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Financing Strategies of the R&D Firm

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This paper investigates the financing strategies of the R&D firm. Our hypotheses are based on Cho's (1992) game theory model where the firm develops a product but needs additional financing to bring it to market. The model generates a particularly rich set of hypotheses: 1) to fund the completion of its project and bring its product to market, the firm initiates negotiations with an established firm; 2) the majority of the acquisitions will be partial cash acquisitions through private secondary offerings. Confirming the model's hypotheses, we find that the majority of the acquisitions are partial cash acquisitions by significantly larger established R&D firms.

Introduction

This paper examines how research and development (R&D) rich but cash poor firms finance continued growth. We find that most acquisitions are seller-initiated partial cash acquisitions of the seller through a private secondary offering. Cho's (1992) game theory model is the foundation for our hypotheses. The empirical results confirm our hypotheses: the effect upon the combined wealth of acquirer and seller will be positive; the acquiring firm is an established firm and experiences positive abnormal returns; cash is the primary means of payment; and if the acquisition is terminated, who terminates the acquisition has a significant influence upon the returns of the acquirer and seller.

In Cho's (1992) model, the firm embarks upon a major project with only partial funding in hand; thus, it must raise additional capital upon reaching a critical point in its research. The market has a good estimate of the firm's assets in place, but does not have a good estimate of the value of the firm's option to develop the new product. Furthermore, because of competitive factors, the firm has a limited period in which to exercise this option and to bring its product to market.

To raise capital, the firm must either attempt a public secondary equity offering, a private secondary equity offering, or return to its original investors. Because of adverse selection problems, a public secondary equity offering may not be possible,

particularly if the firm is of the type whose shares would otherwise be offered under a best efforts form of investment banking contract. Myers and Majluf (1984) show that the market interprets a public secondary equity offering as a negative signal, therefore making a successful public secondary best efforts offering highly unlikely. The original investors or founders are likely to have used all of their capital to fund the original research. Thus, a private secondary offering of the firm to an established company may be the best means of raising the needed capital.

Grinblatt and Titman (1998, p. 677) provide a motivating example of the type of acquisition we address in this study. In their example, a selling firm with significant information asymmetries is reluctant to undertake a public secondary equity offering and seeks a strategic acquisition by a cash rich firm in order to finance a major project. Because we are focusing upon firms with high R&D expenditures, Grinblatt and Titman's reasoning is taken one step further. We posit that the selling firm seeks an acquiring firm that is both cash rich and that is capable of evaluating the state of the selling firm's technology and the true value of the selling firm's real option. It has been established in a number of studies, including Akerlof (1970), that the cost of information asymmetry is always borne by the seller. Therefore, it is in the best interest of the seller to seek the acquiring firm best capable of evaluating the technology in question. By doing so, the seller can minimize the discount at which it must sell its shares. Completing the scenario, the selling firm exists in a vigorously competitive market in which its technology is subject to rapid obsolescence; thus, the selling firm has what amounts to an expiring real option, which it must sell before its expiration date.

Hypotheses

Our hypotheses (Table 1) are based on Cho's (1992) model, which has been applied to best efforts offerings with risk of failure, and applies the sequential equilibrium concept with the intuitive refinement of Cho and Kreps (1987).

Table 1—Hypotheses

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1. The majority of acquisitions will be partial acquisitions
 2. The acquiring firm will be an established technology firm
 3. Means of payment for these partial acquisitions will be cash
 4. There is a combined positive shareholder wealth effect when the selling firm and acquiring firm are combined
 5. The acquiring firm experiences significant and positive abnormal returns due to its bargain purchase of the seller
 6. Termination of negotiations by the selling firm operates as a signal that the offer price was insufficient and that the seller anticipates a better offer elsewhere. In this case, the price of the seller's shares should remain above the price that existed before the beginning of the negotiations
 7. Termination of the acquisition by the acquiring firm provides a signal that the shares of the seller are overvalued. In this case, prices should fall below the price that existed before the beginning of the negotiation
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In developing our hypotheses, the following assumptions are made. The R&D firm embarks upon a major research project with only partial funding in hand, as it would be too risky for investment bankers or venture capitalists to fund the full project from the outset or the founders have only enough capital to fund their research. Thus, it must raise additional capital upon reaching a critical point in its research. The market has a good estimate of the R&D firm's assets in place, but does not have a good estimate of the value of the firm's option to develop and market the new technology. Furthermore, because of competitive factors, the firm has a limited period in which to exercise this option and to bring this technology to market.

