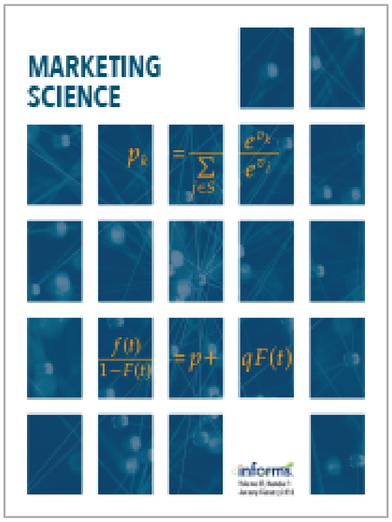

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Findings—Using Stock Prices to Predict Market Events: Evidence on Sales Takeoff and Long-Term Firm Survival

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Findings

Using Stock Prices to Predict Market Events: Evidence on Sales Takeoff and Long-Term Firm Survival

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We evaluate whether stock prices can predict the sales takeoff and the long-term survival of firms at takeoff. We find that abnormal returns are strongly positive in the year prior to takeoff, thus suggesting an important signal of the takeoff. Moreover, we find that negative abnormal returns in the year of takeoff and one year after takeoff increase the hazard of market exit by 9.5 times relative to firms without these negative abnormal returns. We discuss the implications of these findings for managers and researchers.

Key words: sales takeoff; stock market forecast; event study; new product research; product life cycle; forecasting; product management
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1. Introduction

Can stock prices predict market events? Even those events that occur many years in the future? Today, researchers tend to use stock prices to evaluate the immediate impact of strategic decisions and events. In contrast, we evaluate whether stock prices can predict *future* market events and decisions. As an initial test of this proposition, we consider one market event (sales takeoff) and one type of strategic decision (firm exit).

The sales takeoff is the critical event in the market history of really new product categories. At takeoff, sales typically grow by 100%–300%, and a new product emerges into mass-market consciousness. Managers must anticipate this dramatic change by expanding production capacity and distribution channels, increasing advertising intensity and coverage, and adjusting prices to meet the demand from new market segments. Indeed, such a dramatic change requires that managers rethink all elements of their marketing strategy. In addition, industry analysts who advise investors and manufacturers of complementary and substitute products would benefit greatly from any insights about the takeoff.

Several important papers have begun to generate insights about the sales takeoff. These papers document the takeoff phenomenon and highlight the role of variables like price and number of competitors in causing the takeoff (Agarwal and Bayus 2002, Golder and Tellis 1997).[1] Researchers have also found that the takeoff is a consistent phenomenon in international markets, where a country's innovative culture plays an important role in speeding or delaying this event (Tellis et al. 2003).

Although these studies yield valuable insights into the takeoff, there is still much that is unknown. In particular, managers have limited ability to anticipate the takeoff. Also, there is tremendous uncertainty at takeoff about which firms will be winners and which firms will be losers in these promising new markets. Therefore, researchers have called for much more research on the sales takeoff. We answer this call for further research by addressing two fundamental questions:

1. Can the stock market predict the sales takeoff?
2. Can stock market results at takeoff predict which firms will succeed and which firms will fail years beyond takeoff?

Because it is critically important for managers to be able to anticipate the takeoff event, any insights

[1] For other research on market response to innovation, see Hauser et al. (2006) for an overview and Luo et al. (2007) for a recent example.

about the probability of takeoff would be highly valuable. An answer to our first question would benefit managers of all firms in a category. Answering our second question may be much harder using stock market data because it requires making long-term predictions. Whereas it might be reasonable to expect stock prices to contemporaneously reflect the takeoff, and possibly even anticipate the takeoff, it seems much less likely that stock prices at takeoff will predict which firms will exit the market many years later. However, any insights here would be extremely valuable to managers as they wrestle with the difficult decision about whether to withdraw from a promising market or persist in the face of great difficulties. This important decision has only been partially addressed in previous research (e.g., Boulding et al. 1997). Moreover, our second question advances takeoff research in an important new direction by examining the impact of this category-level event on the performance of individual firms. Most important, however, positive answers to either of our questions will provide some initial evidence that stock prices can be used to predict important market events.

Next, we provide background and rationale for using stock prices to analyze market events. Then, we discuss our method and data. Following that, we present our results and conclude by discussing implications for managers and researchers.

2. Using Stock Prices to Understand and Predict Market Events

There is a rich history in the finance and marketing literatures of using stock prices to evaluate market events. These so-called event studies have been used to evaluate a wide range of market phenomena, including company name changes (Horsky and Swyngedouw 1987), the use of celebrity endorsers (Agrawal and Kamakura 1995), brand extension announcements (Lane and Jacobson 1995), and many others.[2] In this section, we begin by providing background information on our research approach. Then, we discuss its application to our specific research questions.

2.1. Background

The efficient market hypothesis (EMH) is the dominant paradigm in finance. It postulates that a company's stock price fully reflects all publicly available information about that company. As such, the stock price is an unbiased measure of a company's future cash flows (Fama 1965). Then, change in stock price (i.e., stock return) associated with a specific event reflects that event's expected impact on future cash flows. Thus, stock returns are a forward-looking measure of firm performance, and might be useful to anticipate future events.

Although there has been a long-running debate over the extent of market efficiency (e.g., Barberis and Thaler 2003), the vast body of empirical research indicates that U.S. capital markets are "very efficient" (Bodie et al. 2002, p. 374). Even critics of market efficiency concede that most individual stocks are efficient, even though there may be pockets of inefficiency (e.g., Jung and Shiller 2005).

Most marketing research based on the efficient market hypothesis has tried to determine the economic value of various events like corporate Olympic sponsorship (Miyazaki and Morgan 2001) and winning a quality award (Hendricks and Singhal 1996). Limited research has evaluated whether stock prices might predict future events such as strikes (Neumann 1980). It finds that the market may reflect the increased probability of a strike a few days before it begins.

Most researchers seem to believe that the stock market provides a good estimate of the economic value of current, well-understood activities. However, its ability to forecast future events is much less certain. Our study addresses this more uncertain domain of using stock prices to predict future events.

