require us to define the distribution of the baseline hazard and it allows us to model the interaction between marketing and R&D capitals with industry growth. It is given by:

$$h_i(t|X_i) = h_o(t)\exp(X_i\beta) \quad (4)$$

where $h_o(t)$ is the baseline hazard function and $\boldsymbol{\beta}$ is a parameter vector associated with the covariate vector.

Therefore, the equation we estimate is the relative hazard (h_{ri}[t]), the ratio of hazard of firm *i* at time *t* to the baseline the hazard) model in the following form:

$$log h_{ri}(t) =$$

$$\beta_1 MKT_{i(t-1)} + \beta_2 RD_{i(t-1)} + \beta_3 IG_{i(t-1)} + \gamma_1 IG_{i(t-1)} * MKT_{i(t-1)} +$$

$$\gamma_2 IG_{i(t-1)} * RD_{i(t-1)} + \boldsymbol{\delta} Z_{i(t-1)} + \boldsymbol{\rho} Y_{i(t-1)} + \sum_{k=1}^{K-1} \pi_k IND_{ki} \quad (5)$$

where the left-hand side of the equation is the log of the relative hazard rate, IG_i is industry growth of the primary operating industry of the firm *i*, $\boldsymbol{Z_i}$ is a vector of time varying firm-specific control variables for each firm *i* and $\boldsymbol{Y_i}$ is a vector of time varying industry-specific control variables for each firm *i.* K is the number of industries in the dataset, ***IND*** is a vector of industry-specific dummy variables, $\boldsymbol{\beta, \gamma, \delta, \rho,}$ and $\boldsymbol{\pi}$ are parameter vectors, and the remaining terms are as defined earlier. We use lagged independent variables to avoid potential endogeneity problems. We include the industry dummies to control for unobserved industry heterogeneity.

Model estimation

The Cox proportional hazard model uses the partial likelihood method for estimation. Stated simply, partial likelihood can be viewed as the probability that a firm *i* has experienced the event at duration time *t* given that firm *i* is in the risk set at this duration time. Following Bolton (1998) and Schmittlein and Helsen (1993), the individual partial likelihood *L* can be expressed as:

$$L\left(i\middle|t, f_1, f_2, \ldots . f_{n(t)}\right) = h_i(t)/\sum_{k=1}^{n(t)} h_k\,(t) \qquad (6)$$

where $f_1, f_2, \ldots, f_{n(t)}$ are firms in the risk set, n(t) is the number of firms in the risk set at duration time *t*, and the remaining terms are as described earlier. Substituting Equation 4 into the above equation results in a likelihood function written in terms of the vector of covariates $\boldsymbol{X_i}$. The total partial likelihood is the product of these individual likelihood functions calculated at all duration times. We obtain the parameter estimates by maximizing this total partial likelihood function.

A distinguishing aspect of our data set is that some of the firms in our database were at risk of the event even prior to 1981, i.e., observations for these firms are left-truncated. The

presence of left–truncated subjects is an econometric concern because it highlights the possibility of sample selection. In particular, because high-risk subjects can drop out of the data set before the beginning of the observation period. In other words, left-truncated subjects tend to have lower risks than those in a normal sample (Bolton 1998; Schmittlein and Helsen 1993). Thus, we need to account for left truncation. When start times are unknown, left truncation is generally accounted for by either assuming a constant hazard rate or by discarding all left-truncated subjects (Allison 1995). However, when start times are known, semi-parametric models can account for left truncation (Bolton 1998; Schmittlein and Helsen 1993). To do so, the analysis needs to exclude from the risk set at any given time, those subjects who have not entered the observation period at that time, even though their duration time is longer than the time between the beginning of the observation period and the current time (Bolton 1998; Schmittlein and Helsen 1993).

In our analysis, we follow the approach described by Bolton (1998) and Schmittlein and Helsen (1993) in accounting for left truncation. Specifically, we create pseudo-observations for each duration time by identifying the correct risk sets at each duration time, group observations into strata based on the risk sets at each duration time, and then run a stratified Cox regression model on this data set.

Results

Hypothesized variables

Table 5 (following References) reports the results of our fully specified model as well as those of a model without the interactions to underscore the importance of considering these

interactions. Hypothesis H_1 argues that marketing capital is positively associated with the probability of survival as a *Fortune* 500 firm. Our result provides support for this hypothesis ($p <$ .01). This result is easier to interpret if we convert the coefficient into a hazard ratio, which is simply the exponential of the reported coefficient. A hazard ratio greater than one increases the probability of exiting the *Fortune* 500 cohort while a hazard ratio less than one implies that the focal variable reduces the hazard of exiting the *Fortune* 500 cohort. The hazard ratio for the direct effect of marketing capital is .9993 which implies that, all else equal, a one unit increase in marketing capital reduces the hazard of exiting the *Fortune* 500 firm cohort by .07%. To put this in perspective, consider the following. The average sales revenues for a firm in our dataset are approximately $12.5 billion. If this average firm was to increase its marketing capital by 1% ($125 million) of this average sales figure, then this action would increase its probability of survival as a *Fortune* 500 firm by 8.4%, all else equal.