To raise the needed capital, the R&D firm must either attempt a public secondary equity offering, a partial sale of the firm through a private secondary offering to an established technology company, or return to its original investors. Because of adverse selection problems (Myers and Majluf, 1984) a public secondary equity offering may not be possible, particularly if the R&D firm is of the type whose shares would otherwise be offered under a best efforts form of investment banking contract. Returning to the founders is possible, but unlikely, because they have used all of their resources to fund the original research and venture capitalists are not likely to risk further capital because the technology is so advanced that only a handful of professionals is qualified to evaluate the quality of the research at that point. Thus, for reasons of information asymmetry, the best alternative is to submit the partial results of their research to the scrutiny of a cash-rich technology firm and sell a portion of the firm through a private secondary offering. A partial acquisition by an established technology company may be the best and only means of raising capital.

Additionally, we assume the selling R&D firm has inside information regarding the value of its option. We assume that all players are risk neutral, but that there is some probability that the acquiring R&D firm will observe the value of the option prior to the end of negotiations. If the acquiring firm observes the value of the option and sees that the seller is overpriced, it ends the negotiations; the option expires worthless.

The model provides the following hypotheses. First, in order to minimize the adverse selection problem, the selling R&D firm will negotiate with a single acquirer. If the terms of the proposed acquisition are unfavorable, the seller may end negotiations and seek another potential acquirer. The seller will only deal with one potential acquirer at a time. Second, a withdrawal from negotiations on the part of the acquirer would represent a strong negative signal to other potential acquirers; thus, it would be virtually impossible for the seller to arrange another acquisition before the expiration of its real option.

The optimal strategy for both parties is for the selling firm to continue as a separately traded firm. Allowing the target firm to continue to sell its shares in the public market allows optimal contracting between the acquiring firm and the selling firm, because it allows for incentive-based compensation for the employees of the target.

With shares that trade independently in the public markets, the target can retain key employees and the acquiring firm can minimize overall compensation costs. Hence, our third hypothesis is that the majority of these acquisitions will be partial acquisitions rather than total acquisitions. Furthermore, we foresee that because firms are looking for cash so they can bring their R&D work to fruition, the means of payment for these partial acquisitions will be cash.

As in Bradley, Desai, and Kim (1988), we expect there will be a combined positive shareholder wealth effect when the selling firm and acquiring firm are combined. For the seller, this positive response results from the fact that the seller is assured of funding for the completion of its R&D project. Some underpricing is involved, but the seller is better off selling a portion of its shares at a discounted price than it would have been if it had lost the opportunity to complete its R&D project. Contrary to Jarrell and Poulsen (1989), we forecast significant and positive abnormal returns to the acquiring firm. The gains are the result of the acquirer's bargain purchase of an interest in the seller. When combined, the selling and acquiring firms show a positive shareholder wealth effect due to the fact that a project with a positive net present value (NPV) will be completed and the wealth gain from the positive NPV R&D project will be shared between the selling and the acquiring firm.