2.2. Stock Prices and Sales Takeoff

Answers to both of our research questions require that the stock market be able to forecast future events. For the first question, the stock market must anticipate the takeoff event by showing higher appreciation in stock prices of firms making up the product category prior to takeoff. This requirement is challenging because new products have typically been on the market for at least several years without experiencing takeoff. In a sense, many people consider these new products to be failures prior to takeoff. Also, sales prior to takeoff may have even included years with large increases, but not large enough to transition to a sustained growth stage. Therefore, after years of limited success and fluctuating sales, is it reasonable to expect that the stock market will be able to anticipate the takeoff in sales? If the market can anticipate takeoff, managers will have a valuable new indicator for anticipating the necessary dramatic changes to their strategies.[3] In contrast, if the stock market is not anticipating takeoff, current models of sales takeoff, albeit limited in their accuracy, could enable investors to benefit from the stock market's current inability to

[2] Market events can also be investigated using other measures, like sales and marketing-mix elasticities and cross elasticities (e.g., Van Heerde et al. 2007).

[3] Some research indicates that stock returns can affect marketing strategies, such as product mix, distribution, or sales force expenditures (Markovitch et al. 2005).

incorporate the positive news of an impending takeoff. Either result will provide some insight into new product markets and change the decision making of managers or stock market analysts.

We propose that stock prices will anticipate takeoff, but not far in advance of the event. Investors may become aware of enhanced product features, lower prices, expanded distribution, or other positive developments prior to consumers responding to these developments with increased purchases. Because of the awareness of these factors, the stock market should reflect the takeoff prior to its onset. The actual takeoff should not provide any additional information to cause unusually high returns during the year of takeoff. Thus, we propose the following hypotheses:[4]

Hypothesis 1 (H1). *Abnormal stock returns will not provide a* long-term *forecast of the sales takeoff.*[5]

Hypothesis 2 (H2). *Abnormal stock returns will provide a* short-term *forecast of the sales takeoff.*

Hypothesis 3 (H3). *Abnormal stock returns during the year of takeoff will not be significantly different from zero.*

Our second research question requires that stock prices be used to make long-term forecasts about the survival of individual firms. Although we hope that stock prices might provide information about some firms, previous research does not indicate that the stock market can accurately make such long-term forecasts. Thus, we propose the following hypothesis:

Hypothesis 4 (H4). *Abnormal returns at takeoff will not predict which firms will succeed and which firms will fail years beyond takeoff.*

3. Method

In this section, we describe our measures and sample of categories and firms.

3.1. Measures of Stock Returns

A firm's stock price is a measure of its future performance. Specifically, the value of a firm's equity is frequently expressed as the expected sum of its appropriately discounted cash flows

$$P_t = E\left[\left(\sum_{s=t}^{s=\infty} \frac{D_s}{(1+r)^{s-t}}\right) \middle| \Omega_t\right],$$

where P_t denotes stock price; D_s denotes cash flow in period s; r is the discount rate; and Ω_t is the set of information available to market participants at time t. Thus, changes in a firm's stock price are driven by shocks to expected cash flows and/or shocks to discount rates. These shocks are essentially news items, such as the firm's performance announcements or competitors' entries or exits. In our study, the stock market's forecast of a product category's future performance is the average difference between the actual return on category stocks in year t and the expected return given all information available prior to year t. This construct is known in the finance literature as the average abnormal return.

Our first three hypotheses investigate the category-level phenomenon of sales takeoff, so our stock price measure must reflect the various companies participating in each category. Financial economics provides four general methods for computing the stock market's long-term baseline return for a group of stocks (i.e., firms in a product category).[6] These are buy-and-hold abnormal returns (BHAR), calendar-time portfolio returns, Ibbotson's returns across time and securities (IRATS), and cumulative average abnormal returns (CAAR). However, the CAAR method does not reflect investor experience, like BHAR, and suffers from statistical problems like biased test statistics resulting from cross-sectional dependence of sample firms, which are addressed in the calendar-time portfolio method. Therefore, we evaluate forecasts based on the first three approaches. These three methods have advantages and limitations that necessitate our comparison of forecasts based on all three measures. As such, we can evaluate the robustness of our results across the three modeling approaches. Next, we discuss each approach in greater detail, starting with BHAR.

The BHAR for firm i over an interval beginning with month T_1 and ending with T_2 can be expressed as

$$\mathrm{BHAR}_{i,T_1,T_2} = \prod_{t=T_1}^{T_2}(1+R_{it}) - \prod_{t=T_1}^{T_2}(1+R_{mt}),$$

where R_{it} is the rate of return of the ith firm in month t and R_{mt} is the rate of return on a market index in the same time period. Then the mean buy-and-hold abnormal return for a portfolio of firms is defined as

$$\mathrm{BHAR}_{T_1,T_2} = \frac{1}{N}\sum_{i=1}^{T}\mathrm{BHAR}_{i,T_1,T_2}.$$

We evaluate forecast windows based on calendar years $t-2$, $t-1$, the takeoff year t, $t+1$, and $t+2$.

[4] Consistent with event study literature, we conduct our investigation using *abnormal* stock returns, or returns relative to a benchmark (discussed in the Method section below).

[5] We use long-term to mean more than one year ahead. Short-term means up to one year ahead.

[6] There are also variations of these approaches, such as the calendar-time model with IRATS, that we do not address in this paper because event study methodology is not our focus. However, hybrid approaches are likely to produce results that are substantively similar to those we obtained using the standard approaches.

For reasons discussed in the next paragraph, we use a bootstrapped version of the cross-sectional time-series t-test (Brown and Warner 1980) to test the hypothesis that the abnormal returns (mean BHAR) over the horizon of interest are significantly different from zero.

The biggest advantage of using BHAR in constructing our forecast is that this approach reflects the actual experience of investors by measuring whether a sample of firms earned abnormal stock returns over the period of interest. The disadvantage of BHAR is that it suffers from skewness and cross-sectional dependence problems (Barber and Lyon 1997, Mitchell and Stafford 2000). The positive skewness of the BHAR leads to an inflated estimate of the cross-sectional standard deviation, and, therefore, downward biased test statistics. The effect of cross-sectional dependence (i.e., major events in a category clustering in time) is the opposite. This leads to positive cross correlation of abnormal returns, making test statistics overstated. However, bootstrapping of test statistics can mitigate this problem (Ikenberry et al. 1995, Lee 1997).

