
The valuation effects of research and development spending announcements by companies listed on the Johannesburg Stock Exchange

1. INTRODUCTION

As we move into the second millennium, companies continue to spend ever more on research and development (R&D). A justification for this trend is that historically, investment in R&D has yielded at least 30% annual return to society, compared with 8% to 10% return on investment in physical capital such as new machines (Mandel, 1998:78). Innovation drives the economy and will continue to do so in the future. However, there is also evidence that the real rate of growth in R&D expenditures has declined in the last decade. The primary emphasis in corporate R&D today is on tying the research more closely to corporate strategy and on shortening the time between the expenditure on R&D and the anticipated benefits to the firm. This has meant, among other things, cutbacks in basic research along with greater collaboration with universities, government research institutions, and other companies operating in the industry concerned (Pinches, Narayanan and Kelm, 1996).

There appears to be widespread concern that short-termism is rampant within the developed economies (Woolridge and Snow, 1990). One claimed manifestation of such short-termism is the failure to invest sufficiently in R&D and, as a consequence, a failure to secure the long-term industrial future of both the individual companies within the South African economy and the South African economy itself. One reason for such under-investment, it is argued, is the failure of the South African capital market to adequately value expenditures in R&D. Inadequate capitalisation of R&D expenditures also arises because the market is fixated on accounting earnings and also that the generally accepted accounting practice prescribed by Accounting Statement AC 122 in South Africa requires that R&D expenditures be expensed rather than capitalized in the measurement of earnings (Opperman and Booyens, 1998). Therefore, it can be argued that as R&D expenditures increase there would be a corresponding decline in share prices.

Head: Finance Department, Graduate School of Business, University of Durban-Westville, Private Bag X54001, Durban 4000, Republic of South Africa. Visiting Professor, University of Luton. The financial assistance of the Centre for Science Development towards this research is hereby acknowledged. Opinions expressed in this paper and conclusions arrived at, are those of the author and are not necessarily to be attributed to the Centre for Science Development.
Email: nbhana@luton.co.za

If R&D expenditures are persistently incurred and are thought to generate benefits not solely in the period of the expenditure, then they can be thought of, presumably, to possess, on average, at least a net present value of zero, if not greater. Thus, there is an argument for treating R&D expenditures as intangible assets by capitalizing them and amortising them over some suitable period. This is no new argument. The argument has serious implications if the South African capital market is, indeed, fixated on accounting earnings. Under such circumstances, accounting becomes implicated in a possible reduction in R & D expenditures which are necessary to ensure the future well-being of the South African economy.

An understanding of how R&D expenditures affect the market valuations of companies incurring such expenditures would be useful. Any understanding gained is useful not only from the point of view of assessing how the South African capital market values R&D expenditures, but also from the point of view of assessing the impact of the accounting treatment of R&D expenditures. If the market appears to recognise R&D expenditures in a "reasonable" fashion, despite their accounting treatment, this would suggest that the accounting treatment does little harm, at least in terms of corporate valuation. Knowledge in this area can, indeed cast light on an accounting policy issue.

This study replicates prior research in overseas countries related to the market response to R & D expenditure announcements. The purpose of this paper is to observe the South African experience on the market valuation of R & D expenditures. Our first step is to explore the share price response to R&D spending announcements by means of "an event" study. This is followed by developing an exploratory cross-sectional valuation model for companies listed on the JSE which engage in R&D activities that can help answer the question: are R&D expenditures valued efficiently by the South African capital market and, if so, to what extent?

2. PREVIOUS RESEARCH

Although a strong systematic relationship between R&D and growth of profitability and productivity has been uncovered in numerous studies, at the industry as well as the firm level (Griliches, 1986), the effect of R&D on ordinary share returns has not generated much attention. Cockburn and Griliches (1988), using the Tobin Q framework, examined the impact of R&D on the firm's value. They postulated that the market's

relative valuation of the firm is a function of the firm's tangible and intangible capital stocks, the latter being dependent on existing stocks of R&D and patents. Their results indicate that the market's valuation of the firm's R&D investment is substantial. However, because their sample is composed of annual observations (share prices at the end of the year), it may be difficult to attribute their findings to "rational share market behaviour", with the "firm's stock price equal to the discounted value of the net income which will be derived from its assets" (Cockburn and Griliches, 1988:419). In an efficient market, a firm's investments should have incremental effects on its valuation only to the extent that they are unexpected. The appropriate time period for analysing the impact of the firm's unexpected investments is not the year-end, unless that period coincides with firm's announced or actual expenditure outlays.