Franks, Harris, and Mayer (1987) and Travlos (1987) show that the means of payment will have a significant effect upon the abnormal returns of the acquiring firm shares. Eckbo, Giammarino, and Heinkel (1990) find that payment by means of shares operates as a signal that there is more uncertainty concerning the quality of the selling firm's technology. Our model predicts, because the seller must complete a promising R&D project, that the seller will only accept cash as the means of payment. Furthermore, we predict a stock for stock transaction signals that the motivation behind the acquisition is something other than the need for cash to complete a favorable R&D project. Hence, we predict positive returns for both the acquiring and acquired firm, given that we anticipate that the means of payment will be cash.

Finally, our model provides us with a specific hypothesis concerning the termination of the negotiations. In Bradley (1980), Dodd (1980), and Bradley, Desai, and Kim (1983), the price of the seller upon the failure of the negotiations stayed higher than existed prior to the beginning of negotiations. They argue that if no information is conveyed by the negotiations, the price should return to its original level after a failed acquisition. In our model, termination of negotiations by the selling firm operates as a signal that the offer price is insufficient and the seller anticipates a better offer elsewhere. In this case, the price of the seller's shares should remain above the price that existed before the beginning of the negotiations.

On the other hand, termination by the acquiring firm provides a signal that the shares of the seller are overvalued. In this case, prices should fall below the price that existed before the beginning of the negotiations. Thus, the termination of negotia-

tions by the acquiring firm should have a catastrophic effect upon the market price of the seller's shares.

Data and Methodology

A list of 953 acquisitions was obtained from Securities Data Corporation. Securities Data Corporation defines an R&D acquisition as one when either the seller or acquirer is from specific SIC codes that are R&D intensive. The data set used in the study spans 1996 through 2000 and consists of 391 matched pairs of R&D acquirers and sellers that have return data available on the Center for Research of Security Prices' (CRSP) tapes for both participants and have financial data available on COMPUSTAT. The history of each contest was found by examining the *Wall Street Journal Index*, the Dow Jones News Wire, or the Lexis/Nexis Business News Service.

The sellers are significantly smaller than acquirers and primarily trade over the counter (Table 2). The set of acquirers (391) consists of 226 exchange-listed firms and 165 over-the-counter traded firms. The market value of equity of the R&D acquirers ranges from \$526 million to \$269.8 billion, with a median market value of \$5.8 billion. R&D acquirers on average spent 36.6 percent of revenue on R&D. The median R&D acquirer applied 10.8 percent of revenue into R&D.

Table 2—Sample Description of R&D Acquirers and Sellers for the 1996-2000 Period

	Acquirers	Sellers
Total	391	391
Exchange Listed	226	63
NASDAQ	165	328
Market Value of Equity:		
Range	\$526 million-\$269.8 billion	\$35 million-\$71.9 billion
Mean	\$26.7 billion	\$2.3 billion
Median	\$5.8 billion	\$141 million
Percent Acquired		
Mean		
Median		
Percent of Revenue Spent on R&D		
Mean	36.6%	1,308%
Median	10.8%	127%
Successful Acquirers	333	
Withdrawn or Defeated	58	
Partial Acquisitions	330	
Partial Cash Acquisition	310	
Friendly Acquisition	319	

In comparison, the set of R&D selling firms (391) comprises 63 exchange-listed firms and 328 firms that trade over the counter. The R&D sellers' market value of equity ranges from \$35 million to \$71.9 billion, with a median market value of \$141 million. They, on average, spent 1,308 percent of revenue on R&D. The median R&D seller invested 127 percent of revenue into R&D.

The event study methodology used to calculate the cumulative abnormal returns (CARs) from the CRSP daily return files is the standard event study methodology presented by Fama, Fisher, Jensen, and Roll (1969). For each security i , an abnormal return (AR) for each event day t is calculated using the single-index market model:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad (1)$$