The second approach we employed is calendar-time portfolio analysis, which is seeing increased use in the marketing literature (e.g., Madden et al. 2006). It eliminates the problem of cross-sectional dependence among firms, because sample firms are aggregated into a single portfolio whose abnormal returns are measured over a long period. Yet, this approach also has two notable limitations. First, it has low power to detect abnormal returns because returns are averaged over months of potentially positive and negative event activity. Second, it does not capture the actual experience of investors who seek a holding period return. Instead, it addresses whether a sample of firms in a category *persistently* earns abnormal monthly returns over a particular period of interest. Thus, this method will result in a somewhat different measure of returns than BHAR and IRATS.

We use ordinary least squares regression to obtain our calendar-time portfolio's abnormal returns by estimating the Fama-French-momentum four-factor model (FFM) as follows:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + u_p UMD_t + \varepsilon_{pt}.$$

This model specifies that portfolio stock returns R_{pt} (relative to a risk-free rate R_{ft}) during month t are a function of abnormal returns on the U.S. stock market R_{mt}, the difference between returns of small-firm and big-firm stocks SMB_t, the difference between returns of high and low book-to-market stocks HML_t (i.e., value vs. growth stocks), and the difference between returns of firms with high and low prior stock price performance UMD_t, all measured during month t. The final variable in this model captures momentum in stock price movements (Carhart 1997) and is a standard modification to the original three-factor model (Fama and French 1998). The estimate of the intercept parameter α_p provides a test of the null hypothesis that the mean monthly abnormal return on the portfolio is zero. For ease of exposition, we report all abnormal returns on an annual basis, multiplying the intercept by 12.

The third approach used is the IRATS procedure (Ibbotson 1975).[7] This approach assumes that returns on sample firms are the same but vary over time. Thus, unlike the calendar-time portfolio method, IRATS allows us to estimate average abnormal returns for each month in the time frame of interest and adjust for monthly risk changes associated with an anticipated takeoff. The IRATS model is evaluated as follows:

$$R_{it} = \alpha_t + \beta_t R_{mt} + \varepsilon_{it},$$

where R_{it} is the rate of return of the ith firm in month t and R_{mt} is the rate of return on an equally weighted market index. Unlike BHAR, the IRATS regression does not use a separate estimation period to obtain estimates of the parameters, and it is estimated for each month in our forecast window. The intercept α_t is the estimate of the abnormal return. We test the null hypothesis that α_t is equal to zero.

A potential concern with any approach to measure long-horizon stock price performance is the extent to which the obtained abnormal returns are caused by the event in question and not by unrelated events in the measurement window. Undoubtedly, unrelated events will have an effect on the stock prices of the firms in our sample—however, their net impact is assumed to have a zero mean. Indeed, empirical evidence corroborates this standard assumption of long-horizon event studies (e.g., Mitchell and Stafford 2000).

3.2. Duration Time Model

To analyze survival durations, we use the proportional hazard model (Cox 1972). This model has been commonly employed for analyzing duration times associated with takeoff (e.g., Agarwal and Bayus 2002, Golder and Tellis 1997). Similar to those studies, we model duration times as a function of a baseline hazard function and independent variables. The time-to-exit for each firm in our sample follows its own hazard function, $h_i(t)$, expressed as $h_i(t) = h(t; z_i) = h_0(t)\exp(z_i\beta)$, where $h_0(t)$ is an unspecified baseline hazard function, z_i is the vector of independent

[7] Unlike other measures of abnormal returns, the statistical properties of IRATS have not been fully explored. However, this measure is being used in the finance literature (e.g., Peyer and Vermaelen 2005).

variables for the ith firm, and β is the vector of parameters to be estimated.[8] The effect of independent variables on the baseline hazard function is captured by the hazard ratio, which is defined as e^{β}. The magnitude of the effect of any independent variable increasing by one unit is $(e^{\beta} - 1) \times 100\%$. Estimation of the hazard model is done with the semi-parametric partial likelihood method (Cox 1972). The partial likelihood considers the probability that one firm exits out of all firms that have not yet exited. Additional details of hazard models can be found in Allison (1995), Golder and Tellis (1997), Helsen and Schmittlein (1993), and Jain and Vilcassim (1991).

3.3. Data

To evaluate our hypotheses, we need to identify the names of many publicly traded firms in several product categories and compile their stock price returns. In addition, we need to determine the entry and exit dates for these firms, as well as annual sales data for each category.

Monthly stock return data come from the Center for Research in Security Prices (CRSP) at the University of Chicago. The three Fama-French factors and Carhart's momentum factor were collected from Professor Kenneth French's website at Dartmouth College.

To select a sample of categories, we first established several sampling criteria. First, each product category must have publicly available sales data during the period around takeoff. Second, each product category must contain a reasonable number of firms so that we can evaluate their aggregate stock price performance in relation to takeoff, as well as examine the survival duration of a large number of firms. Third, many of these firms must be publicly traded so that the necessary stock price data are available. Fourth, the media must provide extensive coverage of each product category because we rely on media reports to determine firm entries and exits. Based on these criteria, we identified four product categories as the focus of our investigation: black and white TVs, color TVs, microwave ovens, and PCs. As a result of our four selection criteria, our sample does not include privately held firms or firms not receiving media coverage.

To determine the year of takeoff, we used the threshold rule developed by Golder and Tellis (1997). This rule calculates a product category's growth rate in year t, relative to its base of sales in year $t-1$. When base sales are small, a high growth rate is required to trigger takeoff. When base sales are larger, the required growth rate is smaller. This threshold can be thought of more broadly as the market momentum required for a large sales increase to result in takeoff and a sustained growth stage. In physics, momentum is calculated as mass times velocity. In the threshold rule, base sales are similar to mass and sales growth is similar to velocity. The multiple of these two measures can be thought of as market momentum in the new product category.

