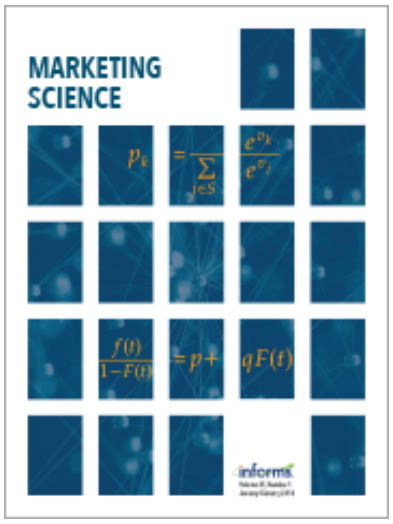


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# The Impacts of Advertising Assets and R&D Assets on Reducing Bankruptcy Risk

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Research has shown that advertising assets and R&D (research and development) assets increase shareholder value. Although one might conclude that their impacts on bankruptcy risk are merely the inverse of their impacts on shareholder value, we argue otherwise and show that the differences hinge on the fact that shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period. We show that current market turbulence moderates the impacts of advertising assets and R&D assets on expected cash flow from the next period but not on expected cash flows from more distant future periods. Therefore, market turbulence moderates the impacts of advertising assets and R&D assets on bankruptcy risk but not shareholder value. Market *stability* increases the impact of advertising assets on reducing bankruptcy risk, whereas market *turbulence* increases the impact of R&D assets on reducing bankruptcy risk. Using a data set of more than 1,000 firms covering three decades, we find support for our hypotheses. Out-of-sample validation indicates that bankruptcy prediction performance improves when including marketing variables in addition to the usual financial predictors.

Data, as supplemental material, are available at http://dx.doi.org/10.1287/mksc.2015.0913.

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## 1. Introduction

Firms are filing for bankruptcy at a dramatic rate. Even for firms with more than $1 billion in assets, the number of bankruptcies has grown by a factor of five in the past three decades, and the book value of assets in bankruptcy has grown by a factor of 10, from $261 billion in the 1980s to $2.7 trillion in the 2000s. Bankruptcies of large firms can negatively affect stakeholders important to marketing, including customers, suppliers, partners, investors, creditors, and employees. A large body of research has investigated the financial factors that affect bankruptcy risk (e.g., Altman 1968, Beaver 1966, Beaver et al. 2005, Chava and Jarrow 2004, Ohlson 1980, Sharma and Mahajan 1980, Shumway 2001). This research has found that a firm's profitability, leverage, liquidity, and size strongly affect the firm's bankruptcy risk.

In this article, we consider whether the assets built by advertising and R&D also affect bankruptcy risk. Although no study has directly examined the impacts of these assets on bankruptcy risk, research has shown (and we replicate) that advertising assets and R&D assets increase shareholder value (e.g., Chan et al. 2001, Joshi and Hanssens 2010, Osinga et al. 2011, Rubera and Kirca 2012). Although these findings might imply that advertising assets and R&D assets reduce bankruptcy risk in the same way they increase shareholder value, we argue otherwise and show that their impacts on bankruptcy risk are not merely the inverse of their impacts on shareholder value. The difference in how advertising assets and R&D assets affect shareholder value versus bankruptcy risk hinges on the fact that shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period.

We argue, on the basis of extant literature, that advertising assets and R&D assets affect expected cash flow from the next period and that market turbulence moderates these impacts. Therefore, because bankruptcy risk is a function of expected cash flow from the next period, we hypothesize that market turbulence moderates the impacts of advertising assets and R&D assets on bankruptcy risk.

Shareholder value is a function of an infinite number of periods, and thus shareholder value is more heavily weighted by expected cash flows from more distant future periods than expected cash flow from the next period. Because advertising assets and R&D assets reflect a firm's strategy and are within a firm's control, they tend to be stable over time; expected advertising assets and R&D assets in more distant

future periods are closely related to current advertising assets and R&D assets. Conversely, market turbulence is not stable over time. Rather than being controlled by the firm's own decisions, market turbulence is driven by unexpected changes in customer preferences. Therefore, the expected market turbulence in more distant future periods is not related to the current market turbulence, so current market turbulence does not moderate the impacts of advertising assets and R&D assets on shareholder value.

By investigating the impacts of advertising assets and R&D assets on bankruptcy risk, our study makes two key contributions. First, we show that advertising assets and R&D assets are significant predictors of bankruptcy risk. Out-of-sample validation analyses indicate that bankruptcy prediction improves by considering advertising assets and R&D assets in addition to the usual finance and accounting predictors. Second, we show that the impacts of advertising assets and R&D assets on bankruptcy risk are not merely the inverse of their impacts on shareholder value. Rather, because shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period, current market turbulence moderates the impacts of advertising assets and R&D assets on bankruptcy risk but not shareholder value. We hypothesize that market *stability* increases the impact of advertising assets on reducing bankruptcy risk, whereas market *turbulence* increases the impact of R&D assets on reducing bankruptcy risk.

We organize the rest of the article as follows: We begin by developing our conceptual arguments and hypotheses for the impacts of advertising assets and R&D assets on bankruptcy risk and how they differ from the impacts of those same assets on shareholder value. Then, we define the measures we use for each of our variables, specify our models, explain the estimation techniques, and describe the data sets assembled. Next, we present and discuss the results of our analyses, validate the out-of-sample performance of the bankruptcy risk model, and assess the robustness of our results. Finally, we review the implications and limitations of our study and consider areas for further research.

## 2. Conceptual Development and Hypotheses

### 2.1. Bankruptcy Risk and Shareholder Value

Both bankruptcy risk and shareholder value are functions of expected future cash flows. Bankruptcy risk, the risk that the firm will not generate enough cash to pay its financial and operating commitments, is the probability that expected cash flow from the next period will fully deplete the firm's liquidity (Beaver 1966, D'Aveni and Ilinitch 1992). The greater the expected cash flow from the next period, the lower the bankruptcy risk. Shareholder value is the discounted sum of expected cash flows from all future periods (Brealey and Myers 2000, Day and Fahey 1988, Rappaport 1986, Srivastava et al. 1998). The greater the expected future cash flows, the greater the shareholder value. Because shareholder value is a function of an infinite number of periods, it is more heavily weighted by expected cash flows from more distant future periods than expected cash flow from the next period.

Because shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period, we argue that the impacts of advertising assets and R&D assets on bankruptcy risk are not merely the inverse of their impacts on shareholder value. In the next section, we discuss how advertising assets and R&D assets affect expected cash flow from the next period and, consequently, bankruptcy risk. We then discuss how advertising assets and R&D assets affect expected cash flows from more distant future periods and, consequently, shareholder value.

### 2.2. The Impacts of Advertising Assets and R&D Assets on Expected Cash Flow from the Next Period (i.e., Bankruptcy Risk)

Marketing theory posits that past advertising and R&D create intangible assets that affect expected future cash flows (Srivastava et al. 1998). Consistent with this, research has empirically shown that the cumulative effects of both advertising (e.g., Sethuraman et al. 2011) and R&D (e.g., Chan et al. 2001, Lev and Sougiannis 1996) from past periods affects cash flow. In this section, we consider how advertising assets (built through past advertising) and R&D assets (built through past R&D) affect expected cash flow from the next period and, consequently, bankruptcy risk.

**2.2.1. Moderating Role of Market Turbulence.** Although both advertising and R&D assets can affect expected cash flow, prior research suggests that the effectiveness of these assets is contingent on the characteristics of the market in which the firm is operating (Boyer 1974, Chan et al. 1990, Chauvin and Hirschey 1993, Eberhart et al. 2004, Hirschey and Weygandt 1985, Porter 1976). Research has shown that a firm's ability to deal with market turbulence has a significantly greater impact on its survival than its ability to deal with other market characteristics, such as market growth or market concentration. Thus, we consider the moderating role of market turbulence on the impacts of advertising assets and R&D assets on expected cash flow from the next period (Anderson and Tushman 2001, D'Aveni and Ilinitch 1992, Hayward et al. 2006).

Market turbulence is characterized by instability, or uncertainty, in customer demand (Anderson and Tushman 2001, Boyd 1990, Carpenter and Fredrickson 2001, Dess and Beard 1984, Gruca and Rego 2005, Jaworski and Kohli 1993). This instability in demand can be driven by factors such as macroeconomic conditions (e.g., regulation changes, financial crises) and market conditions (e.g., competitor actions) and results in a change in the mix of customers, current customers' preferences, or both (Jaworski and Kohli 1993). When the market becomes turbulent, previous advertising messages may become less relevant and firms may need to adapt their products and services to satisfy changing preferences. By contrast, when the market is stable, advertising messages retain more relevance and there is less need for a firm to adapt its products and services (Jaworski and Kohli 1993).