Hypothesis H_2 posits that R&D capital is positively associated with higher probability of survival as a *Fortune* 500 firm. The effect is significant and in the expected direction ($p < .05$). The hazard ratio for the direct effect of R&D capital is .9995 which implies that, all else equal, a one unit increase in R&D capital reduces the hazard of exiting the *Fortune* 500 firm cohort by .05%. If the average firm were to increase its R&D capital by 1% of its average sales revenue figure, then this action would increase the probability of its survival as a *Fortune* 500 firm by 7.2%, all else equal.

Hypothesis H_3 posits that the higher the level of industry growth, the greater is the probability of survival as a *Fortune* 500 firm. The results do not lend empirical support for the main effect of industry growth ($p > .10$).

However, the results lend empirical support for our hypotheses that the moderating effects of industry growth are asymmetric between marketing capital and R&D capital. Specifically, H_4 posits that industry growth positively moderates the relationship between marketing capital and survival as a *Fortune* 500 firm. This effect is significant and is in the expected direction ($p < .05$), suggesting that marketing activities are more valuable in high-growth industries than in low-growth industries. H_5 posits that industry growth negatively moderates the relationship between R&D capital and survival as a *Fortune* 500 firm. Our result supports H_5 ($p < .05$). That is, for the same level of R&D capital, firms operating in high-growth industries have a higher hazard of exit or a lower probability of survival as a *Fortune* 500 firm than those in low-growth industries ($p < .01$). Thus, R&D capital is more valuable in low-growth industries than in high-growth industries.

Control variables

Firm-specific control variables. We posited that a firm's financial leverage, its momentum, its profitability, its degree of diversification, and its strategic shift in emphasis have effects on its survival as a *Fortune* 500 firm. The results of our analysis show that both momentum ($p < .01$) and firm profitability ($p < .05$) are positively associated with the probability of surviving as a *Fortune* 500 firm. However, the effects of financial leverage, strategic shift in emphasis, and diversification on the probability of survival as a *Fortune* 500 firm are not significant ($p > .10$).

Industry-specific control variables. The results in Table 6 highlight the importance of considering industry characteristics when explaining time of survival as a *Fortune* 500 firm. In particular, *Fortune* 500 firms that operate in more concentrated industries have a greater

probability of survival as a *Fortune* 500 firm ($p < .10$). Operating in larger industries also increases the probability of survival as a *Fortune* 500 firm ($p < .10$). However, our results suggest that industry demand volatility is not significant in explaining survival as a *Fortune* 500 firm ($p > .10$). Finally, firms operating in industries with high R&D intensity have a lower probability of survival as a *Fortune* 500 firm ($p < .05$), while high industry advertising intensity does not have a significant effect on survival as a *Fortune* 500 firm ($p > .10$). This result is counter to the entry barrier argument advanced earlier. A possible reason is that heightened industry R&D intensity reflects increasing competition in innovation, hampering the focal firm from exhibiting greater sales growth. Only two industry-specific dummy variables, SIC code 24 (lumber and wood products industry) and SIC code 37 (transportation equipment industry), are significant. Furthermore, the dummy variable controlling for firms exiting the list during the year that service firms were added to the list, is not significant ($p > .10$).

Robustness checks

We conducted several robustness checks to confirm the validity of our findings. First, we examined if our results were robust to alternative models. To this end, consistent with prior research (e.g., Aboulnasr et al. 2008; Srinivasan et al. 2008), we estimated continuous parametric survival models. The results from these analyses are consistent with results from the proportional hazards model. We also estimated a logit model and a discrete hazard model. Again the results from these models are quite similar to those of the proposed model. Because our research explicitly focuses on the survival in a group of the largest of large firms, absolute sales revenues matter and we did not normalize the variables by firm assets or sales revenues. However, we estimated alternative models with firm-specific variables normalized by assets or sales revenues.

The main difference between the results from these models and our proposed model is that marketing capital does not have a significant main effect on survival as a *Fortune* 500 firm ($p > .10$).

Second, consistent with Aboulnasr et al. (2008), we examined if our results are sensitive to the choice of cutoff date. We estimated two models with 2004 and 2005 as the last year of observations. The results show that main model findings are not sensitive to the choice of cutoff date.