Because three of our categories overlap with Golder and Tellis (1997), our takeoff years are the same ones they identified: 1948 for black and white (B&W) TVs, 1962 for color TVs, and 1972 for microwave ovens. For PCs, the takeoff year based on their threshold rule is 1981. Sales growth in this year relative to base sales in the previous year clearly surpasses the takeoff threshold. Similar to previous research (e.g., Bass 1969, Golder and Tellis 1997), our sales data come from *Merchandising Week*, *Electrical Merchandising*, and the *Statistical Abstracts of the United States*.

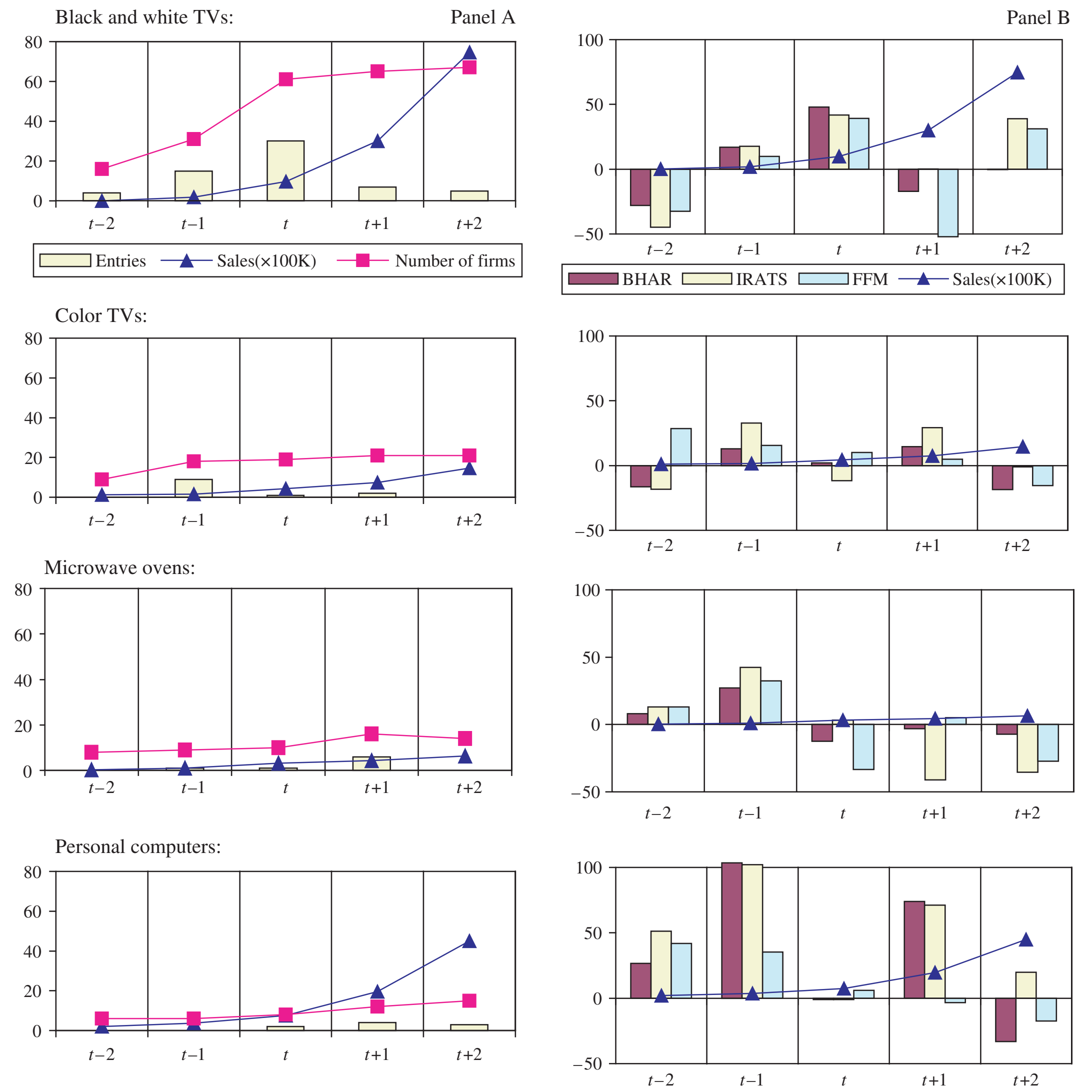
To determine the firms in each product category as well as their entry and exit dates, some previous studies have used *Thomas Register* data. However, our own investigation indicates that these data are unreliable in providing some firm entry and exit dates when compared with media reports, which can be corroborated across multiple sources. Therefore, we researched multiple media sources to identify publicly traded firms in each product category as well as their entry and exit dates. These sources include annual reports, commercial databases (e.g., Lexis-Nexis, Proquest), archived business publications (e.g., *Barron's*, *Commercial and Financial Chronicle*), and credible online sources (e.g., http://www.tvhistory.tv). We focused our investigation on a five-year window starting two years before takeoff and ending two years after takeoff. Every effort was made to improve data set reliability by identifying corroborating sources for each data element. Each product category required well over 100 hours of data collection, on average. For instance, in the TV markets, there were close to 200 manufacturers between 1939 and 1970. Across categories, we identified 71 publicly traded firms during our window of interest around takeoff, and subsequently, identified entry and exit dates for each firm.

4. Results

In Figure 1, we provide an overview of our results on abnormal returns relative to takeoff. In addition, we report findings on the number of entries and number of firms in each category. Two key results emerge from these graphs. First, in three of our categories, we see a peak in entries during the year of takeoff or following it. In contrast, Agarwal and Bayus

[8] Similar to previous research (Golder and Tellis 1997, Helsen and Schmittlein 1993), we do not include a term for unobserved heterogeneity. This approach is appropriate when only nonrepeated events are modeled (Allison 1984), and each firm's exit occurs only once.

Figure 1 **Category Unit Sales (in 100,000s), the Total Number of Firms, and New Entries (Panel A); Category Unit Sales (in 100,000s) and Abnormal Buy-and-Hold Abnormal Stock Returns (BHAR), Ibbotson's Returns Across Time and Securities (IRATS) and Fama-French Momentum (FFM) Four-Factor Model Returns (Panel B) Around the Sales Takeoff Year *t***



(2002) found that entries tend to increase substantially prior to takeoff. The difference in findings may be due to our focus on large, publicly traded firms while their data include both large firms and smaller firms included in the *Thomas Register*. The explanation for the difference in entry strategies between large and small firms may be that larger firms can afford to wait longer to enter a category. They can avoid the early risks of an unproven market and use their strengths in brand name and distribution to enter later. Smaller firms would be less likely to enter a category successfully once larger, established firms have already entered a new market.