**2.2.2. The Impact of Advertising Assets on Expected Cash Flow from the Next Period (i.e., Bankruptcy Risk).** Advertising builds intangible advertising assets that affect expected future cash flows. For example, advertising contributes to brand equity by increasing customers' awareness of and familiarity with the brand and by creating strong, favorable, and unique associations that reinforce the brand's point of difference (Keller 1993). The more relevant the point of difference embodied in the advertising asset is to the customer, the more likely the customer will consider and be persuaded to buy the firm's offerings (Celsi and Olson 1988, Greenwald and Leavitt 1984, MacInnis and Jaworski 1989, Petty et al. 1983).

We posit that advertising assets are more effective at increasing expected cash flow when the market is stable because associations created through past advertising are more likely to continue to be relevant. By contrast, the more turbulent the market, the more customer preferences are unexpectedly changing and the more likely associations created through past advertising are inconsistent with these changed preferences. Consequently, we argue that advertising assets increase expected cash flow from the next period more when the market is stable than when the market becomes turbulent. Because bankruptcy risk is a function of expected cash flow from the next period, we hypothesize the following:

Hypothesis 1A (H1A). *Market stability increases the impact of advertising assets on reducing bankruptcy risk.*

**2.2.3. The Impact of R&D Assets on Expected Cash Flow from the Next Period (i.e., Bankruptcy Risk).** R&D builds intangible R&D assets that affect expected future cash flows. For example, R&D contributes to intellectual property, technical know-how, and patents that allow the firm to develop products and services that fit with customers' preferences. Research has shown that when a market becomes turbulent, R&D assets provide a means for a firm to adapt to the unexpected changes in customers' preferences (Ettlie 1983, Gupta et al. 1986, Han et al. 1998). Consistent with this, research has found that R&D assets are more effective at generating cash flows when the market becomes turbulent than when the market is stable (Russell and Russell 1992, Utterback 1971).

Therefore, we posit that the impact of R&D assets on expected cash flow is greater when the market becomes turbulent because those assets enable the firm to adapt to unexpected changes in customer preferences. By contrast, the more stable the market, the less the firm needs to adapt its products and services and the less R&D assets affect expected cash flow. Consequently, we argue that R&D assets increase expected cash flow from the next period more when the market becomes turbulent than when it is stable. Because bankruptcy risk is a function of expected cash flow from the next period, we hypothesize the following:

Hypothesis 1B (H1B). *Market turbulence increases the impact of R&D assets on reducing bankruptcy risk.*

### 2.3. The Impacts of Advertising Assets and R&D Assets on Expected Cash Flows from More Distant Future Periods (i.e., Shareholder Value)

Shareholder value is a function of an infinite number of periods, and therefore shareholder value is more heavily weighted by expected cash flows from more distant future periods than expected cash flow from the next period. In the previous section, we argued that a firm's expected cash flow in a given period is a function of its advertising assets and R&D assets and the market's turbulence in that period. Therefore, expected cash flow from a distant future period is a function of the expected advertising assets, expected R&D assets, and expected market turbulence in that distant future period.[1]

We argue that the firm's expected future advertising assets and R&D assets are closely related to its current advertising assets and R&D assets because these assets (1) are within a firm's control (i.e., the firm decides each period how much to invest in advertising and R&D) and (2) reflect the firm's strategy and firm strategy tends to be stable over time (Fredrickson and Iaquinto 1989, Hannan and Freeman

[1] We assume that expected future advertising assets and R&D assets are independent of expected future market turbulence. To assess the validity of this assumption, we computed correlation coefficients between advertising assets and market turbulence, and R&D assets and market turbulence, for each firm-year observation in our data set. We found that the correlations are very small. The median correlation between *ADV* and *TURB* is 0.00 and between *RND* and *TURB* is 0.05. Note that the variables *ADV*, *RND*, and *TURB* are measured as defined in §3.2.

1984, Mintzberg 1978). Because these assets decay each period (Grabowski and Mueller 1978, Nerlove and Arrow 1962), their expected stability implies that the firm invests enough each period to maintain them. Consistent with this, prior research has argued that investors use the firm's current R&D assets to forecast its expected future R&D assets (Hall 1993). This argument extends logically to suggest that investors use the firm's current advertising assets to forecast the firm's expected future advertising assets.[2] Finally, and also consistent with our argument that a firm's expected future advertising assets and R&D assets are closely related to its current advertising assets and R&D assets, in our data set we find a high correlation between current advertising assets and advertising assets 10 years in the future ($\rho = 0.87$) and between current R&D assets and R&D assets 10 years in the future ($\rho = 0.87$).

In contrast with the expected stability of advertising assets and R&D assets, market turbulence is not stable over time. Rather than being controlled by the firm's own decisions, market turbulence is driven by unexpected changes in customer preferences (Anderson and Tushman 2001, Boyd 1990, Carpenter and Fredrickson 2001, Dess and Beard 1984, Gruca and Rego 2005, Jaworski and Kohli 1993). We assume that market turbulence evolves similar to an autoregressive process because there is likely to be a carryover effect from the prior period (e.g., a highly turbulent market is likely to continue to have some degree of turbulence the following period) as well as a shock due to unexpected changes in customer preferences. Consequently, the expected value of market turbulence in distant future periods converges to a steady-state value that is not related to the current market turbulence. Consistent with this, in our data set we find a low correlation between current market turbulence and market turbulence 10 years in the future ($\rho = 0.17$).

Given that a firm's shareholder value is heavily weighted by its expected cash flows from distant future periods, we posit that the firm's shareholder value is affected by its expected advertising assets and R&D assets and the market's expected turbulence in those distant future periods. Because the firm's expected distant future advertising assets are closely related to its current advertising assets, we expect to replicate previous findings that a firm's current advertising assets are positively associated with its shareholder value (Barth et al. 1998; Bharadwaj et al. 1999; Chan et al. 2001; Chauvin and Hirschey 1993; Conchar et al. 2005; Hirschey 1982; Hirschey and Weygandt 1985; Joshi and Hanssens 2009, 2010; Montgomery and Wernerfelt 1988; Osinga et al. 2011; Rao et al. 2004). Therefore, we hypothesize the following:

Hypothesis 2A (H2A). *The greater the firm's current advertising assets, the greater its shareholder value.*

Similarly, because the firm's expected distant future R&D assets are closely related to its current R&D assets, we expect to replicate previous findings that a firm's current R&D assets are positively associated with its shareholder value (Bharadwaj et al. 1999, Chan et al. 2001, Chauvin and Hirschey 1993, Cockburn and Griliches 1988, Eberhart et al. 2004, Griliches 1981, Hirschey 1982, Hirschey and Weygandt 1985, Montgomery and Wernerfelt 1988, Pakes 1985, Rubera and Kirca 2012). Therefore, we hypothesize the following:

Hypothesis 2B (H2B). *The greater the firm's current R&D assets, the greater its shareholder value.*

Based on our previous arguments, we posit that the expected distant future market turbulence affects the impacts of the firm's expected distant future advertising assets and R&D assets on the firm's expected distant future cash flows. However, because current market turbulence is not related to the expected distant future market turbulence (which converges to a steady-state value), we hypothesize the following:

Hypothesis 3A (H3A). *Current market turbulence does not moderate the relationship between the firm's current advertising assets and its shareholder value.*

Hypothesis 3B (H3B). *Current market turbulence does not moderate the relationship between the firm's current R&D assets and its shareholder value.*

## 3. Empirical Methodology

To test our hypotheses, we specify bankruptcy risk and shareholder value models that are functions of advertising assets, R&D assets, market turbulence, and control variables found to influence bankruptcy risk and shareholder value in prior literature. In this section, we first present the measures we use for each of our variables, then specify the models for bankruptcy risk and shareholder value, and finally present the data we use to estimate our models.

### 3.1. Dependent Variables

**3.1.1. Bankruptcy.** We set the bankruptcy indicator variable $BANK_{iy}$ to 1 if firm $i$ files for bankruptcy in year $y$ and 0 otherwise.

[2] To our knowledge, this logic has not been explicitly stated in previous advertising research though it is consistent with theories and findings linking current advertising assets and shareholder value (Chan et al. 2001, Joshi and Hanssens 2010, Osinga et al. 2011, Rubera and Kirca 2012, Srivastava et al. 1998).

**3.1.2. Shareholder Value.** Consistent with recent marketing literature, we use Tobin's $q$ to operationalize the shareholder value variable $SV_{iy}$ and use the following measure from Chung and Pruitt (1994):

$$SV_{iy} = \frac{MVE_{iy} + PS_{iy} + DEBT_{iy}}{A_{iy}},$$

where $MVE_{iy}$ is the market value of equity and is measured as the share price multiplied by the number of common shares outstanding, $PS_{iy}$ is the liquidating value of the preferred stock, $DEBT_{iy}$ is measured as short-term liabilities minus short-term assets plus long-term debt, and $A_{iy}$ is the book value of assets for firm $i$ in year $y$ (Anderson et al. 2004, Mittal et al. 2005, Morgan and Rego 2006, Rao et al. 2004).