where R_{it} is the rate of return on security i for event day t and R_{mt} is the rate of return on the CRSP value-weighted index on event day t . α_i and β_i are the ordinary least squares estimates of the intercept and slope of the market model regression, respectively. A value-weighted index is used because theoretically it most appropriately reflects total market performance (Roll, 1981). The estimation period for the market model regression relative to the event date, $t = 0$, is from $t = -210$ to $t = -11$. This period is chosen to estimate the market model to avoid contaminating the regression (Brown and Warner, 1985). The CARs are accumulated over three periods depending on the hypothesis being tested. First, from day $t = -5_i$ to event day $t = +5_i$, with $t = 0$ being the first date on which the acquisition was announced in the *Wall Street Journal*, the Dow Jones News Wire, or the Lexis/Nexis Business News Service. Next, for the entire contest period, from the announcement of the acquisition until the acquirer completes the acquisition or the acquisition is terminated, and from day $t = -5_i$ to event day $t = +5_i$, with $t = 0$ being the date the acquirer completes the acquisition or the termination of the acquisition.

We use Dennis and McConnell's (1986) methodology to obtain a measure of dollar returns. The examination of dollar returns is important due to the possible size differential between the acquirer and seller in the typical acquisition (Jensen and Ruback, 1983). Roll (1986) observes that if the acquirer is substantially larger than the acquired, then the price increase of the acquired would correspond to such a small change in price to the acquirer that the change in market value would be hidden in the bid/ask spread and in the noise of daily return volatility. We ascertain the dollar amounts of abnormal returns in terms of n day market-adjusted cumulative abnormal returns.

$$\$CAR = n\text{-day CAR} * \text{Price on day } (t - 6) * \text{number of shares} \quad (2)$$

where CAR is the cumulative abnormal gain and $t = -6$ is the day before the event window. \$CAR is the abnormal dollar gain during the announcement period.

Aggregate dollar synergies are computed by summing the selling and buying firms' dollar gains involved in successful acquisitions. We exclude the gains on seller's shares already held by the acquirer from the dollar synergy computation.

$$\$SYNERGY = \$BCAR + \$SCAR \times (1 - \text{HELD}) \quad (3)$$

\$BCAR and \$SCAR represent the abnormal dollar gains to the buying and selling firm's shares, respectively, during the announcement period. HELD is the proportion of seller's common stock held by the acquirer prior to the announcement.

Evidence

Strongly supporting our first hypothesis that a majority of the acquisitions will be partial acquisitions (Table 2), 330 of the 333 (99 percent) successful R&D acquirers made only a partial acquisition of the seller. Three hundred thirty-three R&D acquisitions were consummated, while 58 were not completed. Further supporting this hypothesis, we find that 83 percent of all acquisitions were partial acquisitions.

Table 3—Cumulative Abnormal Returns (CARs)

The CARs are accumulated over the various periods depending on the hypothesis being tested. Announcement is defined as from day $t = -5$, to event day $t = +5$, with $t = 0$ being the first date on which the acquisition is announced and from day $t = -5$, to event day $t = +5$, with $t = 0$ being the date the acquirer completes the acquisition or announces its termination of the acquisition in the *Wall Street Journal*, the Dow Jones News Wire, or the Lexis/Nexis Business News Service. Window is defined as the entire contest period, from the announcement of the acquisition until the acquirer completes the acquisition or announces its termination

	Acquirers	Sellers
Announcement:		
All (391)	1.62%**	17.61%***
Partial Acquisition (330)	1.53%**	11.70%***
Total Acquisition (61)	2.04%***	21.54%***
Cash (311)	0.93%	18.67%***
Stock (80)	2.81%***	16.58%***
Termination by Acquirer (29)	-1.61%**	-13.44%***
Termination by Seller (29)	-3.02%***	7.10%*
Window:		
All Completed (333)	1.40**	11.26%***
Partial Acquisition (290)	0.76	5.71%**
Total Acquisition (43)	1.58**	20.25%***
Cash (311)	0.99**	9.57%***
Stock (80)	0.81	12.54%***
Termination by Acquirer (29)	-0.34	-22.90%***
Termination by Seller (29)	-3.76***	23.78%***

*, **, ***denotes statistical significance at the 10 percent, 5 percent and 1 percent levels, respectively

We find that in 842 of 953 acquisitions (86 percent) both the seller and the buyer are R&D firms, thus confirming our hypothesis that the majority of the acquisitions would be between technology firms.