Third, it could be argued that the initial rank of the company in the *Fortune* 500 firm cohort is an important predictor variable. To control for this possibility, we introduced a categorical variable that classifies *Fortune* 500 firms into different groups based on their starting ranks in the list. Specifically, we classify firms that are ranked 1-50 in 1981 as belonging to Category 1, firms ranked 51-100 as belonging to Category 2, firms ranked 101-150 as belonging to Category 3, and so on. We did not find this variable to significantly affect the probability of survival as a *Fortune* 500 firm ($p > .10$).

Fourth, we recognize marketing and R&D capitals as assets and use stock measures of these variables. To control for different possible retention rates of these variables, we tried lower alternative retention rates for marketing capital (25%) and R&D capital (60%) based on some prior research (e.g., Dutta et al. 2005, Hanssens et al. 2003). However, these alternative retention rates did not substantively change the results.

Fifth, we did not consider firms whose exit from the *Fortune* 500 firm cohort was due to their being acquired. Our reasoning is that such exits are not necessarily an outcome of poor performance of the acquired firm. However, to perform more comprehensive robustness checks, we estimated a cause-specific competing risks model that allows for two types of exit: exit due to

acquisitions and exit due to poor relative performance. Table 6 (following References) highlights the results from this competing risk model only for firms that exit due to relative poor performance. These results are similar to those reported in Table 5. The coefficient for interaction of marketing capital and industry growth is no longer significant ($p > .10$), but is in the expected direction. These results justify our dropping the acquired firms from the scope of our analysis.

Sixth, to control for the mechanism for survival on the *Fortune* 500 list, we construct an indicator variable that captures whether the sales growth of the focal firm exceeds the average annual sales growth for the *Fortune* 500 cohort. The logic for including this variable is that firms whose sales growth exceeds the average annual sales growth of the *Fortune* 500 cohort may retain their elite status as a *Fortune* 500 firm, while firms that fail to do so may exit from the list. This variable did not turn out to be significant in our model ($p > .10$).

Seventh, to test the robustness of the results to the operationalization of marketing expenditures, we conducted a subsample analysis of 42 *Fortune* 500 firms that reported both R&D and advertising expenditures. For this sample, we use advertising expenditures instead of marketing expenditures. The results of this analysis are consistent with those of our proposed model.

Eighth, prior research suggests firm-level and industry-level characteristics may moderate the effect of a shift in strategic emphasis on *stock market response* (Mizik and Jacobson 2003). To explore the possibility of a moderating effect of shift in strategic emphasis on *survival* as a *Fortune* 500 firm, we estimated a separate proportional hazards model that includes the interaction of the strategic shift in emphasis with industry growth. The results of the main model do not substantively change and the interaction term is not significant ($p > .10$).

Finally, we checked the predictive validity of our model. To do so, first we estimated the model parameters on an estimation sample that includes all observations up to Year 2001. We calculated the hazard ratios for each surviving firm for the actual covariates for each year during the holdout period, 2002-2006. We ranked the firms by hazard of exit. The actual exits of firms during the holdout period are consistent with our ranking.

A summary of the results of the hypotheses with interpretation and brief rationale appears in Table 7 (following References). All the hypotheses, except H_3 (the main effect of industry growth) are supported. The asymmetry between the roles of marketing and R&D capitals on survival as a *Fortune* 500 firm is striking. Marketing capital enhances survival in high-growth industries. In contrast, R&D capital dampens survival in high-growth industries.

A summary of the new insights on survival as a *Fortune* 500 firm appears in Table 8. Here, we compare the new insights from our research on survival as a *Fortune* 500 firm with knowledge from research on firm survival, per se. First, the insights offered by our research on the role of industry growth, which has not been previously studied, are new. Second, our research provides a more nuanced understanding of the factors that affect survival as a *Fortune* 500 firm than those offered by research on firm survival, per se. Third, and importantly, the insights on asymmetry between the influences of marketing and R&D capitals on survival as a *Fortune* 500 firm are significantly new contributions to the literature.

Discussion

Our analysis uses RBV and SCP theories to explain how a firm's unique collection of resources, namely its marketing and R&D capitals, can provide it with a sustained opportunity to

survive as a *Fortune* 500 firm. In addition, our results offer unique insights into how industry growth moderates the relationship between these firm-specific resource variables and survival as a *Fortune* 500 firm.

Managerial implications

First, our finding on the direct effects of marketing and R&D capitals on survival as a *Fortune* 500 firm underscores the importance of sustained investments in marketing and R&D. To maintain the leadership position of their respective firms, managers should continue making investments in marketing and R&D, regardless of other factors.

Second, ours is the first study to focus on the importance of marketing to sustaining membership in the *Fortune* 500 firm cohort. Our finding of the differential moderating influence of industry growth on the effects of marketing and R&D capitals on survival as a *Fortune* 500 firm points to a valuable take-away in resource allocation. Managers should give careful consideration to allocating relatively more resources to marketing in high-growth industries and more resources to R&D in stagnant or slow-growth industries.