McConnell and Muscarella (1985) use an event study approach, which is more consistent with rational capital market behaviour in that it focuses on the stock market's reaction at the time firms actually announce their R&D spending plans. In contrast to Cockburn and Griliches (1988), they report an insignificant market response to corporate R&D expenditures. However, it is difficult to draw strong conclusions from the McConnell and Muscarella study for three reasons. First, their sample of R&D announcements is extremely small (6 observations). Second, using the standard Miller and Modigliani (1961) framework, they assume symmetry of information, which implies that an R&D announcement effect is simply resolution of uncertainty about investment opportunities. Because the market, by assumption, knows everything that management knows, R&D announcements should elicit no share price reaction except in rare cases in which a resolution of uncertainty happens to coincide with a management announcement. In a world where resolution of uncertainty occurs frequently if information is really symmetric, there should be no significant announcement effects. Finally, the McConnell-Muscarella study does not account for market structure effects; that is, the R&D announcement effect may be influenced by the nature of the firm's market concentration as implied by the Schumpeterian hypothesis, which holds that the economic impact of R&D may be greater when the firm operates in an industry surrounded by higher concentration (Schumpeter, 1950).

A number of cross-sectional regression valuation analyses have been performed in the United States. For example, Hirschey (1982) and Hirschey and Weygandt (1985) regressed deflated market value on the contemporaneous deflated values of annual profits, annual research and development expenditures, and annual advertising expenditures, together with a number of other control variables such as industry concentration, growth and risk. Despite the slightly differing approaches, the coefficients of research and

development expenditures in both studies are significantly positive.

More recent studies by Hirschey and Spencer (1992) and Chauvin and Hirschey (1993 and 1994) confirm these findings of a significantly positive coefficient for research and development expenditures in cross-sectional valuation models for the years between 1975 and 1991. Hirschey and Spencer (1992) suggest that the coefficients for research and development expenditures varies by firm-size class. Chauvin and Hirschey (1993) also provide evidence to support this latter observation but, in addition, suggest that the coefficient is different for manufacturing and non-manufacturing firms. Overall, these studies suggest that the United States capital markets value R&D expenditures as if they were long-term investments.

Empirical evidence on the stock market reaction to R&D expenditure announcements indicates a generally positive response. Woolridge and Snow (1990) report a two-day cumulative average abnormal return of 1,13% at announcement in a sample of 52 R&D expenditure announcements. Similarly, Chan, Martin, and Kensinger (1990) document a statistically significant two-day abnormal return of 1,38% in a sample of 95 increased R&D spending announcements. Furthermore, cross-sectional regression analyses revealed some systemic factors that explain why the share price responses are positive in some cases but negative in others. Specifically, higher R&D intensity than the industry average leads to larger share price increases for high-technology firms announcing increases in R&D spending but has a neutral or negative effect for low-technology firms.

Doukas, and Switzer (1992) investigated the stock market's valuation of R&D expenditure plans of a sample of 45 companies making 87 announcements during the period 1975-90. The results obtained from a group of companies classified as operating in highly concentrated industries show that announcements of spending increases have a positive and significant impact on the company's share price. On the other hand, the valuation effect of R&D announcements by companies operating in industries characterized by low concentration, on average, is significantly negative. Investors tend to interpret a company's announcement of an increase in R&D spending as good news if it operates in a highly concentrated market. On the other hand, a similar announcement is perceived as bad news when the announcing company is operating in an industry characterized by low seller concentration. This differential signal may be attributed to the enhanced ability of companies in highly concentrated industries to exploit uniquely the inherent advantages in R&D programmes in comparison with those operating in more competitive market structures.

Sudaram, John and John (1996) tested the hypothesis that "competition matters" when firms announce changes in R & D expenditures. They categorize competitive behaviour as "strategic substitutes" or "strategic complements." Intuitively, the idea of strategic substitutes is that competitors accommodate a firm's strategic move, and thus act complaisantly. With strategic complements, competitors match a firm's strategic move, thereby escalating competition. The investigators examined the effect of R & D expenditure announcements on the share prices of announcing firms, as well as those of their competitors in the industry. They found that the average announcement effect is significantly related to the nature of competitive strategy. When the announcing firm competes in strategic substitutes, the announcement effect of R & D spending is positive; when the firm competes in strategic complements, the announcement effect is negative.