### 3.2. Key Predictor Variables

**3.2.1. Advertising Assets, R&D Assets.** We calculate the variables $ADV_{iy}$ and $RND_{iy}$ as advertising stock divided by the book value of assets and R&D stock divided by the book value of assets, respectively, for firm $i$ in year $y$. Advertising stock is measured as a Koyck-type distributed lag function of advertising expenditures with a decay parameter of 0.6 and R&D stock is measured as a Koyck-type distributed lag function of R&D expenditures with a decay parameter of 0.8 (see Dutta et al. 1999).[3]

**3.2.2. Market Turbulence.** We measure the market turbulence variable $TURB_{jy}$ consistent with the approach used in marketing and management literature, for market $j$ in year $y$ (Boyd 1990, Cannella et al. 2008, Carpenter and Fredrickson 2001, Dess and Beard 1984, Gruca and Rego 2005). Following this literature, we first calculate market sales by summing the sales for each firm in the market as

$$SALES_{jy} = \sum_{i \in j} sales_{iy},$$

where $SALES_{jy}$ is sales for market $j$ in year $y$ and $sales_{iy}$ is sales for firm $i$ in year $y$. We then estimate the sales growth coefficient $\lambda_{1jy}$, for market $j$ in year $y$, by regressing $SALES_{jy}$ on time for the last five years as

$$SALES_{j,\,y+\tau-6} = \lambda_{0jy} + \lambda_{1jy}\tau + \epsilon_{jy}, \qquad (1)$$

where $\tau = (1, \ldots, 5)$ and $\epsilon_{jy} \sim N(0, \sigma^2)$. We then calculate market turbulence as the standard error of the estimated sales growth coefficient, $\hat{\lambda}_{1jy}$, from the regression of Equation (1), divided by the five-year sales average for market $j$ as

$$TURB_{jy} = \frac{\text{std. error}(\hat{\lambda}_{1jy})}{(1/5)(\sum_{s=y-5}^{y-1} SALES_{js})}.$$

### 3.3. Control Variables

**3.3.1. Market Control Variables.** To separate the effects of market turbulence $TURB_{jy}$ from other market variables, we control for market growth $GROW_{jy}$ and market concentration $CONC_{jy}$ in our models. We calculate market growth, consistent with measures used in marketing and management literature (Boyd 1990, Cannella et al. 2008, Carpenter and Fredrickson 2001, Dess and Beard 1984, Gruca and Rego 2005), as the estimated sales growth coefficient from the regression of Equation (1) divided by the five-year sales average for market $j$ as

$$GROW_{jy} = \frac{\hat{\lambda}_{1jy}}{(1/5)(\sum_{s=y-5}^{y-1} SALES_{js})}.$$

We calculate market concentration $CONC_{jy}$ as the Hirschman-Herfindahl index for market $j$ in year $y$. Consistent with Chava and Jarrow's (2004) contention that it is important to consider the impact of unobserved market effects on bankruptcy risk, we also include market binary control variables $MKT_{j_i}$ (which are set to 1 if firm $i$ is in market $j$ and 0 otherwise) and market bankruptcy indicator variables $D_j$ (which are set to 1 if market $j$ has a bankruptcy in our observation window and 0 otherwise).

**3.3.2. Firm Control Variables.** We also include firm variables that have been found to impact bankruptcy risk and shareholder value in prior research. We calculate profitability, $PROFIT_{iy}$, as EBITDA (earnings before interest, taxes, depreciation, and amortization) divided by the book value of assets for firm $i$ in year $y$. Research has shown that profitability lowers bankruptcy risk (Altman 1968, Beaver 1966, Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004, Deakin 1972, Ohlson 1980, Shumway 2001) and increases shareholder value (Fama and French 1998, Rao et al. 2004). We calculate leverage, $LEV_{iy}$, as long-term liabilities divided by the book value of assets for firm $i$ in year $y$. Leverage decreases expected cash flow from the next period through interest payment commitments but can increase expected cash flows from more distant future periods if the debt is used to fund growth opportunities. Consequently, research has shown that although leverage increases bankruptcy risk (Beaver 1966, Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004, Deakin 1972, Ohlson 1980, Shumway 2001), it can also increase shareholder value (e.g., Masulis 1983, McConnell and

[3] Prior literature has used decay parameters in the range of 0.4 to 0.85 for advertising and R&D (DeKinder and Kohli 2008, Dutta et al. 2005, Hall et al. 2005, Narayanan et al. 2004, Osinga et al. 2011, Srinivasan et al. 2011). As a robustness check, we also performed analyses using decay parameters in this range and found consistent results.

Servaes 1990, Modigliani and Miller 1963, Ross 1977). We calculate liquidity, $LIQUID_{iy}$, as working capital divided by the book value of assets for firm $i$ in year $y$.[4] Research has shown that liquidity lowers bankruptcy risk (Altman 1968, Beaver 1966, Campbell et al. 2008, Deakin 1972, Ohlson 1980). Although greater liquidity can result from a disciplined managerial approach to avoiding wasteful spending, it may also result from management not fully funding growth opportunities (Jensen 1986). Whereas the former should increase shareholder value, the latter should decrease shareholder value. Therefore, we do not have any expectations on the sign or significance of liquidity on shareholder value and note that recent shareholder value models in marketing do not include liquidity as a predictor (e.g., Anderson et al. 2004, Joshi and Hanssens 2010, Morgan and Rego 2009, Rao et al. 2004). Finally, we calculate firm size, $SIZE_{iy}$, as the book value of assets (in units of \$10 B) for firm $i$ in year $y$. Research has found that larger firms have lower bankruptcy risk (Campbell et al. 2008, Chava and Jarrow 2004, Ohlson 1980, Shumway 2001) and lower shareholder value, as measured by Tobin's $q$ (Bharadwaj et al. 1999, Morgan and Rego 2009).

### 3.4. Bankruptcy Risk Model

There is a rich history of approaches used in modeling bankruptcy risk. Altman (1968) uses multivariate discriminant analysis on matched pairs of 33 bankrupt and 33 nonbankrupt firms. The key limitation of this approach is the use of matched pairs, which resulted in a nonrandom sample that suffered from sample biases due to oversampling bankrupt firms. Ohlson (1980) addresses this limitation by including all large industrial firms in the estimation of his bankruptcy logit model. Shumway (2001) further extends these approaches by using a hazard model to account for firm characteristics that change over time as well as the large number of censored observations in predicting bankruptcy risk. Recent bankruptcy risk models have adopted the Shumway (2001) approach of modeling bankruptcy risk with a hazard model (e.g., Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004). In marketing, Helsen and Schmittlein (1993, p. 395) also note that when censored observations are prevalent, hazard models are "preferable to the regression, logit, and discriminant analyses that marketers have typically used." Furthermore, Van den Bulte and Iyengar (2011) show that omitting right-censored observations can bias results.

We therefore specify bankruptcy risk with a hazard function

$$h_{iy} = \Pr(Y_i = y \mid Y_i \geq y, x_{iy}),$$

where $Y_i$ is the year firm $i$ files for bankruptcy and the hazard function, $h_{iy}$, is the probability that firm $i$ with covariates $x_{iy}$ files for bankruptcy in year $y$, given that the firm has not filed for bankruptcy so far. Although the underlying hazard is continuous in that a firm can file for bankruptcy at any point in time, the covariates are only observed annually because of financial reporting standards. In cases such as this, that have an underlying continuous hazard with predictors observed at discrete intervals, research has shown that using a discrete-time hazard model with a complementary log-log link is most appropriate, yielding results that are more robust than those of the logit link (Prentice and Gloeckler 1978). Consequently, we specify the bankruptcy risk model as a discrete-time hazard model with a complementary log-log link

$$\begin{aligned}
&\ln(-\ln(1-h_{i,y+2}))\\
&= \alpha_y + \beta_1(ADV_{iy} \times TURB_{j_i y}) + \beta_2(RND_{iy} \times TURB_{j_i y})\\
&\quad + \beta_3 ADV_{iy} + \beta_4 RND_{iy} + \beta_5 PROFIT_{iy} + \beta_6 LEV_{iy}\\
&\quad + \beta_7 LIQUID_{iy} + \beta_8 SIZE_{iy} + \beta_9 TURB_{j_i y} + \beta_{10} GROW_{j_i y}\\
&\quad + \beta_{11} CONC_{j_i y} + \sum_j \phi_j (MKT_{j_i} \times D_j) + u_i, \qquad (2)
\end{aligned}$$

where $h_{i,y+2}$ is the hazard of filing for bankruptcy for firm $i$ in year $y+2$. The predictors include the baseline hazard function ($\alpha_y$), observed firm variables ($ADV_{iy}$, $RND_{iy}$, $PROFIT_{iy}$, $LEV_{iy}$, and $LIQUID_{iy}$), observed market variables ($TURB_{j_i y}$, $GROW_{j_i y}$, and $CONC_{j_i y}$), market dummy variables $MKT_{j_i}$ to control for unobserved market characteristics, and a firm-specific effect $u_i \sim N(0, \sigma_c^2)$ to control for unobserved firm heterogeneity.