The second interesting result from Figure 1 is that the year prior to takeoff appears to be the only year in which abnormal returns are consistently positive across the four categories and three measurement approaches. These results suggest that the stock market may actually be able to predict the takeoff event. Next, we evaluate this possibility more formally.

4.1. Abnormal Returns and Sales Takeoff

Table 1 reports the three measures of abnormal returns for a seven-year period around sales takeoff in the four product categories.[9] Before discussing our results, we would like to point out that the event window we are studying is an entire year. Recent studies have pointed out the usefulness of measuring abnormal returns for important events over longer event windows, because the market's reaction develops over time as better information about an

[9] As stated earlier, our analysis focuses on five years centered around the takeoff year. The two extra pretakeoff years are considered as part of our robustness checks.

Table 1 Category Annual Unit Sales ($\times$100K) and Average Abnormal Returns (%) Around Sales Takeoff[a]

		Year relative to takeoff[c]						
Product category	Method[b]	$t-4$	$t-3$	$t-2$	$t-1$	t	$t+1$	$t+2$
Black and white TVs	Number of firms[d]			6	8	14	16	18
	Sales	—	—	0.1	1.8	9.8	30	74.6
	BHAR[e]	—	—	−27.9***	16.9*	48***	−17.2	−0.2
	IRATS	—	—	−42.8****	17.7***	41.8****	0.2	−10.7***
	FFM[f]			−32.2****	11	39.1****	−52.1****	−11.8*
Color TVs	Number of firms	11	12	10	10	10	12	11
	Sales	0.8	0.9	1.2	1.5	4.4	7.5	14.6
	BHAR	57.4**	29.1	−16.4***	13	2	14.7*	−18.6**
	IRATS	77.7****	38.4****	−18.2**	32.8****	−11.8***	29.2****	−0.9
	FFM	−24.2	−14.8	28.6***	15.6**	10.2	4.9	−15.4***
Microwave ovens	Number of firms	2	5	7	9	9	10	10
	Sales			0.3	1	3.3	4.4	6.4
	BHAR	−58.6***	−3.5	8	27.1****	−12.4*	−3	−7.3**
	IRATS	−9.8	−25.8***	12.9	42.5****	3.2	−41.1****	−35.5****
	FFM	−12.8	1.4	13****	32.4**	−33.4**	5	−27.2***
Desktop PCs	Number of firms	3	4	6	6	7	10	13
	Sales			2	3.7	7.5	19.5	45
	BHAR	26.9	−0.7	26.7	122****	−1.1	74*	−16
	IRATS	35.9	33.7**	51.3****	102****	−1	61.2****	20**
	FFM	33.7	11.4*	41.8****	35.2**	6.1	−3.4	−17.5

[a]Black and white TV manufacturing was on hold until 1946 (year $t-2$) due to World War II.
[b]BHAR = buy and hold abnormal return; IRATS = Ibbotson's return across time and securities; FFM = Fama-French momentum four-factor model.
[c]The symbols *, **, ***, **** denote statistical significance at the 10%, 5%, 1%, and 0.1% levels, respectively.
[d]This number includes publicly traded firms for whom stock return data are available.
[e]BHAR significance tests are based on bootstrapped test statistics.
[f]FFM significance tests are based on heteroscedasticity-consistent test statistics.

event becomes available (e.g., Pauwels et al. 2004, Sood and Tellis 2006). Therefore, any significant findings on abnormal returns around the takeoff (either positive or negative) reflect either the great potential or great disappointment associated with the takeoff event. As such, significant abnormal returns confirm the importance of the takeoff event. We find generally consistent results across the three measures of abnormal returns, with correlations among measures of at least 66%. These moderately high correlations reflect the different approach of each measure.

Based on Table 1, the only year with uniformly positive abnormal returns is the year prior to takeoff. Ten of 12 measures during this year are statistically significant. Tests of proportions show statistically significant differences between year $t-1$ and the other four years between $t-2$ and $t+2$ with respect to the proportion of directionally positive to directionally negative returns ($p < 0.01$) and positive significant returns to negative significant returns ($p < 0.05$). An examination of the broader window of abnormal returns supports the idea that abnormal returns are exceptionally positive in the year before takeoff.[10]

[10] We appreciate the contribution of an anonymous reviewer, who corroborated our results in the commercial aviation industry. S/he found that BHAR were very high in the year before takeoff (63.2%, $p < 0.001$).

In microwave ovens and PCs, there is some evidence that the stock market may be anticipating takeoff two years prior to the event. However, even in these categories, abnormal returns are consistently higher just one year before takeoff. Certainly, across all four categories we cannot conclude that the stock market anticipates takeoff two years before this event.

As we move earlier in the categories' histories, there is even less information to suggest that the stock market is anticipating takeoff three or more years before the event. In years $t-3$ and $t-4$, only five of 18 abnormal returns are significantly positive. Overall, these results provide support for H1 and H2. The stock market does appear to anticipate the sales takeoff one year prior to the event based on consistently and unusually high abnormal returns during that year. However, the stock market does not appear to be a reliable predictor of the takeoff more than one year in advance. However, even a prediction one year ahead provides tremendous information to managers who must revamp much of their strategy and tactics at takeoff. Even if all firms share this information, they can all benefit by operating more efficiently.

Now we consider whether the stock market fully incorporates the importance of the sales takeoff event in the year prior to takeoff or whether there are also abnormal returns in the year of takeoff itself. Based

Table 2 Decision Rules for Detecting Takeoff Using Three Measures of Abnormal Returns in Each Year Prior to Takeoff

Decision rule	Number of measures positive and significant	Number of measures positive, but not significant	Number of measures negative but not significant	Correct prediction: Takeoff	Correct prediction: No takeoff	False positive predictions	False negative predictions
1	3	0	0	2	16	0	2
2	2	1	0	4	15	1	0
3	1	2	0	4	14	2	0
4	2	0	1	4	13	3	0
5	1	1	1	4	11	5	0
6	1	0	2	4	11	5	0

on the results in Table 1, it appears that the stock market has incorporated the benefits of the takeoff in the year prior to takeoff in three of the four categories. The only category with significantly positive abnormal returns in the year of takeoff is B&W TVs. The most likely explanation for this result is that the takeoff in B&W TVs was much larger than the average takeoff. The three other categories show sales doubling or tripling during takeoff, which is consistent with the median growth rate at takeoff of 207% (Golder and Tellis 2004). Because B&W TV sales during takeoff grew by 444%, the stock market reacted favorably to this category's above average growth at takeoff. In contrast, the other categories saw insignificant, or possibly even negative, abnormal returns during the year of takeoff.