Third, managers of *Fortune* 500 firms can use the figures in Table 9 (following References) as a general guide to assess the relative effects of marketing and R&D expenditures. Although marketing *capital* has a more positive effect than does R&D *capital* on survival as a *Fortune* 500 firm, because R&D capital has a much higher retention rate than does marketing capital, R&D *spending* has a more positive impact than does marketing spending on survival as a *Fortune* 500 firm. If a *Fortune* 500 manufacturing firm were to incrementally spend 1% of average firm sales revenues or $125 million in marketing (R&D) for five years, then its hazard of exit from *Fortune* 500 would directly decrease by 11.4% (20.5%). However, after factoring in

the moderating effects of industry growth, the net decrease in hazard of exit due to incremental annual spending of 1% of the average sales revenues in marketing (R&D) expenditures for five years would be 12.0% (17.9%). Importantly, if a *Fortune* 500 manufacturing firm were to incrementally spend 1% of average firm sales revenues on each of marketing and R&D activities for five years, then their combined effect would be a drop in hazard of exit from the *Fortune* 500 list by 27.8%.

Fourth, our results also provide insights to managers on the importance of industry-specific characteristics to survival as a *Fortune* 500 firm. The finding that firms operating in industries with high R&D intensity are more likely to exit the *Fortune* 500 firm cohort suggests that managers of *Fortune* 500 firms in such industries need to balance the direct positive effects of firm-specific R&D capital on survival as a *Fortune* 500 firm with the negative effect of industry level R&D intensity on survival as a *Fortune* 500 firm.

Limitations and future research directions

Our research suffers from certain shortcomings that merit being addressed in future research. First, while our study indirectly shows that both quality (stock variable) and quantity (expenditures) of R&D matter, future research could more precisely account for the quality of these R&D investments, perhaps, by incorporating measures such as patents in the analysis.

Second, we examine survival as a *Fortune* 500 firm. A related important variable for a *Fortune 500 firm* is growth rate. A relatively comprehensive examination of determinants of organic growth for *Fortune* 500 firms constitutes a second avenue for future research. Such research would extend work on drivers of organic growth (Bahadir, Bharadwaj, and Parzen 2009).

Third, CEO characteristics have been identified as a reason for firm failure (Charan and Useem 2002). Investigating the effects of CEO and senior management characteristics on survival as a *Fortune* 500 firm constitutes a promising avenue for future research.

Finally, we focused on manufacturing firms because they invest significantly in both marketing and R&D activities. Firms in service industries tend to invest less in R&D than firms in manufacturing industries. Research focusing on the differences in the effects of R&D capital and marketing capital on survival as a *Fortune* 500 firm between goods versus service industries constitutes a promising avenue for future research.

Conclusion

Marketing capital and R&D capital have significant effects on a firm's survival as a *Fortune* 500 firm. While both marketing and R&D capitals are directly and positively associated with survival as a *Fortune* 500 firm, there are asymmetries in the moderating effects of industry growth on these relationships. Marketing capital indirectly enhances survival as a *Fortune* 500 firm through the positive moderating effects of industry growth. In contrast, R&D capital indirectly dampens the probability of survival as a *Fortune* 500 firm through the negative moderating effect of industry growth. Nevertheless, due to a much higher retention rate for R&D spending than for marketing spending, if a *Fortune* 500 manufacturing firm were to incrementally spend 1 % of average sales revenues for five years on marketing (R&D), then its hazard of exit from *Fortune* 500 would drop by 12.0% (17.9%). The results suggest that from the standpoint of survival as a *Fortune* 500 firm, managers should consider investing more in marketing (R&D) when industry growth is high (low).

Notes

[i] For expositional ease, we use the terms moderating effect and interaction effect interchangeably throughout the paper.

[ii] We subsequently include these firms in our sample and repeat our analysis as a robustness check.

[iii] We do not report correlations involving interaction terms due to save space. All variables included in the final model had correlations below .71. Interested readers can contact the authors for an extended correlation matrix.

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FIGURE 1
Industry and Firm-Specific Factors Affecting Survival as a Manufacturing *Fortune* 500 Firm: A Conceptual Model