We lag the predictors by two years to be consistent with prior bankruptcy risk literature (Beaver et al. 2005, Ohlson 1980, Shumway 2001). Using lagged data allows us to assess the impact of prior period predictors on bankruptcy risk in the current period. We choose a lag of two years to allow sufficient time between the reporting of financial data and the bankruptcy filing (e.g., if the firm files for bankruptcy at the beginning of the fiscal year, a lag of only one year could mean that financial variables were not yet reported). Furthermore, a lag of two years allows us to maximize the data available for analysis because many firms stop reporting financial information in the year prior to filing for bankruptcy.[5]

Parametric assumptions about baseline hazards can produce inconsistent coefficient estimates (Meyer 1990), so we specify a nonparametric baseline hazard

$$\alpha_y = \alpha_0 + \sum_y \psi_y YEAR_{y_i},$$

[4] Working capital is the difference between current assets (e.g., cash, accounts receivable, inventories) and current liabilities (e.g., accounts payable).

[5] As part of our robustness analyses, we also consider lags of one year and three years.

where $\alpha_0$ is an intercept term and $YEAR_{y_i}$ are year dummy variables. As Campbell et al. (2008) note, including year dummy variables allows us to control for unobserved macroeconomic events (e.g., recessions) whose effects may not be fully captured by the other predictor variables in our model. Furthermore, Iyengar et al. (2011) note that year dummy variables provide a nonparametric control for duration dependence.

**3.4.1. Endogeneity.** If a firm views advertising and R&D as discretionary expenditures, it may cut back in these areas when it becomes financially distressed and reduce the size of its advertising assets and R&D assets. To account for this source of potential endogeneity, we cannot use the standard approaches for linear models, such as two-stage least squares, because they would provide inconsistent results for our nonlinear model (Abrevaya et al. 2010). Instead, to avoid the bias created by these potentially endogenous regressors, we adopt a "control function approach" (Albuquerque and Bronnenberg 2012, Luan and Sudhir 2010, Petrin and Train 2010, Rivers and Vuong 1988, Smith and Blundell 1986). The control function approach has two stages. In the first stage, we recover the estimated residuals from regressing each of the endogenous variables on all of the exogenous variables and instrumental variables. In the second stage, the estimated residuals from the first-stage regressions enter without transformation into the bankruptcy risk model in Equation (2) to "control" for the endogenous regressors.

We use historical market-average advertising intensity (advertising expenditures divided by the book value of assets), historical market-average R&D intensity (R&D expenditures divided by the book value of assets), and their interactions with market turbulence to obtain four instruments. We use the Akaike information criterion and the Bayesian information criterion to determine the size of the window to use for the historical market averages. The information criteria point to a model with a three-year window for historical market-average advertising intensity and R&D intensity.

These instruments are appropriate if historical market-average advertising and R&D intensities reflect common norms of budgeting for advertising and R&D (i.e., the instruments are relevant) but not common risks of bankruptcy (i.e., the instruments are exogenous). We see no reason (nor is there any published evidence) that after controlling for the predictors in our model, historical market-average advertising intensity and historical market-average R&D intensity are related to an individual firm's bankruptcy risk two years later. Therefore, we posit that the instruments are exogenous. To test the relevance of the instruments, we compute the correlations of the instruments with the associated endogenous regressors. We find that they are strongly correlated (all correlation coefficients $> 0.60$, $p < 0.001$). We also find that coefficient estimates for the associated instruments in each of the first-stage regressions are significant ($p < 0.001$), indicating that the instruments are relevant.

**3.4.2. Tests of Hypotheses.** The coefficient for $ADV_{iy} \times TURB_{j_iy}$, $\beta_1$, is our coefficient of interest to test Hypothesis H1A that market stability (i.e., smaller $TURB_{j_iy}$) increases the impact of advertising assets on reducing bankruptcy risk. Therefore, a positive and significant $\hat{\beta}_1$ would support Hypothesis H1A. The coefficient for $RND_{iy} \times TURB_{j_iy}$, $\beta_2$, is our coefficient of interest to test Hypothesis H1B. A negative and significant $\hat{\beta}_2$ would support Hypothesis H1B that market turbulence (i.e., larger $TURB_{j_iy}$) increases the impact of R&D assets on reducing bankruptcy risk.

**3.4.3. Estimation.** We estimate the bankruptcy risk model using a random-effects estimator to account for unobserved firm heterogeneity (i.e., the firm-specific effects $u_i$ in Equation (2)).[6] We integrate out the firm-specific effects to obtain the conditional likelihood and then use maximum likelihood estimation (see Chintagunta et al. 1991, Wooldridge 2002). To appropriately evaluate the statistical significance of the coefficient estimates, we estimate cluster-robust standard errors—a generalization of heteroskedastic robust standard errors that accounts for time-series correlation across observations for a given firm (Arellano 1987, White 1980).

### 3.5. Shareholder Value Model

Using the same predictors as the bankruptcy risk model, we specify the shareholder value model as

$$\begin{aligned} SV_{i,\,y+2} &= \gamma_0 + \gamma_1(ADV_{iy} \times TURB_{j_iy}) + \gamma_2(RND_{iy} \times TURB_{j_iy}) \\ &\quad + \gamma_3 ADV_{iy} + \gamma_4 RND_{iy} + \gamma_5 PROFIT_{iy} + \gamma_6 LEV_{iy} \\ &\quad + \gamma_7 LIQUID_{iy} + \gamma_8 SIZE_{iy} + \gamma_9 TURB_{j_iy} + \gamma_{10} GROW_{j_iy} \\ &\quad + \gamma_{11} CONC_{j_iy} + \sum_j \theta_j MKT_{j_i} + \sum_y \delta_y YEAR_{y_i} \\ &\quad + v_i + \varepsilon_{iy}, \end{aligned} \tag{3}$$

where $SV_{i,\,y+2}$ is shareholder value for firm $i$ in year $y+2$, $v_i$ is a firm-specific effect, and $\varepsilon_{iy}$ is the idiosyncratic error term.[7]

[6] We did not consider the fixed-effects estimator for the bankruptcy risk model because the complementary log-log fixed-effects estimator suffers from the incidental parameters problem, which leads to biased estimates (see Wooldridge 2002).

[7] We use predictors lagged by two years to be consistent with the bankruptcy risk model. As part of our robustness analyses, we also consider lags of one year and three years.

Because prior research suggests that a firm's stock performance can influence its marketing spending (Chakravarty and Grewal 2011, Markovitch et al. 2005, Srinivasan and Hanssens 2009) and because marketing spending affects the sizes of advertising assets and R&D assets, we account for potential endogeneity as we did in the bankruptcy risk model. That is, we adopt the control function approach and use the same instruments of three-year historical market-average advertising intensity and R&D intensity, as well as their interactions with market turbulence. These instruments were shown to be relevant in the previous section. We posit that they are exogenous to an individual firm's shareholder value two years later and note that market-average marketing intensities have been used as instruments in previous studies of the impact of marketing on shareholder value (Tuli et al. 2012).

To replicate findings from prior research on the impacts of advertising assets and R&D assets on shareholder value, we first estimate only the main effects in the shareholder value model (i.e., we set $\gamma_1 = \gamma_2 = 0$ in Equation (3)). A positive and significant $\hat{\gamma}_3$, the coefficient estimate for $ADV_{iy}$, would support Hypothesis H2A that advertising assets increase shareholder value. A positive and significant $\hat{\gamma}_4$, the coefficient estimate for $RND_{iy}$, would support Hypothesis H2B that R&D assets increase shareholder value. To test whether turbulence moderates the impacts of advertising assets and R&D assets on shareholder value, we estimate the full shareholder value model (Equation (3)). A nonsignificant $\hat{\gamma}_1$ would be consistent with Hypothesis H3A that market turbulence does not moderate the impact of advertising assets on shareholder value, and a nonsignificant $\hat{\gamma}_2$ would be consistent with Hypothesis H3B that market turbulence does not moderate the impact of R&D assets on shareholder value.

We estimate the shareholder value model using a random-effects estimator to account for unobserved firm heterogeneity (i.e., the firm-specific effects $v_i$ in Equation (3)).[8] We compute standard errors that are robust to heteroskedasticity and serial correlation to appropriately evaluate the statistical significance of the coefficient estimates.

### 3.6. Data

To test our hypotheses, we create a data set that combines stock market data, firm financial data, and bankruptcy filing information for all large public U.S. companies (book value of assets > \$100 M in 1980 dollars) from 1980 to 2006.[9] We draw stock market data from the Center for Research in Security Prices at the University of Chicago's Booth School of Business, annual income statement and balance sheet items from Standard & Poor's Capital IQ Compustat database, and information on whether and when a firm filed for bankruptcy from the Bankruptcy Research Database of Lynn M. LoPucki at the UCLA (University of California, Los Angeles) School of Law. We source the CPI (Consumer Price Index) from the U.S. Department of Labor's Bureau of Labor Statistics and define markets using four-digit standard industrial classification codes.