Overall, these results provide support for H3. The stock market generally seems to incorporate the beneficial impact of the takeoff in the preceding year, rather than in the takeoff year itself.

As a final analysis of these data, we also examined the distribution of monthly abnormal returns in year $t-1$ to gain further insight into the timing of the stock market's anticipatory reaction to takeoff. Our statistical tests revealed no difference between the stock market's reactions in the first half and the second half of $t-1$. We would have expected to see somewhat higher abnormal returns in the second half of $t-1$ because the takeoff event is closer, but the stock market seems to anticipate takeoff equally well in the first half of $t-1$.

4.1.1. Robustness Checks for Abnormal Returns at $t-1$. Consistently, positive abnormal returns in the year prior to takeoff seem to signal the takeoff. However, if returns are also positive in earlier years, this measure is not a *reliable* indicator of takeoff. To investigate potentially false positive signals from positive, abnormal returns, as well as false negative signals from these measures, we consider multiple decision rules and present results on both types of false indicators in Table 2. As part of our decision rules, we allow for the possibility that positive returns without conventional levels of statistical significance might still have predictive ability.[11] We have an unequal number of years before takeoff across our categories because we require the entry of a publicly traded firm. Also, we only consider the post-World War II period for black and white TV. Thus, we have 2 years before takeoff for black and white TV, 7 years for color TV, 5 years for microwave ovens, and 6 years for desktop PCs. Overall, we have 20 years to evaluate whether abnormal returns provide correct, false positive, or false negative predictions of takeoff.

Results in Table 2 indicate that decision rule 2 provides the best indicator of takeoff. Investigation of additional categories will likely lead to recalibration of these decision rules. However, at least within our data, there are more correct predictions of takeoff than false positives and correct predictions of no takeoff than false negatives for the first four decision rules. Overall, it seems that when all three measures are positive, with one or two being statistically significant, takeoff is more likely to occur than not.

We now consider whether abnormal returns in the year prior to takeoff vary based on firm size and market share. We divide our sample of firms based on a median split using assets as our measure of firm size. Because large firms are more likely to have broader product lines, positive returns associated with impending takeoff may be muted by a firm's other products. Therefore, we expect smaller, but still positive, abnormal returns for large firms. Results in Table 3 show that large firms do tend to have lower returns than small firms across all 12 measures. For market share, we do not have any prior belief because it is not clear how the takeoff event will lead to share increases or decreases for high-share versus low-share firms. Here the results are mixed across categories, but surprisingly, somewhat consistent within categories. Large-share firms tend to do substantially better in desktops PCs and somewhat better in color TVs. However, small-share firms tend to do better in microwave ovens and on two of three measures in B&W TVs.

[11] See Lodish et al. (1995) for an example of results based on lower levels of statistical significance (i.e., higher p values).

Table 3 Average Abnormal Returns by Firm Type

		Returns in the year prior to takeoff ($t-1$)[b]				
Product category	Method[a]	Full sample	Small firms	Large firms	Large market share	Small market share
Black and white TVs	BHAR[c]	16.9*	29.5	4.3	13.7	20.1
	IRATS	17.7***	27.8***	7.5	13.2*	21.1**
	FFM[d]	11	22.6***	−0.4	13.3	8.9
Color TVs	BHAR	13	45.8*	−19.9***	44.2*	−18.2***
	IRATS	32.8****	55.6****	10.1	54****	11.6
	FFM	15.6**	16.8	14.5	17.8	13.6
Microwave ovens	BHAR	27.1****	54.6****	5.1	12.1***	39.1****
	IRATS	42.5****	63.5****	25.6****	32.3****	50.6****
	FFM	32.4**	62.6***	8.3	7.3	52.6***
Desktop PCs	BHAR	122****	199****	59.6***	267****	25.6
	IRATS	102****	144.5***	74.2****	168****	57.8****
	FFM	35.2**	83.2***	16.3	76.6***	7.7

[a]BHAR = buy and hold abnormal return; IRATS = Ibbotson's return across time and securities; FFM = Fama-French momentum four-factor model.
[b]The symbols *, **, ***, **** denote statistical significance at the 10%, 5%, 1%, and 0.1% levels, respectively.
[c]BHAR significance tests are based on bootstrapped test statistics.
[d]FFM significance tests are based on heteroscedasticity-consistent test statistics.

Based on our finding that a positive agreement of the three measures of abnormal stock returns may forecast takeoff, we also evaluate a hazard model that reflects our takeoff detection approach more formally. A proportional hazard regression of "years until takeoff" on category dummy variables, and a current and once lagged indicator variable that takes on the value of 1 if the three measures are all positive and zero otherwise, is significant overall ($N = 15$, $p < 0.05$). The lagged indicator variable is also significant ($p < 0.05$) and large in magnitude. More specifically, categories with positive BHAR, IRATS, and FFM abnormal returns in a given year have a 12 times higher hazard of takeoff the following year than categories without these positive abnormal returns. Therefore, we believe that these measures provide an important forecasting signal of takeoff.

Next, we investigate whether stock returns at takeoff can predict which firms will survive and which firms will fail.

4.2. Stock Returns at Takeoff as a Long-Term Predictor of Firm Survival

Because we find that stock prices can predict the category-level takeoff event, we now evaluate whether stock prices at takeoff can also predict firm survival and failure within a category. If our results show that stock prices cannot predict which firms will fail in a given category, this evidence will support those who believe that the stock market is not prescient, at least over longer periods. However, it may also encourage researchers to uncover more information about long-term predictors of market exit. Individuals who uncover such predictors could then benefit by trading stocks based on that information. In contrast, if our results show that stock prices can predict which firms will fail, then managers may have a critically important piece of information to use in deciding whether to exit such promising growth markets. We focus on stock prices at takeoff and the year after takeoff because we believe that investors will be especially focused on firms' long-term prospects at this high-potential time.