Bushee (1998) examines whether institutional investors create or reduce incentives for corporate managers to reduce R & D investment to meet short-term earnings goals. Some critics argue that the frequent trading and short-term focus of institutional investors encourages managers to engage in myopic investment behaviour. Others argue that the large shareholdings and sophistication of institutions allow managers to focus on long-term value rather than short-term earnings. Bushee (1998) examines these competing views by testing whether institutional ownership affects R & D spending for firms that could reverse a decline in earnings with a reduction in R & D. The results indicate that managers are less likely to reduce R & D to reverse an earnings decline when institutional ownership is high, implying that institutions are sophisticated investors who typically serve a monitoring role in reducing pressures for myopic behaviour. However, it was found that a large proportion of ownership by institutions that have high portfolio turnover and engage in momentum trading significantly increases the probability that managers reduce R & D to reverse an earnings decline.

Financial literature has largely ignored studies related to a manager's incentive to disclose or withhold information whose revelation is not required. Finance researchers have also largely ignored the role of voluntary disclosure as an alternative mechanism for managers to eliminate or reduce information asymmetries between themselves and external parties. Wagenhofer (1990) has demonstrated that voluntary disclosure of R & D expenditures may serve as a signal to discourage entry into the product market and also influence the marketing effort of counterpart firms.

Discretionary disclosure is a theory suggesting that a manager's decision to voluntary disclosure information is influenced by how external parties without access to the information (such as competitors) interpret its

absence in the event that it is withheld. If there are no costs associated with its disclosure then a manager is always forced to disclose what he knows, since otherwise external parties anticipate the worst (Milgrom, 1981).

Darrough and Stoughton (1988) have proposed a notion of an entry game which considers the incentives the manager of an incumbent firm has to reveal information to a potential entrant in the same product market, the knowledge of which has some benefit to the entrant. In effect, this model proposes a managers' choice between the inclination to disclose "good news", which reduces the cost of raising capital but also encourages entry, versus the temptation to disclose "bad news", which makes capital more expensive but thwarts entry. When the costs of entering the product market are low and/or prior beliefs about the information in question is optimistic, a firm "separates" good news from bad news and, in effect, have a tendency to disclose. When entry costs are high/ or prior beliefs about the information is pessimistic, a firm "pools" good news with bad news and, in effect, may withhold.

The entry game model proposed by Darrough and Stoughton (1988) assumes that competition results from potential entry. Therefore, voluntary disclosure of information, especially "bad news", can be employed to discourage entry into the product market. Verrecchia (1983), on the other hand, implicitly assumes that firms are already in competition, and thus disclosure only serves to reduce their competitive advantage. Verrecchia (1990) has criticized the entry game model because it gives an exaggerated benefit to "bad news". The model exaggerates the positive impact of "bad news" by ignoring the costs to managers associated with attempts to terminate their tenure in the wake of "bad news", either externally in the form of hostile take-overs or internally in the form of shareholder disapproval.

3. METHODOLOGY AND SAMPLE DATA

3.1 Sample selection and data

The sample for this investigation consists of JSE listed companies that made 151 announcements of plans to increase R&D expenditures during the 1980-97 period. As in Chan, Martin, and Kensinger (1990), the study assumes that investors expect no change in capital expenditures from the previous financial year. Accordingly, this study identifies the increase in R&D spending as the unexpected portion of the announcement.

This study obtained data related to R&D spending announcements from the *Reuters News Services* which provides selected news service stories and articles from *Business Day* and other publications. The archive product, *Reuters Business Briefing* allows access to a

database of all news items released through Reuters. This publication was used to identify news related to R&D spending announcements during the period of investigation.

The Reuters data will have a tendency to focus on those R & D spending announcements that are "newsworthy". To avoid size and survivorship biases additional data relating to all companies listed on the JSE making R & D spending announcements during the investigation period was obtained from the database of the Bureau of Financial Analysis at the University of Pretoria. This approach has the advantage of having a larger sample size and also provides a mechanism for checking the accuracy of the Reuters data. The sample announcements satisfy four selection criteria :

- (1) The announcement is an initial unanticipated announcement of a future plan to increase R&D spending.
- (2) The announcing company and its counterpart must operate independently and should not be subsidiaries of one-another.
- (3) The announced plan does not pertain to a joint venture or cooperative agreement with another company.
- (4) The announcing company and its rival have sufficient share-price observations on the database of the JSE.