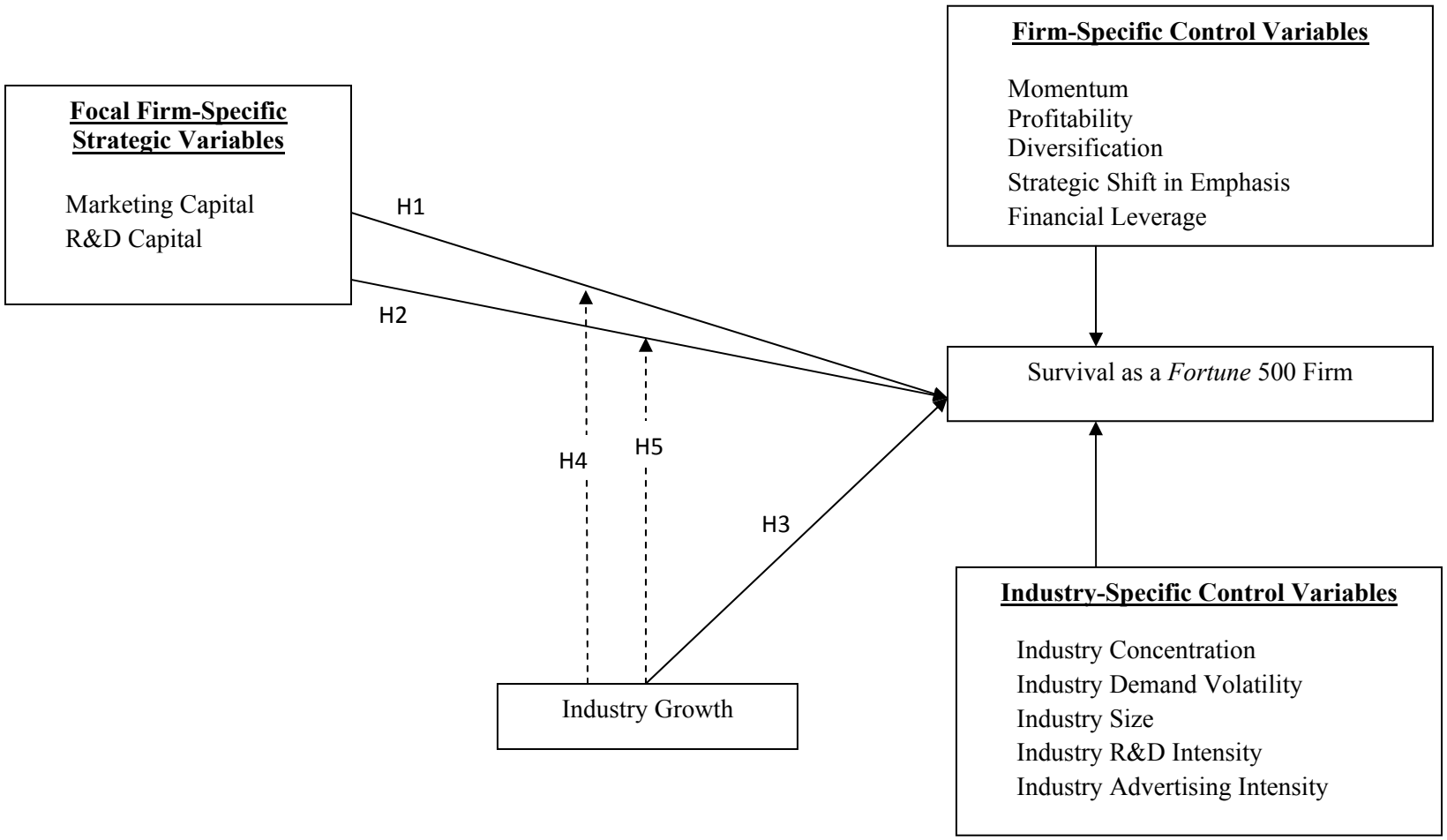

FIGURE 2
Kaplan –Meier Probability of Survival

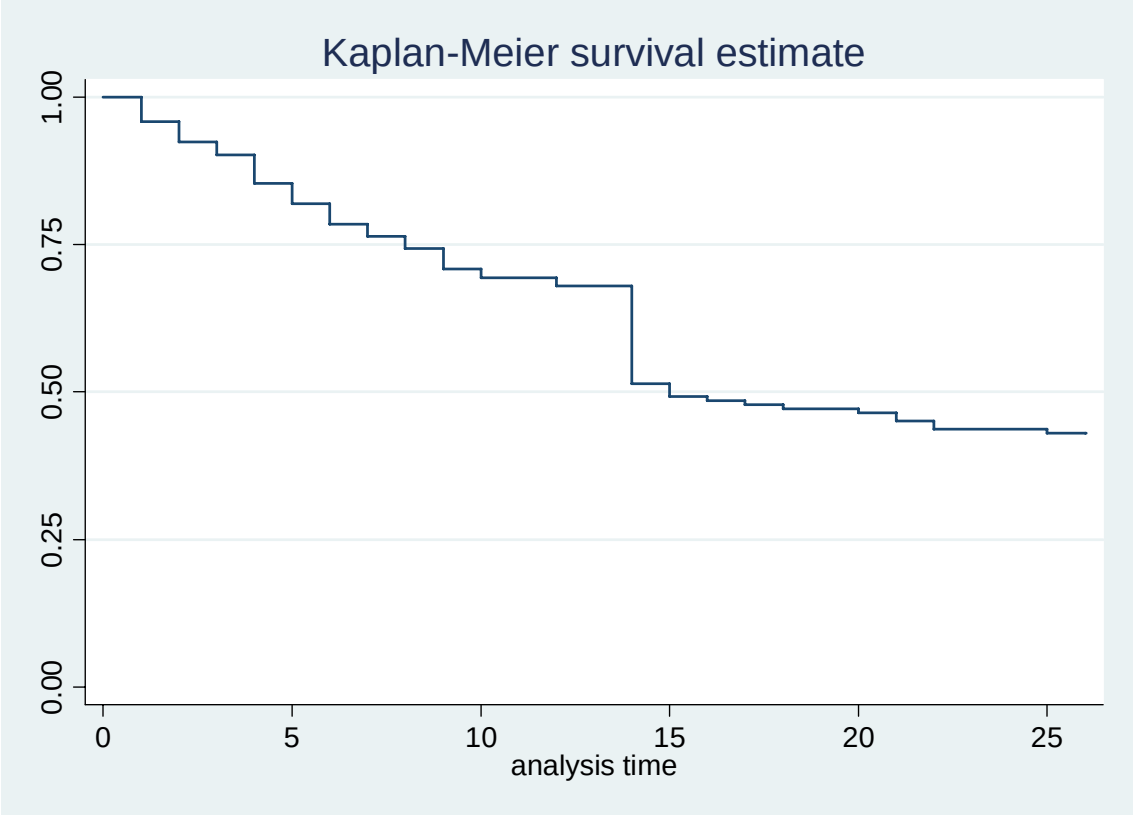

TABLE 1
Breakout of Database by Manufacturing Industries and Number of Companies

Two-Digit SIC Code	Industry Description	Number of Companies
20	Food and Kindered Products	11
22	Textile Mill Products	1
23	Apparel and Other Textile Products	1
24	Lumber and Wood Products	2
25	Furniture and Fixtures	3
26	Paper and Allied Products	7
27	Printing and Publishing	1
28	Chemical and Allied Products	31
29	Petroleum and Coal Products	3
30	Rubber and Misc Plastic Products	3
32	Stone Clay & Glass Products	7
33	Primary Metal Industries	6
34	Fabricated Metal Products	5
35	Industrial Machinery and Equipment	19
36	Electronics and Other Electric Equipment	14
37	Transportation	16
38	Instruments and Related Products	10
39	Misc Manufacturing	3

TABLE 2
Variables, Measures, and Data Sources

Conceptual Variable	Notation	Operationalization	Data Source
Focal Independent Variables			
Marketing Capital	MKT	Koyck structured variable constructed using marketing expenditures (where marketing expenditures = SG&A - R&D)	Constructed Variable (COMPUSTAT, 10K)
R&D Capital	RD	Koyck structured variable constructed using R&D expenditures	Constructed Variable (COMPUSTAT, 10K)
Industry Growth	IG	Change in total industry sales revenue (at the two-digit SIC code level) between two consecutive years	COMPUSTAT