To adjust for the effects of inflation, we scale all financial data to 1980 values by multiplying the nominal values in year $y$ with the ratio of the CPI in 1980 to the CPI in year $y$. We Winsorize all continuous variables at the 99% level to reduce the influence of outliers. We set observations higher than the 99th percentile of each variable to the 99th percentile value and observations lower than the first percentile of each variable to the first percentile value. We delete observations with missing values.

The final data set has 9,199 firm-year observations. Less than 1% of the observations have a bankruptcy filing, consistent with the 0.06% to 0.75% bankruptcy filing rates in prior studies that estimate bankruptcy hazard models (Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004, Shumway 2001). We estimate the shareholder value model on the 7,904 observations that are not missing data needed to calculate Tobin's $q$. Table 1 presents the descriptive statistics. To diagnose multicollinearity, we compute correlation matrices, condition indexes, and variance inflation factors. Tables A.1 and A.2 in the appendix report the correlation matrices for the full data set and the shareholder value data set, respectively. The condition indexes are below the "rule of thumb" of 30 (Belsley et al. 1980) and all variance inflation factors are below the "rule of thumb" of 10 (Marquardt 1970), suggesting that multicollinearity is not a problem.

## 4. Empirical Results

### 4.1. Bankruptcy Risk Model

The first column of Table 2 reports the estimation results for the bankruptcy risk model. Negative values indicate lower bankruptcy risk.

[8] We use a random-effects estimator for consistency with the bankruptcy risk model. We also considered a fixed-effects estimator and found that the coefficient estimates from the fixed-effects estimator were directionally consistent with the estimates from the random-effects estimator.

[9] Bankruptcy risk changed with the passing of the Bankruptcy Reform Act of 1978, which substantially changed bankruptcy protection and processes for firms in the United States. Therefore, we chose to use the date when the act became effective (end of 1979) as the starting point for our analysis. Because we have data that goes back to this time in our data set, the hazard analyses are less subject to left-truncation issues.

**Table 1 Descriptive Statistics**

| | Full data set $N = 9{,}199$ Bankruptcies = 40 | | | | | | | | Shareholder value data set $N = 7{,}904$ Bankruptcies = 17 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Did not file for bankruptcy | | | | Filed for bankruptcy | | | | All observations | | | |
| | Min | Max | Mean | SD | Min | Max | Mean | SD | Min | Max | Mean | SD |
| Stable markets | | | | | | | | | | | | |
| *ADV* | 0.001 | 0.542 | 0.077 | 0.100 | 0.002 | 0.379 | 0.062 | 0.093 | 0.001 | 0.519 | 0.074 | 0.095 |
| *RND* | 0.003 | 0.834 | 0.151 | 0.155 | 0.012 | 0.834 | 0.175 | 0.202 | 0.003 | 0.880 | 0.155 | 0.159 |
| Turbulent markets | | | | | | | | | | | | |
| *ADV* | 0.001 | 0.542 | 0.069 | 0.098 | 0.002 | 0.329 | 0.065 | 0.095 | 0.001 | 0.519 | 0.066 | 0.094 |
| *RND* | 0.003 | 0.834 | 0.142 | 0.146 | 0.003 | 0.560 | 0.075 | 0.129 | 0.003 | 0.880 | 0.148 | 0.152 |
| All markets | | | | | | | | | | | | |
| *BANK* | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 1.000 | 0.000 | 0.000 | 1.000 | 0.002 | 0.046 |
| *SV* | | | | | | | | | −0.013 | 7.169 | 1.325 | 1.267 |
| *ADV* | 0.001 | 0.542 | 0.074 | 0.099 | 0.002 | 0.379 | 0.063 | 0.093 | 0.001 | 0.519 | 0.071 | 0.095 |
| *RND* | 0.003 | 0.834 | 0.148 | 0.152 | 0.003 | 0.834 | 0.130 | 0.178 | 0.003 | 0.880 | 0.153 | 0.157 |
| *PROFIT* | −0.312 | 0.396 | 0.139 | 0.108 | −0.312 | 0.262 | 0.031 | 0.123 | −0.311 | 0.391 | 0.143 | 0.107 |
| *LEV* | 0.000 | 1.014 | 0.236 | 0.194 | 0.002 | 0.889 | 0.424 | 0.264 | 0.000 | 0.912 | 0.221 | 0.176 |
| *LIQUID* | −0.170 | 0.770 | 0.282 | 0.192 | −0.088 | 0.712 | 0.183 | 0.182 | −0.148 | 0.770 | 0.289 | 0.190 |
| *SIZE* | 0.002 | 3.580 | 0.230 | 0.548 | 0.002 | 0.492 | 0.075 | 0.107 | 0.002 | 3.885 | 0.240 | 0.579 |
| *TURB* | 0.003 | 0.147 | 0.027 | 0.025 | 0.005 | 0.147 | 0.040 | 0.039 | 0.003 | 0.144 | 0.026 | 0.025 |
| *GROW* | −0.221 | 0.371 | 0.052 | 0.097 | −0.186 | 0.371 | 0.058 | 0.116 | −0.216 | 0.363 | 0.052 | 0.096 |
| *CONC* | 0.053 | 0.928 | 0.281 | 0.195 | 0.060 | 0.851 | 0.332 | 0.196 | 0.053 | 0.927 | 0.279 | 0.195 |

*Notes.* Stable markets are those below and turbulent markets are those above the median market turbulence. Min, Minimum, Max, maximum, SD, standard deviation.

**4.1.1. Key Predictors.** We find that market turbulence moderates the impact of advertising assets on bankruptcy risk ($\hat{\beta}_1 = 144.05$, $p < 0.05$). The positive sign for $\hat{\beta}_1$ indicates that the lower the market turbulence, the more advertising assets reduce bankruptcy risk. This result provides support for Hypothesis H1A that market stability (i.e., less market turbulence) increases the impact of advertising assets on reducing bankruptcy risk.

We also find that market turbulence moderates the impact of R&D assets on bankruptcy risk ($\hat{\beta}_2 = -190.55$, $p < 0.01$). The negative sign for $\hat{\beta}_2$ indicates that the greater the market turbulence, the more R&D assets reduce bankruptcy risk. This result provides support for Hypothesis H1B that market turbulence increases the impact of R&D assets on reducing bankruptcy risk.

**4.1.2. Control Variables.** The estimates for the coefficients of the financial control variables in the bankruptcy risk model are as expected. The negative coefficient estimate for *PROFIT* replicates prior findings that profitability reduces bankruptcy risk (Altman 1968, Beaver 1966, Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004, Ohlson 1980, Shumway 2001), and the positive coefficient estimate for *LEV* replicates prior findings that leverage increases bankruptcy risk (Altman 1968, Beaver 1966, Beaver et al. 2005, Campbell et al. 2008, Chava and Jarrow 2004, Ohlson 1980, Shumway 2001). The negative coefficient estimates for *LIQUID* and *SIZE* also indicate that liquidity and firm size reduce bankruptcy risk, in line with prior findings (Altman 1968, Beaver 1966, Campbell et al. 2008, Chava and Jarrow 2004, Deakin 1972, Ohlson 1980, Shumway 2001).

### 4.2. Shareholder Value Model

The second and third columns of Table 2 report the estimation results for the shareholder value model. Positive values indicate greater shareholder value.

**4.2.1. Key Predictors.** The second column replicates findings from prior research and provides support for Hypotheses H2A that advertising assets increase shareholder value ($\hat{\gamma}_3 = 2.63$, $p < 0.05$) and H2B that R&D assets increase shareholder value ($\hat{\gamma}_4 = 6.55$, $p < 0.001$). The third column includes the interactions of market turbulence with advertising assets and R&D assets to check whether evidence refutes our hypotheses that market turbulence does not moderate the impacts of advertising assets or R&D assets on shareholder value. Consistent with Hypotheses H3A and H3B, we find no support that market turbulence moderates the impact of advertising assets on shareholder value ($\hat{\gamma}_1 = -8.87$, $p > 0.05$) or the impact of R&D assets on shareholder value ($\hat{\gamma}_2 = -15.74$, $p > 0.05$).