Supporting the hypothesis that most of the partial acquisitions would be cash acquisitions, we find the method of payment is cash for 310 of the 330 partial acquisitions. Furthermore, 319 of 333 (96 percent) completed acquisitions are friendly, leading us to conclude that the seller, rather than the acquirer, initiates most acquisitions.

Next, affirming the hypothesis of positive synergies, we find the average combined wealth effect of the 391 matched pairs is a positive \$524.33 million for all acquisitions. Supporting the hypothesis that the acquiring firm's shareholders will experience significant positive abnormal returns, all acquirers on average earned a significant 1.62 percent abnormal return. Those that made only a partial acquisition experienced a significant 1.53 percent abnormal return. Sellers on average earned a significant 17.61 percent upon the announcement of their pending acquisition. Furthermore, those firms who sold a minority stake in the firm experienced a significant increase in value of 11.70 percent upon the announcement of the proposed sale.

Franks, Harris, and Mayer (1989), Travlos (1987), and Eckbo, Giammarino, and Heinkel (1990), find that the means of payment will have a significant effect upon abnormal returns; we observe that those acquirers that paid cash earned a positive but insignificant 0.93 percent and those acquirers that paid for the acquisition in stock earned a significant 2.81 percent. Shareholders of sellers that were bought with cash earned a significant abnormal return of 18.67 percent, whereas shareholders of sellers that were paid for through a stock swap earned a significantly less 16.58 percent.

Last, as predicted, the termination of negotiations by the acquiring firm does have a catastrophic effect upon the market price of the seller's shares. Upon the announcement that the acquirer has terminated the negotiations, the average seller experiences a significant loss of 13.44 percent, and the average acquirer returns all and then some of the increase in shareholder wealth that occurred when the acquirer announced its intended acquisition, a significant loss of 1.61 percent. When the entire negotiation period is considered, sellers suffer a significant loss of 22.90 percent and acquirers lose an insignificant 0.34 percent.

Alternatively, when the seller terminates the sale it earns a significant abnormal increase in value of 23.78 percent over the contest period, whereas the average acquirer loses a significant 3.76 percent. This evidence suggests these findings are due to the replacement of one acquirer with another.

Conclusion

We examine the strategies of R&D firms that have developed a prototype technology but need financing in order to bring their ideas to market. It is assumed that the market has a good estimate of the R&D firm's assets in place, but does not have a good estimate of the value of the firm's option to develop the new technology. Furthermore, it is assumed because of competitive factors that the R&D firm has a limited period of time in which to exercise this option and to bring this technology to market. The model leads to six hypotheses: 1) the majority of these acquisitions will be partial acquisitions; 2) the acquiring firm will be an established technology company; 3) the combined wealth effect of the acquirer and acquired will be positive; 4) the acquiring firm will experience positive abnormal returns; 5) the means of payment will be cash; and 6) who terminates the acquisition will have a

dramatic impact upon the returns of the acquirer and the seller. The empirical results validate the hypotheses. It is discovered that most acquirers only make a partial acquisition of the seller, acquiring firms are established technology companies, and the seller initiates the acquisition. The evidence supports the hypothesis that the combined wealth effect of acquirer and seller will be positive and the hypothesis that the acquiring firm will experience positive abnormal returns. Furthermore, we find that the means of payment is generally cash. Who terminates the acquisition has a significant influence upon the returns of the acquirer and seller.

We conclude from the study's results that these acquisitions are beneficial to the stockholders of both parties and to society as a whole. The stockholders of both benefit from the increase in their wealth. Society benefits from the acquisitions because they allow for the furtherance of R&D activity that might otherwise be abandoned due to a lack of capital.

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