Firm-Specific Control Variables			
Momentum	MOM	Year-to-year change in sales revenue	COMPUSTAT
Profitability	ROA	Ratio of net income to total assets	COMPUSTAT
Diversification	DIV	Number of segments in which the firm operates	COMPUSTAT Segments File
Strategic Shift in Emphasis	SS	The difference between change in marketing expenditures and change in R&D expenditures	COMPUSTAT
Financial Leverage	FL	Debt to asset ratio	COMPUSTAT
Industry-Specific Control Variables			
Industry Concentration	IC	Sum of the squared market share of each firm operating in the two-digit SIC code industry	COMPUSTAT
Industry Demand Volatility	DVOL	Three year moving average of the coefficient of variation of total sales revenues of the two-digit SIC code industry	COMPUSTAT
Industry Size	IS	Total sales of the two-digit SIC industry	COMPUSTAT
Industry R&D Intensity	IRD	Five year moving average of the ratio of industry R&D spending to industry sales revenues (at the two-digit SIC code level)	COMPUSTAT
Industry Advertising Intensity	IADV	Five year moving average of the ratio of industry advertising spending to industry sales revenues (at the two-digit SIC code level)	COMPUSTAT
Year of Services Firms Introduction	SIY	Dummy variable set to 1 for firms that exit the *Fortune* 500 list due to the introduction of service firms on the *Fortune 500* list	*Fortune* 500 list