**4.2.2. Control Variables.** The positive coefficient estimate for *PROFIT* replicates prior findings that

**Table 2 Estimation Results**

| | Bankruptcy risk model | Shareholder value model (main effects) | Shareholder value model (full model) |
|---|---|---|---|
| | H1A, H1B | H2A, H2B | H3A, H3B |
| *ADV* × *TURB* | 144.05* | | −8.87 |
| | (72.34) | | (12.79) |
| *RND* × *TURB* | −190.55** | | −15.74 |
| | (69.25) | | (11.53) |
| *ADV* | −8.09 | 2.63* | 2.69 |
| | (5.79) | (1.33) | (1.51) |
| *RND* | 3.29 | 6.55*** | 6.96*** |
| | (3.15) | (1.43) | (1.58) |
| *PROFIT* | −6.37** | 2.79*** | 2.52*** |
| | (2.37) | (0.50) | (0.27) |
| *LEV* | 2.17** | 0.55** | 0.54** |
| | (0.76) | (0.17) | (0.17) |
| *LIQUID* | −2.68** | 0.12 | 0.14 |
| | (0.94) | (0.23) | (0.23) |
| *SIZE* | −1.99* | 0.05 | 0.05 |
| | (0.92) | (0.11) | (0.11) |
| *TURB* | 13.77 | 0.64 | 3.49 |
| | (8.43) | (0.74) | (1.82) |
| *GROW* | −0.47 | 0.74*** | 0.75*** |
| | (1.51) | (0.22) | (0.22) |
| *CONC* | −2.87 | 0.91*** | 0.90*** |
| | (1.96) | (0.27) | (0.27) |
| (Intercept) | −9.36*** | 0.21 | 0.20 |
| | (1.27) | (0.15) | (0.16) |
| Market dummies | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes |
| Control functions | Yes | Yes | Yes |
| Parameters | 63 | 96 | 100 |
| *N* | 9,199 | 7,904 | 7,904 |
| BIC | 507.69 | | |
| *F*-statistic | | 16.20*** | 15.90*** |

*Notes.* Robust standard errors are in parentheses. BIC, Bayesian information criterion.

*Significant at $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

profitability increases shareholder value (e.g., Fama and French 1998, Rao et al. 2004) and the positive coefficient estimate for *LEV* replicates findings that leverage increases shareholder value (Masulis 1983, McConnell and Servaes 1990, Modigliani and Miller 1963, Ross 1977). The large standard error (and associated large *p*-value) for the coefficient estimate of *LIQUID* is consistent with liquidity having the ability to both increase (signals that management is not engaging in wasteful spending) as well as decrease (signals the firm is not fully funding growth opportunities) shareholder value. Although prior research has found that firm size affects shareholder value (Bharadwaj et al. 1999, Morgan and Rego 2009), we find that the impact of *SIZE* on shareholder value is not significant. Because we consider only large firms in our analysis, it may be the case that results in prior studies were driven by differences with small firms. The positive coefficient estimate for *CONC* is consistent with prior research that argues that firms in concentrated markets have greater market power, which increases their shareholder value (Hirschey and Weygandt 1985). Although our finding is consistent with prior studies (e.g., Anderson et al. 2004), we note that other studies have found that industry concentration decreases or has no impact on shareholder value (e.g., Montgomery and Wernerfelt 1988, Simon and Sullivan 1993).

### 4.3. Quantifying Impacts

To quantify the impact of each of the marketing and financial variables, we compute the predicted median difference in bankruptcy risk and shareholder value associated with a 1% higher level for each variable. We use the estimated coefficients from the first column in Table 2 for bankruptcy risk and those from the second column for shareholder value to compute the predicted difference for each observation. For bankruptcy risk, we compute the effects of advertising assets and R&D assets separately for stable and turbulent markets, where we define stable markets as those below and turbulent markets as those above the median market turbulence. The results for bankruptcy risk, presented in the first column of Table 3, indicate that a 1% higher level of advertising assets is associated with bankruptcy risk that is 0.22% lower when the market is stable and 0.04% lower when the market becomes turbulent, consistent with our hypothesis that market stability increases the impact of advertising assets on reducing bankruptcy risk. A 1% higher level of R&D assets is associated with a 0.04% higher bankruptcy risk when the market is stable, suggesting that R&D assets are not effective at reducing bankruptcy risk when the market is stable. Conversely, the same higher level of R&D assets is associated with a 0.44% lower bankruptcy risk when the market becomes turbulent,

**Table 3 Predicted Difference for a 1% Higher Level for Marketing and Financial Variables**

| Variable | Percentage difference in predicted bankruptcy risk (%) | Percentage difference in predicted shareholder value (%) |
|---|---|---|
| *ADV* (stable market) | −0.22 | |
| *ADV* (turbulent market) | −0.04 | |
| *ADV* | | 0.05 |
| *RND* (stable market) | 0.04 | |
| *RND* (turbulent market) | −0.44 | |
| *RND* | | 0.36 |
| *PROFIT* | −0.91 | 0.21 |
| *LEV* | 0.45 | 0.05 |
| *LIQUID* | −0.72 | 0.02 |
| *SIZE* | −0.09 | 0.00 |

*Notes.* Impacts are calculated as the median predicted difference for a 1% higher level for each variable. Stable markets are those below and turbulent markets are those above the median market turbulence.

consistent with our hypothesis that market turbulence increases the impact of R&D assets on reducing bankruptcy risk. For comparison, we note that a 1% higher profitability is associated with a 0.91% lower bankruptcy risk, a 1% higher leverage is associated with a 0.45% higher bankruptcy risk, a 1% higher liquidity is associated with a 0.72% lower bankruptcy risk, and a 1% higher size is associated with a 0.09% lower bankruptcy risk.

The results for shareholder value, presented in the second column of Table 3, indicate that a 1% higher level of advertising assets is associated with a 0.05% higher shareholder value and a 1% higher level of R&D assets is associated with a 0.36% higher shareholder value. For comparison, we note that a 1% higher profitability is associated with a 0.21% higher shareholder value, a 1% higher leverage is associated with a 0.05% higher shareholder value, a 1% higher liquidity is associated with a 0.02% higher shareholder value, and a 1% higher size is not associated with a substantial change in shareholder value.

## 5. Out-of-Sample Validation of the Bankruptcy Risk Model

Although several studies model the impacts of advertising and R&D on shareholder value (e.g., Bharadwaj et al. 1999, Chan et al. 2001, Chauvin and Hirschey 1993, Hirschey 1982, Hirschey and Weygandt 1985, Montgomery and Wernerfelt 1988), to our knowledge our study is the first to model the impacts of advertising and R&D on bankruptcy risk. Therefore, we validate the out-of-sample performance of the bankruptcy risk model. Because the data set we used for estimating the bankruptcy risk model ends in December 2006, we validate the model using new data from January 2007 to July 2012. This validation data set has 3,402 observations and 17 bankruptcies.

We compute the predicted hazard of filing for bankruptcy for each observation in the validation data set using the coefficient estimates from the first column in Table 2. Following the approach used to assess out-of-sample performance in prior bankruptcy studies, we sort the observations in the validation data set by predicted bankruptcy hazard each year (Beaver et al. 2005, Chava and Jarrow 2004, Shumway 2001). We then calculate the percentage of actual bankruptcies above and below the median predicted bankruptcy hazard each year. A perfect model would have 100% of the actual bankruptcies above the median predicted bankruptcy hazard. If our model had no predictive power, the expected fraction of actual bankruptcies above the median predicted bankruptcy hazard would be 50%, the same as the model-free approach. Panel A of Table 4 reports the out-of-sample performance. The performance of the bankruptcy risk model (column II) is substantially better than the model-free approach (column I), with 94.12% of the actual bankruptcies above the median predicted bankruptcy hazard and only 5.88% of the actual bankruptcies below the median predicted bankruptcy hazard.

**Table 4 Out-of-Sample Bankruptcy Risk Model Validation**

| | Model free | Bankruptcy risk model | Alternative model A | Alternative model B |
|---|---|---|---|---|
| | I | II | III | IV |
| Marketing variables interacted with turbulence | No | Yes | No | No |
| Marketing variables | No | Yes | No | Yes |
| Other predictors | No | Yes | Yes | Yes |
| Panel A. Percentage of actual bankruptcies above and below the median predicted bankruptcy hazard (%) | | | | |
| Above median | 50.0 | 94.12 | 88.24 | 88.24 |
| Below median | 50.0 | 5.88 | 11.76 | 11.76 |
| Panel B. Ratio of predicted hazards for bankrupt firm-years to nonbankrupt firm-years | | | | |
| | 1.00 | 14.45 | 4.87 | 7.41 |

An alternative approach to assessing out-of-sample performance is to calculate the ratio of the median predicted hazard for actual bankrupt observations to the median predicted hazard for actual nonbankrupt observations. The larger the ratio, the better the performance. If our model had no predictive power, the predicted hazards for the two groups would be the same, and the ratio would be 1, the same as the model-free approach. Panel B of Table 4 reports the ratios of the median predicted hazards. We find that the bankruptcy risk model substantially outperforms the model-free approach, with a ratio of 14.45.

We also considered the performance of a model that does not include marketing variables but is otherwise identical to the bankruptcy risk model (column III in Table 4). For this model, 88.24% of the actual bankruptcies were above the median predicted bankruptcy hazard (versus 94.12% for the bankruptcy risk model), and the ratio of the median predicted hazard for actual bankrupt observations to the median predicted hazard for actual nonbankrupt observations was 4.87 (versus 14.45 for the bankruptcy risk model). These results suggest that considering marketing variables such as advertising assets and R&D assets can substantially improve the ability to predict bankruptcy risk.