A total of 151 announcements met the criteria and were chosen for the final sample for this investigation. For each company included in the sample, daily data on share prices and JSE market index were obtained from the database of the JSE and "McGregor's Online information Services". Of the 151 announcements, 83 are "contaminated". That is, they were made simultaneously with other corporate announcements that relate to sales, earnings, dividends, or capital expenditures. The remaining 68 non-contaminated announcements are made by those companies that did not include other corporate announcements when releasing R&D spending intentions. In the full sample of 151 announcements, 119 include the complete data necessary to perform cross-sectional analysis.

3.2 Research methodology

The event study methodology described by Brown and Warner (1985) is used to analyse the effects of the announcements of plans to increase R&D expenditures on the share price of announcing companies and their counterparts. The day R&D announcement appeared in the wire services was specified as day 0 in event time. The computed abnormal returns represent the cumulative market model prediction error. We choose event date (0,1) instead of (-1,0) relative to the *Reuters News Services* announcement date because the wire

services data generally precede the *Business Day* publication by one day (Chan, Martin and Kensinger, 1990).

For each company making an R&D announcement, daily abnormal returns for the period $t = -15$ to $t = +15$ in event time were computed as:

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

where AR_{it} is the abnormal return for company i on the day t relative to the R&D announcement date. R_{it} is the return for company i on day t , and the term in parenthesis is the normal return. R_{mt} is the return on the market portfolio represented by the JSE Overall Index on day t , α_i and β_i are the market model coefficients for company i . The market model coefficients were estimated using daily returns for the period 330 days to 16 days before the announcement date. An estimation period that did not overlap with any R&D announcements was chosen to avoid potential biases in the market model coefficients. Portfolio average abnormal returns for days $t = (-15, +15)$ relative to the announcement date were obtained as:

$$AAR_t = \frac{\sum_{i=1}^N Ar_{it}}{N} \quad \dots (2)$$

where N is the number of shares in the sample portfolio. The Cumulative Average Abnormal Returns for each day were computed as follows:

$$CAAR_t = CAAR_{t-1} + AAR_t \text{ for } t = (-15, +15) \quad \dots (3)$$

In the absence of abnormal performance, the AAR on any day t should not be significantly different from zero. The test statistic suggested by Brown and Warner (1985) is the ratio of the average abnormal return to its estimated standard deviation, where the standard deviation is estimated from the time series of portfolio average abnormal returns during the estimation period. Following the procedure described by Mikkelsen and Partch (1986), we calculate the Z-statistics to evaluate the significance of the abnormal returns.

A major objective of this study is to examine the effect of announcements of plans to increase R&D expenditures on the share price of counterparts (control group). As in previous research on intra-industry information transfers, we define counterparts as firms operating in the same industry as the announcing firms and of the same size, in terms of sales (Bernstein, 1988). Based on the size criterion in our one-to-one matching technique, only firms in the same strategic groups as the announcing firms are considered. As Eckbo (1983) argues, the inclusion of firms that are unaffected by the announcement biases, the estimated wealth effect on rivals is expected to be zero. Exclusion of relevant firms is a potential problem only to the extent that the actual number of identified

rivals is small, possibly leading to imprecise estimates of abnormal returns.

Since there is consensus that technological innovation plays a major role in enhancing a firm's competitive advantage, the announcement of an increase in R&D expenditures of one firm may result in an intra-industry information transfer. It may signal to shareholders of their counterparts that the announcing firm will be the first to innovate, thereby benefiting from first-mover advantages, and/or it may signal that their counterparts will be lucky beneficiaries of technology spillovers. Accordingly, two hypotheses may be developed for the control group. First, counterparts lose in the race to be the first to innovate; second, counterparts are free-riders of technology spillovers.

Beath, Katsoulacos, and Ulph (1989) argue that competitors' threat is one of the critical determinants of a firm's R&D expenditures. While a firm might myopically overinvest in reaction to the competitive threat, an R&D investment announcement may be taken as a signal that the announcing firm is moving ahead in the race to be the first to innovate. Accordingly, the competitive structure of the industry may be altered to its advantage.