We operationally define market exit as a firm stopping all production and sale in a product category under its brand name or on an original equipment manufacturer basis. Exiting firms in our data set either ceased to exist or continued operations in other product categories. We do not consider as exits firms that were acquired, because acquisition may also be a sign of success. We treat mergers as right censoring in our data.

To address the long-term survival of firms, we use a hazard model to evaluate those firms in our sample present in the market at takeoff. Our primary interest is to determine whether stock returns at takeoff, or soon after, can help to predict the survival of firms. Therefore, we include abnormal returns in year t and year $t+1$. To capture the possibility that either the presence or magnitude of negative abnormal returns might be informative, we evaluate three models that reflect different operationalizations of these effects. We focus on negative returns because of our interest in modeling the durations until firms exit. The first model includes an interaction of returns in years t and $t+1$ multiplied by an indicator variable that takes on the value of 1 if the abnormal returns were both positive, −1 if the returns were both negative (to preserve the sign), and 0 otherwise ($R_t * R_{t+1} * I$). This operationalization assumes that the magnitude of returns is informative provided that returns are positive or negative two years in a row. The second model includes an indicator variable taking on the value of 1 if abnormal returns were negative in both those years, and zero otherwise. This operationalization essentially assumes that the duration of the negative signal is informative, but not its magnitude. The third model includes a sum of returns multiplied by an indicator that takes on the value of 1 if the returns in years t and $t+1$ were both negative, and 0 otherwise ($[R_t + R_{t+1}] * I$). This operationalization assumes that the magnitude of returns is informative provided that returns are negative two years in a row. As control variables, we include category indicator variables, firm assets as of January 1 of the takeoff year, and the number of years each firm entered the market prior to takeoff (i.e., one year before takeoff $= -1$, two years before takeoff $= -2$, etc.).

We use BHAR abnormal stock returns in this analysis for two reasons. First, firms evaluate their performance over a calendar year and relative to the market, which is exactly captured by BHAR, but not by IRATS or calendar-time portfolio methods. Second, unlike IRATS or calendar-time portfolios, BHAR produces firm-level abnormal returns. We obtained data on firm assets from COMPUSTAT.

Before presenting our model results, we report descriptive statistics on firm exit in Table 4. We have data on 40 firms across the four categories that were present in the takeoff year.[12] Thirty of these firms eventually exited the market. Exits were recorded through 2000 for all categories except black and white TV, where we recorded exits through 1978, which was when the category started receiving too little media coverage. The mean posttakeoff survival duration for all firms is 16.2 years. For firms with positive abnormal returns both in year t and $t+1$, the mean survival duration is directionally larger. The bigger changes for survival duration appear to be among firms with negative abnormal returns in years t and $t+1$. In particular, firms with negative abnormal returns in both of those years have significantly lower survival duration than firms that did not have negative abnormal returns two years in a row ($p < 0.05$). These results provide some preliminary evidence that the stock market may be able to predict the relative success of firms at the time of takeoff. Now, we turn to our hazard model results on survival duration.

We use our data on entries and exits to model the survival duration of all firms present in these four product categories at the time of takeoff. We present the results of our hazard model in Table 5. We find that the hazard of exit is significantly lower

[12] Two firms are not part of our modelling results because Compustat did not cover them, so we do not know their assets.

Table 4 **Survival Duration (Years) in a Category Among Public Firms That Eventually Exited**

	N	Median	Mean	S.D.
Firms with positive abnormal return in year t	15	23	18.3	8.4
Firms with positive abnormal return in year $t+1$	19	14	18	9.4
Firms with positive abnormal returns in both years t and $t+1$	9	24	19.3	8.1
Firms with negative abnormal return in year t	15	13	14.1	10
Firms with negative abnormal return in year $t+1$	11	10	13.2	8.8
Firms with negative abnormal returns in both years t and $t+1$	5	6	8.8	6.2
All firms that exited the market	30	13.5	16.2	9.3

for microwave ovens. This result may be due to the smaller number of firms in this category, which also tend to be larger and stronger. In contrast, the larger number of firms in other categories includes a combination of stronger and weaker firms.

We also find that the survival duration is affected by a firm's entry time relative to takeoff. A longer period between entry and takeoff increases the negative value of this variable, which, when multiplied by the positive parameter, decreases the hazard of exit. On average, these 38 firms entered 2.9 years prior to takeoff, yet the time from commercialization of the category to takeoff is much longer (14 years). Therefore, significance on this variable does not allow us to make any conclusions about the advantage or disadvantage of pioneering these markets. However, it does indicate the benefit of being established for longer in these markets prior to takeoff.

Most important, the final significant result in our hazard model is for the variable indicating negative abnormal returns in both years t and $t+1$ (Model 2). This parameter is highly significant. Moreover, its effect size is large. For firms with negative abnormal returns in these two years, the hazard of exit is 9.5 times higher than for other firms. Although we were surprised to find that the percent of negative abnormal returns was not significant (Models 1 and 3), the significant result with Model 2's indicator variables is still very promising. In contrast with H4, our finding suggests that two consecutive years of negative abnormal returns at takeoff are a good predictor of whether a firm will fail many years in the future.