Finally, we consider the performance of a model that includes the marketing variables but does not include their interactions with market turbulence (column IV in Table 4). For this model, 88.24% of the actual bankruptcies were above the median predicted bankruptcy hazard (versus 94.12% for the bankruptcy risk model), and the ratio of the median predicted hazard for actual bankrupt observations

to the median predicted hazard for actual nonbankrupt observations was 7.41 (versus 14.45 for the bankruptcy risk model). These results suggest that considering the moderating impact of market turbulence on the marketing variables can substantially improve the ability to predict bankruptcy risk.

## 6. Robustness Checks and Additional Analyses

### 6.1. Advertising Assets and R&D Assets Measures

We measure advertising assets and R&D assets using Koyck-type distributed lag functions with decay parameters of 0.6 and 0.8, respectively. As noted previously, we also ran our analyses with decay parameters in the range of 0.4 to 0.85 and found that results are robust to these changes. As an additional robustness check, we also considered distributed lag functions that do not assume a Koyck-type decay by measuring advertising assets and R&D assets using the Erickson and Jacobson (1992) distributed lag weights of 0.7 and 0.3 for advertising lags of two and three years and 0.25, 0.21, 0.18, 0.14, 0.11, 0.07, and 0.04 for R&D lags of two to eight years. Estimation results for the bankruptcy risk model using these alternative marketing assets measures, presented in the first column of Table 5, are consistent with the coefficients in Table 2 in terms of signs and significance. The difference in magnitudes indicates the importance of considering the distributed lag weights used when interpreting effect sizes. The results for the shareholder value model using these alternative marketing assets measures (not presented) are also consistent with the coefficients in Table 2 in terms of signs and significance.

### 6.2. Advertising and R&D Moderated by Other Market Factors

We hypothesized that market turbulence would moderate the impacts of advertising assets and R&D assets on bankruptcy risk. Our hypotheses are consistent with research that shows that a firm's ability to deal with market turbulence has a significantly greater impact on its survival prospects than a firm's ability to deal with other market characteristics, such as market growth or market concentration (Anderson and Tushman 2001, D'Aveni and Ilinitch 1992, Hayward et al. 2006). However, to ensure we have not overlooked

**Table 5 Robustness Checks Estimation Results**

| | Bankruptcy risk model | | | | | | Shareholder value model | |
|---|---|---|---|---|---|---|---|---|
| | Alternative marketing assets measure | Marketing assets interacted with concentration | Marketing assets interacted with growth | Alternative macroeconomic controls | Additional firm controls | DV = Failure risk | DV = Market to book | |
| | | | | | | | Main effects | Interactions |
| | I | II | III | IV | V | VI | VII | VIII |
| *ADV* × *TURB* | 293.47* | | | 152.71* | 145.70* | 93.46* | | −59.03 |
| | (138.15) | | | (73.35) | (73.28) | (46.71) | | (52.88) |
| *RND* × *TURB* | −663.31** | | | −309.00* | −191.94** | −116.89** | | −46.18 |
| | (231.66) | | | (122.24) | (68.09) | (43.58) | | (27.90) |
| *ADV* × *CONC* | | −12.81 | | | | | | |
| | | (23.60) | | | | | | |
| *RND* × *CONC* | | 9.91 | | | | | | |
| | | (11.93) | | | | | | |
| *ADV* × *GROW* | | | −11.66 | | | | | |
| | | | (50.84) | | | | | |
| *RND* × *GROW* | | | −18.21 | | | | | |
| | | | (18.19) | | | | | |
| *ADV* | −15.98 | −0.26 | −2.77 | −6.70 | −7.90 | −6.43 | 14.08** | 15.25** |
| | (10.20) | (6.73) | (3.73) | (5.12) | (5.80) | (3.66) | (4.30) | (5.19) |
| *RND* | 12.86 | −2.99 | 1.28 | 4.14 | 3.65 | 1.48 | 18.01*** | 19.20*** |
| | (11.11) | (5.16) | (3.36) | (3.61) | (3.38) | (1.58) | (3.91) | (4.14) |
| Market dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| Control functions | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Parameters | 63 | 63 | 63 | 49 | 65 | 74 | 96 | 100 |
| *N* | 9,199 | 9,199 | 9,199 | 9,199 | 9,199 | 9,199 | 7,904 | 7,904 |
| BIC | 508.02 | 510.27 | 512.14 | 591.78 | 514.64 | 735.60 | | |
| *F*-statistic | | | | | | | 9.21*** | 9.00*** |

*Notes.* All models also include the financial and market control variables from Equations (2) and (3). Robust standard errors are in parentheses. BIC, Bayesian information criterion.

*Significant at $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

other market characteristics that might also moderate the impacts of advertising assets and R&D assets on bankruptcy risk, we test whether market concentration and market growth moderate the impacts of advertising assets and R&D assets on bankruptcy risk.

Column II of Table 5 reports the estimates for an alternative bankruptcy risk model with the interaction terms $ADV \times TURB$ and $RND \times TURB$ replaced with $ADV \times CONC$ and $RND \times CONC$, and column III presents the estimates for an alternative bankruptcy hazard model with the interaction terms replaced with $ADV \times GROW$ and $RND \times GROW$. We find that none of the coefficients for any of the alternative market characteristics interactions are significant. These results suggest that although the turbulence of the market moderates the impacts of advertising assets and R&D assets on bankruptcy risk, neither the concentration of firms in the market nor the growth of the market significantly moderate the impacts of advertising assets or R&D assets on bankruptcy risk.

### 6.3. Alternative Controls for Macroeconomic Factors

To control for macroeconomic events, we follow precedence from the bankruptcy risk literature and include year dummy variables in the bankruptcy risk model (Campbell et al. 2008). We conduct an additional robustness analysis by adding controls for financial market events and business cycle events to the bankruptcy risk model.[10] Because the year dummy variables were part of the baseline hazard function, and because we need to drop them in this robustness analysis because of multicollinearity with the alternative macroeconomic control variables, we use a Cox proportional hazards model (which allows for an unspecified baseline hazard) for this analysis. We use $SPGROW_y$ (growth in the S&P 500 index) and $SPTURB_y$ (turbulence in the S&P 500 index) as controls for financial market events and $RECESSION_y$ (a dummy variable set to 1 in recession years and 0 otherwise) as the control for business cycle events. Following Frankenberger and Graham (2003), Kashmiri and Mahajan (2014), and Srinivasan et al. (2011), we classify 1980, 1982, 1990, and 2001 as recession years since the majority of the year occurred during a recession as classified by the NBER (National Bureau of Economic Research). The results of this robustness analysis, presented in column IV of Table 5, are consistent with the estimates in Table 2 in terms of signs and significance, though this model does not fit the data as well.

### 6.4. Additional Controls for Firm Factors

We also checked the robustness of our results to adding additional firm control variables to our models. We estimated an alternative bankruptcy risk model with the number of business segments and the number of patents included as additional control variables.[11] We draw segments data from the Compustat Segments database and set the segments variable $SEGS_{iy}$ equal to the number of segments for firm $i$ in year $y$. We set the variable to 1 if the data were missing. We use data from the NBER Patent Data Project to capture the number of patents for a firm. We set the variable $PATS_{iy}$ to the number of patents granted divided by the book value of assets for firm $i$ in year $y$. The results of this robustness analysis, presented in column V of Table 5, are consistent with the estimates in Table 2, though the model does not fit the data as well.

### 6.5. Broader Measure of Failure

We also assess the robustness of our findings by considering a broader measure of failure.[12] We adopt the Campbell et al. (2008) failure measure, which includes bankruptcy filings, financially driven stock delistings, and D ("default") credit ratings. This broader failure measure enables us to capture cases in which the firm defaults on its credit commitments and cases in which the firm performs so poorly that it is delisted from the stock exchange—events that sometimes precede bankruptcy. Recall that, consistent with other studies, less than 1% of observations have a bankruptcy filing in our data set. An additional benefit of the broader failure measure is that it captures 58% more failures than when using only bankruptcy filings. The estimation results using the broader failure measure, presented in column VI of Table 5, are consistent with the bankruptcy risk model estimates in Table 2.

### 6.6. Alternative Shareholder Value Measure

We also assess the robustness of our findings by measuring shareholder value as market-to-book instead of Tobin's $q$. Columns VII and VIII of Table 5 report the estimation results for this model. The results are consistent with the shareholder value results in Table 2, providing further support for Hypotheses H2A and H2B that advertising assets and R&D assets increase shareholder value, respectively, and Hypotheses H3A and H3B that market turbulence does not moderate the impacts of advertising assets or R&D assets on shareholder value, respectively.

### 6.7. Additional Robustness Analyses

We conducted several additional analyses to assess the robustness of our results. We checked the robustness of our results to using predictors from one year prior and three years prior instead of predictors from two years prior. We also analyzed the robustness of our results to alternative measures of the financial control variables and market control variables. We then checked the robustness of our results to alternative

[10] We thank the editor for this suggestion.

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

[12] We thank the editor for this suggestion.

instruments and also checked for the presence of interaction effects between advertising assets and R&D assets. We provide the results of these analyses in the Web Appendix (available as supplemental material at http://dx.doi.org/10.1287/mksc.2015.0913).