Unless counterparts respond quickly to a competitive threat by some alternative innovation or an imitation, they may have to overcome high entry and mobility barriers as first movers enjoy a competitive advantage (Lieberman and Montgomery, 1988). In an efficient capital market, this potential innovation-induced erosion of the competitive advantage of counterparts translates into negative abnormal returns.

On the other hand, the free-rider hypothesis predicts a positive wealth effect on counterparts because of the potential for spillovers. Firms that invest in R&D often cannot exclude others from freely obtaining the benefits. If counterparts must undertake their own R&D investment to use the freely available knowledge, their commitment can be relatively small compared with the innovator's investment (Cohen and Levinthal, 1989). Spence (1984) considers R&D spillovers as completely free and perfect substitutes for own R&D. Even if the announced R&D project has a negative net present value to the investing firm, counterparts may either benefit or not lose from spillovers.

These two hypotheses are not necessarily mutually exclusive, which means that abnormal returns to counterparts may represent the net effect of both signals. An important question is which signal dominates. Perhaps most intriguing of all is the question of why managers announce their plans to increase R&D expenditures when revealing their plans constitute a voluntary disclosure of private information.

The following hypotheses are tested:

H_0 : Across a variety of industries, companies, and strategic decisions, competitive advantages are at

best temporary. Therefore, it can be predicted that the stock market will not react quickly or strongly to corporate announcements of R&D decisions.

H_1 : In an efficient capital market, positive abnormal share returns are expected for companies announcing an increase in R & D expenditures. Their counterparts can be expected to earn negative abnormal share returns in the period immediately following R & D announcements by innovating companies.

H_2 : The control group (counterparts) will benefit from intra-industry technology spillovers. Therefore, the free-rider hypothesis predicts a positive wealth effect on counterparts.

4. EMPIRICAL RESULTS

4.1 Share price response to R&D announcements

The cumulative average abnormal returns (CAAR) to the announcing firms and their counterparts are presented in Table 1. Panel A shows the results for the full sample, and Panel B shows those for the non-contaminated subsample.

In general, the results indicate that announcements of plans to increase R&D expenditures are associated with statistically significant positive abnormal returns to announcing firms and statistically significant negative abnormal returns to their counterparts. Results in the full sample are similar to results in the non-contaminated subsample. This similarity suggests that results in the full sample are not caused by the contemporaneous release of other firm-specific information in the *Reuters News Services* announcements.

Firms announcing plans to increase R&D expenditures realize, on average, an abnormal return of 1,194 percent during the period (0,1). This abnormal return is statistically significant at the 1 percent level. This result is not affected by a few outlier observations, since 69,7 percent of the sample abnormal returns are positive. The abnormal return is 1,267 percent in the non-contaminated subsample, significant at the 1 percent level with 70,7 percent of the sample abnormal returns being positive.

Counterparts suffer, on average, an abnormal return of -0,563 percent, significant at the 5 percent level. Of the sample abnormal returns to counterparts, 60,8 percent are negative. In the non-contaminated subsample, the abnormal return to firms is about the same, -0,619 percent, significant at the 10 percent level with 65,5 percent of the abnormal returns being negative.

Table 1: Cumulative Average Abnormal Returns (CAAR) to announcing firms and their counterparts

Panel A. CAAR to announcing firms and their counterparts in the full sample (n = 151)				
Period relative to Reuters News Service announcement date	Announcing firms		Counterparts	
	CAAR	% Positive	CAAR	% Positive
(-15, -1)	-0,991*	45,2	-0,382	44,7
(-10, -1)	-0,353	46,9	-0,475	42,5
(0, 1)	1,194***	69,7	-0,563**	39,2
(2, 10)	-0,287	48,5	0,464	51,6
(2, 15)	-0,472	46,3	0,559	52,1
Panel B. CAAR to announcing firms and their counterparts in the non-contaminated sample (n = 68)				
Period relative to Reuters News Service announcement date	Announcing firms		Counterparts	
	CAAR	% Positive	CAAR	% Positive
(-15, -1)	-0,837	48,4	-0,742	46,3
(-10, -1)	-0,363	46,1	-0,427	50,7
(0, 1)	1,267***	70,7	-0,619*	34,5
(2, 10)	-0,352	45,9	0,195	45,2
(2, 15)	-0,381	44,3	0,526	56,4

*Significant at the 10% level, based on a two-tailed Z-test.