TABLE 3
Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Marketing Capital (in MM of 2006$)	4,705.08	6,123.09	92.12	45,812.71
R&D Capital (in MM of 2006$)	2,339.52	3,839.47	4.28	39,321.22
Industry Growth (in MM of 2006$)	13,288.59	65,792.93	-402,520.00	733,229.90
Momentum (in MM of 2006$)	411.88	4,369.01	-36,839.20	70,302.66
Profitability	.06	.09	-2.52	.60
Diversification	3.52	1.89	1.00	11.00
Strategic Shift in Emphasis (in MM of 2006$)	27.12	575.48	-8,595.01	9,734.25
Financial Leverage	.18	.14	.00	1.44
Industry Concentration	.05	.02	.02	.21
Industry Demand Volatility	.06	.04	.00	.33
Industry Size (in MM of 2006$)	577,289.60	451,743.00	17,837.71	2,598,977.00
Industry R&D Intensity	.03	.02	.00	.09
Industry Advertising Intensity	.01	.01	.00	.06
Year of Services Firms Introduction	.14	.35	.00	1.00

Note: Profitability, financial leverage, industry concentration, industry demand volatility, industry R&D intensity, and industry advertising intensity are ratios. Diversification is a count variable.

TABLE 4
Correlation Matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Marketing Capital	1.00													
2	R&D Capital	.61*	1.00												
3	Industry Growth	.10*	.10*	1.00											
4	Momentum	.13*	.08*	.30*	1.00										
5	Profitability	.12*	.13*	.09*	.07*	1.00									
6	Diversification	.14*	.20*	.05*	.14*	-.05*	1.00								
7	Strategic Shift in Emphasis	.02	.05*	.16*	.26*	.07*	.06*	1.00							
8	Financial Leverage	-.10*	-.18*	-.07*	-.05*	-.19*	.07*	-.03	1.00						
9	Industry Concentration	-.10*	-.19*	-.08*	.01	-.21*	.10*	-.02	.18*	1.00					
10	Industry Demand Volatility	.07*	.03	.13*	.17*	-.06*	.11*	.02	.05*	.21*	1.00				
11	Industry Size	.42*	.32*	.20*	.19*	.03	.12*	.04*	-.10*	-.12*	.06*	1.00			
12	Industry R&D Intensity	.31*	.52*	.20*	.01	.11*	.13*	.03	-.10*	-.44*	-.08*	.36*	1.00		
13	Industry Advertising Intensity	.06*	.04*	.03	-.03	.18*	-.13*	.02	-.01	-.36*	-.24*	-.02	.16*	1.00	
14	Year of Services Firms Introduction	-.25*	-.21*	-.06*	-.04*	-.08*	-.19*	-.02	.06*	-.01	-.06*	-.11*	-.10*	.02	1.00

* $p < .05$, N= 2414.

TABLE 5
Results from Extended Cox Proportional Hazards Model (Accounting for Left-Truncation)

Variable	No Interaction Terms Coefficient (SE)	With Interaction Terms Coefficient (SE)
Marketing Capital $_{i(t-1)}$	-.0007***	-.0007***
	(.0002)	(.0002)
R&D Capital $_{i(t-1)}$	-.0004	-.0006*
	(.0003)	(.0003)
Industry Growth $_{i(t-1)}$ x 10^{-3}		.0003
		(.0036)
Marketing Capital $_{i(t-1)}$ * Industry Growth $_{i(t-1)}$ x 10^{-6}		-.0031**
		(.0015)
R&D Capital $_{i(t-1)}$ * Industry Growth $_{i(t-1)}$ x 10^{-6}		.0062**
		(.0027)
Momentum $_{i(t-1)}$	-.0004**	-.0005***
	(.0001)	(.0002)
Profitability $_{i(t-1)}$	-2.8496**	-3.1322**
	(1.3833)	(1.4212)
Diversification $_{i(t-1)}$	-.0206	-.0316
	(.0862)	(.0875)
Strategic Shift in Emphasis $_{i(t-1)}$	-.0013	-.0001
	(.0013)	(.0015)
Financial Leverage $_{i(t-1)}$	.5256	.5581
	(.8137)	(.8189)
Industry Concentration $_{i(t-1)}$ x 10^{4}	-.0034**	-.0033*
	(.0017)	(.0017)
Industry Demand Volatility $_{i(t-1)}$	-6.4611	-6.7294
	(4.1473)	(4.2125)
Industry Size $_{i(t-1)}$ x 10^{3}	-.0025*	-.0027*
	(.0015)	(.0015)
Industry R&D Intensity $_{i(t-1)}$ x 10^{4}	.0050**	.0051**
	(.0020)	(.0020)
Industry Advertising Intensity $_{i(t-1)}$ x 10^{4}	.0071	.0073
	(.0045)	(.0045)
Year of Services Firms Introduction	-.4985	-.5433
	(.3431)	(.3468)
Industry Dummy Variables	2 out of 17 significant	2 out of 17 significant
Log Likelihood	-196.7856	-194.51798
LR χ^2 (d.f.)	120.60 (31)	125.13 (33)
No. of Firms	143	143

*** p < .01, ** p < .05, * p < .10. Note: N=2,414. The signs of the coefficients represent the effects on the hazard of failure, so the signs for the probability of survival are the opposite. SE = Standard Error.