# 7. Conclusion

Our study provides new insights into whether and how assets built by advertising and R&D reduce bankruptcy risk. We find robust empirical support for our hypotheses that the impacts of advertising assets and R&D assets on bankruptcy risk are not merely the inverse of their impacts on shareholder value. The results show that the impacts of advertising assets and R&D assets on bankruptcy risk are moderated by market turbulence, whereas their impacts on shareholder value are not moderated by market turbulence. Market stability increases the impact of advertising assets on reducing bankruptcy risk, whereas market turbulence increases the impact of R&D assets on reducing bankruptcy risk.

## 7.1. Implications

Insight into the impact of marketing on bankruptcy risk has become increasingly important because of the dramatic rate at which firms are filing for bankruptcy. These bankruptcies are costly to firms because they create both direct (e.g., legal, accounting, and other administrative costs) as well as indirect (e.g., opportunity costs of management distraction, customer concerns with long-term support) costs (Altman 1984). Our findings have implications for top management teams, supplier marketing managers, financial institution marketing managers, investors, and theory.

**7.1.1. Top Management Teams.** Across many years with varying levels of market turbulence, top management teams likely realize that marketing assets build shareholder value. However, although they might expect these marketing assets to reduce bankruptcy risk in the same way they build shareholder value, our results suggest that this is not likely the case. Understanding this is particularly important for top management teams because bankruptcies have become more prevalent in recent years.

Top management teams should realize that when the market is stable, advertising assets more effectively insulate the firm from bankruptcy. When the market becomes turbulent, R&D assets more effectively insulate the firm from bankruptcy. Our results indicate that when a firm's marketing assets are not well matched to the market turbulence it is experiencing, the top management team should employ other resources to bolster the firm's financial position.

**7.1.2. Supplier Marketing Managers.** This research also has important implications for a supplier's marketing managers. To the extent that the firm sells through intermediaries, marketing managers must monitor and react to both the growth prospects and the financial stability of intermediate customers. If a distressed intermediary is a particularly important customer, the manager can adjust the terms of trade credit to help ease the customer's financial distress (Molina and Preve 2012). Because the customer's bankruptcy risk clearly plays into that trade credit decision (Loten and Lublin 2014), the marketing manager needs to understand that the customer's advertising assets will better protect the customer from bankruptcy when the market is stable whereas the customer's R&D assets will better protect the customer from bankruptcy when the market becomes turbulent.

**7.1.3. Financial Institution Marketing Managers.** Similar to suppliers, financial institutions have a vested interest in assessing the risk that their customers will file for bankruptcy. Unsecured lenders in particular are often at significant risk of not receiving payment if customers file for bankruptcy. Evaluating how well the customers' marketing assets are aligned with market turbulence should help marketing managers in financial institutions better assess that risk.

**7.1.4. Investors.** The U.S. Securities and Exchange Commission warns investors that shares in bankrupt companies can become worthless because "In most instances, the company's plan of reorganization will cancel the existing equity shares. This happens in bankruptcy cases because secured and unsecured creditors are paid from the company's assets before common stockholders."[13] The results indicate that when assessing the risk of their holdings, investors should account for the firm's marketing assets and how well they are aligned with the turbulence of the market in which the firm operates.

**7.1.5. Theory.** Our findings also have important theoretical implications. It is not the case that marketing's impact on bankruptcy risk is merely the inverse of its impact on shareholder value. The differences hinge on the fact that shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period. We show that current market turbulence moderates the impacts of advertising assets and R&D assets on expected cash flow from the next period but not on expected cash flows from more distant future periods. Therefore, market turbulence moderates the impacts of advertising assets and R&D assets on bankruptcy risk but not shareholder value.

## 7.2. Limitations and Areas for Future Research

To our knowledge, this study is the first to explore the ways that marketing might insulate a firm from

[13] http://www.sec.gov/investor/pubs/bankrupt.htm.

bankruptcy risk. Given that bankruptcies are increasing, further investigation of the link between marketing and bankruptcy risk is warranted. Our study considers the impacts of advertising assets and R&D assets on reducing bankruptcy risk. Future research should consider the impacts of more disaggregated assets, distinguishing between the types of advertising used and the types of R&D pursued in creating the assets. For example, advertising assets could be separated by media type or by whether the advertising used to create the asset was price oriented or differentiation focused. R&D assets could be separated by those built through radical versus incremental R&D or process versus product R&D. Future research should also consider more aggregated marketing assets (e.g., brand equity) that are built through a combination of marketing activities such as advertising and R&D.

Our study uses annually reported financial data. A limitation of our data is that it does not allow for the study of a firm's short-term tactical actions. It may be that some firms take short-term actions, such as temporary price reductions and sales promotions, to increase sales when they become financially distressed. Such actions may not be captured in annual financial reports. As new data sources become available, as well as new proxies based on publicly reported data, future research should consider the implications of short-term marketing actions on bankruptcy risk and explore how they may differ from their impacts on shareholder value.

We estimated our models using data from large publicly traded firms in the United States. However, the impacts of advertising assets and R&D assets on bankruptcy risk might differ in other countries or for smaller or private firms. Future research should address these questions.

### 7.3. Summary

By investigating the impacts of advertising assets and R&D assets on reducing bankruptcy risk, our research makes two key contributions. First, we show that advertising assets and R&D assets significantly affect bankruptcy risk. Out-of-sample validation analyses indicate that bankruptcy prediction improves by considering advertising assets and R&D assets in addition to the usual finance and accounting predictors. Second, we show that the impacts of advertising assets and R&D assets on bankruptcy risk are not merely the inverse of their impacts on shareholder value. Because shareholder value is a function of expected cash flows from all future periods, whereas bankruptcy risk is a function of expected cash flow from only the next period, current market turbulence moderates the impacts of advertising assets and R&D assets on bankruptcy risk but not shareholder value. We show that market stability increases the impact of advertising assets on reducing bankruptcy risk, whereas market turbulence increases the impact of R&D assets on reducing bankruptcy risk.

### Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mksc.2015.0913.

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## Appendix. Correlation Matrices

**Table A.1 Correlation Matrix (Full Data Set)**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) *BANK* | 1.00 | | | | | | | | | |
| (2) *ADV* | −0.01 | 1.00 | | | | | | | | |
| (3) *RND* | −0.01 | −0.06*** | 1.00 | | | | | | | |
| (4) *PROFIT* | −0.07*** | 0.12*** | −0.20*** | 1.00 | | | | | | |
| (5) *LEV* | 0.06*** | 0.05*** | −0.28*** | −0.07*** | 1.00 | | | | | |
| (6) *LIQUID* | −0.03** | −0.09*** | 0.22*** | −0.01 | −0.41*** | 1.00 | | | | |
| (7) *SIZE* | −0.02 | −0.06*** | −0.06*** | 0.03*** | 0.09*** | −0.31*** | 1.00 | | | |
| (8) *TURB* | 0.03*** | −0.06*** | −0.02 | −0.04*** | 0.05*** | 0.04*** | −0.09*** | 1.00 | | |
| (9) *GROW* | 0.00 | −0.05*** | 0.17*** | −0.04*** | −0.09*** | 0.09*** | −0.03* | 0.11*** | 1.00 | |
| (10) *CONC* | 0.02 | 0.00 | −0.17*** | 0.00 | 0.05*** | 0.01 | −0.02 | 0.19*** | −0.11*** | 1.00 |

*Note.* $N = 9{,}199$ time-series cross-sectional observations.
*Significant at $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

**Table A.2 Correlation Matrix (Shareholder Value Data Set)**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) *SV* | 1.00 | | | | | | | | | |
| (2) *ADV* | 0.08*** | 1.00 | | | | | | | | |
| (3) *RND* | 0.26*** | −0.04*** | 1.00 | | | | | | | |
| (4) *PROFIT* | 0.20*** | 0.13*** | −0.21*** | 1.00 | | | | | | |
| (5) *LEV* | −0.15*** | 0.02 | −0.26*** | −0.08*** | 1.00 | | | | | |
| (6) *LIQUID* | 0.06*** | −0.08*** | 0.21*** | −0.02* | −0.41*** | 1.00 | | | | |
| (7) *SIZE* | −0.05*** | −0.07*** | −0.06*** | 0.02* | 0.12*** | −0.31*** | 1.00 | | | |
| (8) *TURB* | −0.03** | −0.06*** | 0.00 | −0.05*** | 0.00 | 0.05*** | −0.09*** | 1.00 | | |
| (9) *GROW* | 0.17*** | −0.04*** | 0.18*** | −0.03** | −0.12*** | 0.11*** | −0.03* | 0.09*** | 1.00 | |
| (10) *CONC* | −0.15*** | 0.02* | −0.16*** | 0.01 | 0.04** | 0.02 | −0.01 | 0.18*** | −0.11*** | 1.00 |

*Note.* $N = 7{,}904$ time-series cross-sectional observations.
*Significant at $p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

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