**Significant at the 5% level, based on a two-tailed Z-test.

***Significant at the 1% level, based on a two-tailed Z-test.

These results clearly reject the null hypothesis (H_0) and strongly support the alternative hypothesis (H_1). In brief, the findings strongly indicate that the announcement of a plan to increase R&D expenditures results in a simultaneous upward revision in the investors' assessment of the market value of the announcing firm and a downward revision in their assessment of the market value of counterparts. These results imply that at the announcement of increased R&D expenditures, the signal that the firm is moving ahead in the race to be the first to innovate and benefit from first-mover advantages dominates the signal that counterpart firms benefit from intra-industry technology spillovers.

Disclosure of plans to increase R&D expenditures could induce counterparts to increase their R&D expenditures in an effort to draw even in the race to be the first to innovate. The firm (and its management) may benefit from reducing information asymmetries between the firm and investors. That is, if the firm reports lower-than-expected earnings as a result of the increase in R&D expenditures, advance disclosure of the decision may forestall a downward assessment of the firm's market value (and may prevent a reduction in managerial compensation). This argument, however, still does not explain why managers disclose information before the realization of an R&D expenditure increase, and not afterward when earnings must be reported.

If the net wealth effect on counterparts is negative, on average, there may be a rationale for the decision to disclose the private information. That is, the voluntary disclosure of a plan to increase R&D expenditures may be strategically beneficial because it leads to a positive

abnormal return to the announcing firm and a negative abnormal return to counterparts. The results of this empirical study indicate that firms announcing plans to increase R&D expenditures earn statistically significant positive abnormal returns at the announcement date. Counterparts suffer from statistically significant negative abnormal returns at the announcement date. We can regard the disclosure as a pre-emptive strategy by the announcing firm.

4.2 Cross-sectional analysis of abnormal returns to counterparts

Table 2 presents the results of the cross-sectional analysis of the standardized cumulative abnormal returns to counterparts during the period (0,1) relative to the *Reuters News Services* announcement date. Two models are specified in Table 2.

Model 1 is designed to test the signal that the increased spending on R & D must help the firm to move ahead of its counterparts in the R & D race. To test this hypothesis it is necessary to regress the standardized cumulative abnormal returns of counterpart firms ($SCAR_{cj}$) on the standardized cumulative abnormal returns to announcing firms ($SCAR_{aj}$). To control for some other possible influential factors we regress four additional variables. These are the size of the increase in R & D expenditures, announcing firm size and market structure, and industry R & D intensity.

Table 2: Results of the cross-sectional analysis of the Standardised Cumulative Abnormal Returns to the counterparts during period (0, 1) relative to the Reuters News Service announcement date using the following models

$$\text{Model 1: } \text{SCAR}_{cj} = 0_0 + 0_1 (\text{SCAR}_{aj}) + 0_2 (\text{PERINC}_j) + 0_3 (\text{MARPOS}_j) + 0_4 (\text{INCON}_j) + 0_5 (\text{R\&DINT}_j) + e_j$$

$$\text{Model 2: } \text{SCAR}_{cj} = 0_0 + 0_1 (\text{SCAR}_{aj}) + e_j \quad j = 1, 2, \dots, N$$

Model number	Ordinary least squares estimates for:					
	0 ₀	0 ₁	0 ₂	0 ₃	0 ₄	0 ₅
1	-0,285	0,179	0,003	0,152	-0,028	-0,003
	(-0,98)	(2,17)**	(0,14)	(0,60)	(-0,04)	(-0,16)
		R ² =6,8%	F=1,07			
2	-0,241	0,148				
	(-2,42)**	(1,94)*				
	R ² =4,5%	F=3,73*				

Notes: The data for the first model are 119 announcements. The data for the second model are 151 announcements. SCAR_{cj} and SCAR_{aj} are the standardized cumulative abnormal returns over the period (0,1) to the counterparts and announcing firms, respectively, pertaining to announcement j. PERINC_j is the percentage increase in the R&D budget relative to the previous year's budget. MARPOS_j is the dummy variable for the market position of the announcing firm in the industry in which it operates; it equals zero if the announcing firm is among the top strategic group in the industry and one otherwise. INCON_j is the Herfindahl index of industry concentration. R&DINT_j is the R&D intensity of the industry in which the announcing firm and its counterpart operate. The asymptotic t-statistics are shown in parentheses.