TABLE 6
Results of Competing Risk Model for Exit from the *Fortune* 500 Firm Cohort

Variable	With Interaction Terms Coefficient (SE)
Marketing Capital $_{i(t-1)}$	-.0004***
	(.0001)
R&D Capital $_{i(t-1)}$	-.0007**
	(.0003)
Industry Growth $_{i(t-1)}$ x 10^{-3}	-.0038
	(.0063)
Marketing Capital $_{i(t-1)}$ * Industry Growth $_{i(t-1)}$ x 10^{-6}	-.0037
	(.0027)
R&D Capital $_{i(t-1)}$ * Industry Growth $_{i(t-1)}$ x 10^{-6}	.0068**
	(.0027)
Momentum $_{i(t-1)}$	-.0007***
	(.0002)
Profitability $_{i(t-1)}$	-2.5848*
	(1.4788)
Diversification $_{i(t-1)}$	.0069
	(.0933)
Strategic Shift in Emphasis $_{i(t-1)}$	.0001
	(.0014)
Financial Leverage $_{i(t-1)}$	1.1687
	(1.0411)
Industry Concentration $_{i(t-1)}$ x 10^{4}	-.0026
	(.0019)
Industry Demand Volatility $_{i(t-1)}$ x 10^{2}	.0765*
	(.0442)
Industry Size $_{i(t-1)}$	-.0000
	(.0000)
Industry R&D Intensity $_{i(t-1)}$ x 10^{4}	.0054**
	(.0023)
Industry Advertising Intensity $_{i(t-1)}$ x 10^{4}	.0063
	(.0054)
Year of Services Firms Introduction	.2570
	(.4044)
Log Likelihood	-157.0981
LR χ^2 (d.f.)	115.09 (33)
No. of Firms	201

*** p < .01, ** p < .05, * p < .10. Note: N =3096. The signs of the coefficients represent the effects on the hazard of failure, so the signs for the probability of survival are the opposite. We do not report industry dummy variable results because none of the coefficients were significant. SE = Standard Error.

TABLE 7
Summary of Hypotheses Results on Survival as a *Fortune* 500 Firm

Hypothesis	Expected Sign	Actual Sign	Interpretation
Marketing capital (H_1)	+	+	Greater marketing capital directly affects sales growth significantly higher than those of other firms for continued *Fortune* 500 membership.
R&D capital (H_2)	+	+	Greater R&D capital is directly related to more innovation outputs and higher relative growth for continued inclusion in *Fortune* 500 list.
Industry growth (H_3)	-	NS	Industry growth may not directly affect a firm's survival as a *Fortune* 500 firm because growth relative to *Fortune* 500 firms outside its industry may matter more for continued inclusion in the list.
Industry growth-Marketing capital interaction (H_4)	+	+	In fast-growing industries, greater marketing capital boosts firm revenue growth relative to other firms to sustain inclusion in the *Fortune* 500 list.
Industry growth-R&D capital interaction (H_5)	-	-	In slow-growing industries, greater R&D capital boosts firm revenue growth relative to other firms to sustain inclusion in the *Fortune* 500 list.

TABLE 8
New Insights on Survival as a *Fortune* 500 Firm

Issue	Insights on Firm Survival	New Insights on Survival as a *Fortune* 500 Firm
Effect of marketing capital	Not previously studied.	Marketing capital has a direct positive effect on survival as a *Fortune* 500 firm. It also has an interaction effect with industry growth.
Effect of R&D capital	R&D capital's positive impact on survival is greater for smaller firms than for larger firms.	R&D capital has a positive direct effect on survival as a *Fortune* 500 firm. It also has an interaction effect with industry growth.
Direct effect of industry growth	Firms operating in growth industries have a higher likelihood of failure.	Industry growth does not have a direct effect on survival as a *Fortune* 500 firm.
Contingent effects of industry growth	Not previously studied.	Asymmetric effect. Industry growth negatively moderates the relationship between R&D capital and survival as a *Fortune* 500 firm, while it positively moderates the relationship between marketing capital and survival as a *Fortune* 500 firm.

TABLE 9
Percentage Reductions in the Hazard of Exit from the *Fortune* 500 List due to Incremental Marketing and R&D Expenditures of 1% of Average Sales Revenues for 5 Years

Variable	Direct/Main Effect	Moderating Effect of Industry Growth	Net Effect
Marketing spending	11.40	.71	12.03
R&D spending	20.47	-3.20	17.93
Marketing spending and R&D spending combined	29.54	1.02	27.80

Note: The net effect is not an additive function of the direct and moderating effects because of the nonlinear nature of the function in Cox's proportional hazard formulation. Similarly the combined effect of marketing and R&D spending is not an additive result of the individual effects of marketing spending and R&D spending.