5. Conclusion

We find that stock prices have some ability to predict the sales takeoff and long-term survival of firms. However, we caution readers not to generalize these results beyond the specific context of this study. Our hope is that these initial, speculative findings on stock

Table 5 Results of Hazard Regression of Individual Firm Survival Duration from Category Sales Takeoff Until Exit[a, b]

	Model 1			Model 2**			Model 3		
Variable	Parameter estimate	Standard error	Hazard ratio	Parameter estimate	Standard error	Hazard ratio	Parameter estimate	Standard error	Hazard ratio
B&W TVs	−0.59	0.87	0.56	−0.40	0.93	0.67	−0.62	0.89	0.54
Color TVs	−0.04	0.6	0.96	−0.10	0.64	0.9	−0.14	0.62	0.87
Microwave ovens	−1.3*	0.79	0.27	−1.98**	0.91	0.14	−1.4*	0.81	0.25
Entry relative to takeoff	0.16**	0.07	1.18	0.2**	0.08	1.22	0.18**	0.08	1.2
Assets	−0.02	0.04	0.98	−0.03	0.04	0.97	−0.03	0.04	0.97
Return (t)	−1.21	0.94	0.3	−0.42	0.59	0.66	−0.41	0.61	0.66
Return ($t+1$)	−1.01	0.87	0.36	0.6	0.83	1.83	0.01	0.81	1.09
Return(t) $*$ Return($t+1$) $*\, I$	1.7	1.58	5.47	—	—	—	—	—	—
Negative return (t and $t+1$)	—	—	—	2.25**	0.84	9.47	—	—	—
[Return(t) + Return($t+1$)] $*\, I$	—	—	—	—	—	—	−1.55	1.21	0.21

[a] $N = 38$.
[b] The symbols * and ** denote statistical significance at the 10% and 5% levels, respectively.

prices' predictive ability will prompt further investigation of this important topic across a broader range of events, decisions, and contexts.

In addition to providing initial evidence for the predictive ability of stock prices, our study contributes to the growing literature on sales takeoff by moving beyond the category-level phenomenon to examine potential firm-level effects. Now, we summarize our key findings, discuss their implications for managers, and suggest directions for future research. Based on 71 firms in four new product categories, we find that:

- Abnormal returns in a new product category are uniformly and significantly positive in the year prior to takeoff.
- Abnormal returns in a new product category two or more years before takeoff do not show any consistent and positive pattern.
- Negative abnormal returns for a firm at takeoff and one year after takeoff are associated with the survival duration of the firm. In particular, when a firm has negative abnormal returns in these two years, its hazard rate of market exit is 9.5 times higher than for other firms without these negative abnormal returns.

Our finding that abnormal stock returns precede the takeoff, and do not occur simultaneously, is in line with the fundamental view of stock returns as a forward-looking measure of firm performance. Stock prices adjust to reflect new information pertaining to firms' future cash flows. Therefore, the stock market's observed anticipatory reaction to sales takeoff most likely reflects (1) the arrival of such information in the year preceding takeoff and (2) the correct processing of this information by stock market participants.

5.1. Managerial Implications

Our study suggests four potential implications for managers, all of which might help firms during the highly uncertain period around the sales takeoff. First, managers should pay attention to the stock prices of all firms in their product category.[13] Along with other predictors, the return on this basket of stocks may provide some indication of when sales will takeoff. However, there is also some possibility of a false positive indication of takeoff using abnormal returns. In our sample, using the two most stringent decision rules, significantly positive abnormal returns signaled takeoff correctly more often than not. Although these predictions can only be made one year in advance of takeoff, current one-year ahead predictions have an average error of 1.2 years (Golder and Tellis 1997). Using strong, positive, abnormal returns in conjunction with other methods of predicting takeoff could enable managers to revise their production capacity, distribution coverage, and pricing strategy in anticipation of the takeoff rather than in response to it.

A second implication of our results is that managers may be able to use stock prices as one guide in deciding whether to exit a market. The firms in our sample with negative abnormal returns in the year of takeoff and the year following takeoff persisted in the face of this negative feedback for almost nine years, on average. This escalation of commitment in the face of poor performance and eventual exit could have been avoided. If the firm had withdrawn from the market soon after takeoff, it could have devoted its resources to other potentially more promising opportunities. Moreover, such a firm may have been able to sell its line of business to another firm eager to enter a fast-growing market. Alternatively, negative returns could signal that a change in strategy or a new management team is required to avoid exit.

[13] It is possible that managers already know about the future prospects of their firms and other firms as well as impending takeoff and would not derive additional value from monitoring stock prices. However, previous research indicates that managers know little about the takeoff (Golder and Tellis 1997).

A third implication is that managers can use other firms' stock prices at takeoff as an indicator of the relative strength of their competitors. This information can help firms determine which market segments to attack and which to avoid. As a result, a firm can increase its own return on investment and establish a stronger overall market presence.

A fourth implication is that potential entrants can use stock prices to try to time their entry in the year prior to takeoff. Such an approach could minimize the firm's losses in the pretakeoff period when demand is modest. Also, it could help to ensure that the firm does not wait to enter until after takeoff, when greater investments are likely to be required.

5.2. Directions for Future Research

Our study has several limitations that provide opportunities for future research. First, we investigate only 71 public firms in four consumer durables in the U.S. market. Future studies should examine whether stock prices can predict sales takeoff in a broader set of products and countries. Second, we only consider one market event (takeoff) and one type of strategic decision (firm exit). Many other events and decisions seem worthwhile to investigate, including sales slowdown, entry and exit patterns over the product life cycle as a function of category-level stock returns, and long-term survival predictions as a function of firm-level stock returns at the time of entry. Third, researchers should investigate whether the stock market's ability to predict takeoff has improved over time. Our results in Table 1 are consistent with this conjecture. The highest and most significant positive abnormal returns occur in the most recent category, desktop PCs. However, we do not see evidence that the magnitude of abnormal returns can predict the magnitude of sales growth at takeoff. Perhaps a larger set of categories will reveal this relationship, or perhaps the stock market cannot do any better than to predict takeoff with an average magnitude of sales increase. Fourth, researchers should investigate whether using a single method to derive abnormal returns might perform as well or better than using three methods (BHAR, IRATS, FFM) together. Fifth, researchers should investigate changes in market structure at takeoff. Our results indicate that high market share firms tend to benefit more in some categories, whereas low market share firms benefit more in other categories. It will be important to try to identify whether there are any generalizable characteristics of product categories that help to explain these results. Finally, researchers should conduct more fine-grained studies to investigate how managers can make better decisions by incorporating the same information or the same decision-making process as those people collectively determining stock prices. It is possible that markets simply reflect all information, whereas managers have access to only a subset of information. Also, it may be that the market's overall evaluation of this information is less biased than individual managers' evaluations. These better evaluations may come from people who have experienced takeoffs before, whereas many current managers have not. All of these investigations will help us understand whether stock prices can actually predict market events.

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