*Significant at the 10% level, based on a two-tailed test.

**Significant at the 5% level, based on a two-tailed test.

This study does not include any measures of R & D spillover in the cross-sectional analysis, although Jaffe (1986) found this to be important. Unfortunately, the data set used for this investigation does not contain a complete set of relevant "neighbouring" firms (sources of spillovers), and thus it would not be possible to completely account for this determinant of market value. Cohen and Levinthal (1989) suggested that the magnitude of the spillover effects (or the problems with appropriability of R & D results) seems to vary from industry to industry. The spillover effects are, at least partially, captured by the industry concentration and industry R & D intensity variables in model 1.

The first variable (PERINC_j) is the percentage increase in the R&D budget relative to the previous year's budget. We predict that the larger the percentage increase, the faster the announcing firm is moving ahead to be the first to innovate. Therefore, the coefficient of this variable should be negative.

The second variable (MARPOS_j) is a dummy variable for the market position of the announcing firm in the industry in which it operates. It takes a value of zero if the announcing firm is among the top strategic group in the industry and one otherwise. Since large firms may be more apt at appropriating (i.e., limiting the spillover of) a technology they introduce, we expect MARPOS_j to have a positive coefficient.

The third variable (INDCON_j) is the Herfindahl index of industry concentration. According to the Schumpeterian models of innovation, diffusion is easier in concentrated markets. Therefore, we expect that INDCON_j will have a positive coefficient.

The fourth variable (R&DINT_j) is the R&D intensity of the industry in which the announcing firm and its rival operate. Bernstein (1988) finds that intra-industry spillovers complement R&D capital in industries that exhibit relatively strong propensities to spend on R&D and substitute it in other industries. Therefore, we expect the coefficient of this variable to be negative; i.e., the higher the R&D intensity of the industry, the smaller the gains from spillovers.

Table 2 shows that model 1 is not a good fit. The F-statistic is not statistically significant and the coefficient of SCAR_{aj} is the only statistically significant coefficient. These results suggest that there are no simple generalizations about the effects of the size of the increase in R&D expenditures, firm size, market structure, and industry R&D intensity that apply to the sample announcements and sample industries of companies listed on the JSE. Contrary to apparent common sense, the evidence indicates that none of these variables helps explaining differences in the market's reactions to R&D announcements across companies that are listed on the JSE.

Model 2 is designed to test the free-rider hypothesis which predicts that the control group will benefit from intra-industry spillovers. To test this hypothesis it is necessary to regress the standardized cumulative abnormal returns of counterpart firms on the standardized cumulative abnormal returns to the announcing firms. The standardized cumulative abnormal return to the announcing firm is used as measure of the credibility of the announcement as perceived by investors. Model 2 differs from Model 1 in that it specifies $SCAR_{aj}$ as the only determinant of $SCAR_{cj}$.

Table 2 shows that model 2 is a much better fit than model 1. For model 2 the F-statistic is significant at the 10 percent level, and the intercept term and the coefficient of $SCAR_{aj}$ are statistically significant at the 5 percent and 10 percent levels, respectively. However, the coefficient of $SCAR_{aj}$ is positive, and the intercept is negative. This finding suggests that the intercept represents the average effect of the signal that the announcing firm is moving ahead of competitors in innovation, while $SCAR_{aj}$ multiplied by its coefficient represents the gains from the expected intra-industry technology spillovers. When $SCAR_{aj}$ is more than 1,85, $SCAR_{cj}$ is positive, although much smaller. These findings generally confirm the hypothesis (H_2) which predicts gains to rival firms arising from intra-industry technology spillovers.

Results of our cross-sectional analysis indicate that when the announcing firm earns a relatively large positive abnormal return at announcement, its counterpart also earns a positive, although smaller, abnormal return. When the announcing firm's share price response is relatively small or negative, its counterpart suffers a more substantial wealth loss. Therefore, it pays the announcing firm, strategically, to disclose its plan to increase R&D expenditures, because whatever the anticipated response to its share price, it ends up in a better position than its counterparts.

These results suggest that when the announcement is highly credible, as indicated by $SCAR_{aj}$, the signal that the announcing firm is ahead of the competition dominates the signal that the counterpart will benefit from intra-industry technology spillovers. Therefore, regardless of whether the announcement has a favourable or unfavourable effect on the market value of the announcing firm, the management has an incentive to disclose the firm's future plans to increase R&D expenditures. The announcing firm hurts its counterparts more than it can hurt itself. This conclusion is consistent with previous research on voluntary disclosures.

Dontoh (1989) investigates incentives for firms to voluntarily disclose private information about future outcomes. He finds that the likelihood of disclosing favourable or unfavourable information depends partly on the level of endogenous disclosure costs, which in

turn depend on the extent of intra-industry information transfers and the resulting reaction by the firm's competitors. Wagenhofer (1990) analyzes voluntary disclosure strategies of a firm when the information is relevant to its market value and the market value of a competitor. Assuming that favourable information increases the market value of the disclosing firm but may induce the competitor to take discrete action that imposes proprietary costs on it, Wagenhofer shows there is always a full-disclosure equilibrium.

An extensive theoretical discussion on the spillover effects of R & D investments has been provided by Reinganum (1989). Each manager of a firm in an industry is assumed to behave according to a model wherein its R & D efforts jointly produce knowledge and a private good (e.g. a new product or process). Knowledge is public between firms, whereas the good arising from R & D activity is private between firms. This publicness of research activity, along with the desire to maintain a competitive edge over actual and potential rivals, may be such that firms may not necessarily maximize current profits at the R & D stage (Henriques, 1992).

The assumption that R & D activity (whether successful or not) yields knowledge was observed by Cohen and Levin (1989) in their conversations with R & D managers. These managers found it very valuable to know what technical problem a competitor was trying to solve, what technical approach had been adopted or what approach had succeeded. Cohen and Levin (1989) go on to suggest that the problem of appropriability is not limited to the protection of successful innovations – in fact, knowledge that a project had failed may save a competitor money or help a competitor succeed.

Since knowledge is a public good, the existence of technologically related research efforts of other firms may allow a given firm to achieve results with less research effort than otherwise. Jaffe (1986) reports that, for certain innovations, imitation is much cheaper than innovation. Jaffe (1986) investigated the spillover phenomenon by looking at the average effect that competitor firms' R & D has on the productivity of a firm's own R & D. Jaffe (1986) reports that firms whose research is in areas where there is much research by other firms have on average, more patents per dollar of R & D, and a higher return to R & D in terms of accounting profits or market value, though firms with very low own R & D suffer lower profits and market value if their competitors are R & D intensive. Jaffe (1986 : 986) concludes that the existence of technological spillovers implies that a firm's R & D success is affected by the research activity of its competitors in technology space.

The result of this investigation provides evidence in support of the hypothesis that rival firms may benefit from intra-industry technology spillovers. This has major

implications for both the companies making R & D announcements as well as their competitors. Firms making R & D announcements could reduce the spillover effects by providing a "bad news" signal which could discourage entry into the product market. Furthermore, a "bad news" signal can also reduce the spillover effects by influencing the level of production and marketing effort of rival firms that are already competing in the product market.

The strategic competition within an industry can be expected to have an influence on the level of technology spillovers arising from R & D expenditure announcements. If the competitive behaviour of rival firms can be characterized as "strategic substitutes", competitors act complaisantly, and the potential for spillover is minimal. In an industry characterized by "strategic complements", competitors match the firm's strategic investment and are more likely to be beneficiaries of technology spillovers. The market structure distinctions among rival firms could influence the share price announcement effect, depending on whether one or the other type of strategic interaction is prevailing in the industry. Companies making R & D announcements should give proper consideration to the strategic competition prevailing in the industry and should provide an appropriate signal in the announcement in order to minimize the possible spillover benefits to competitors.

The results of this study also have implications for companies listed on the JSE. The most important implication is that managers need not worry unduly about adverse share market reaction as they formulate corporate and business strategies. As evidenced in the diverse array of industries and companies examined in this study, announcements of long-term investments in R&D projects generated, on average, substantial value for shareholders. To be sure, managers cannot ignore the market's expectations of short-run earnings, but it is clear that they are not compelled to develop short-term strategies aimed only at producing short-term profits.

5. SUMMARY AND CONCLUSION

The basic premise underlying our research is that signals sent by competitors can influence the market value of firms. We focus on signals conveyed by the announcement of a plan to increase R&D expenditures. Two signals may be implicit in such announcements. The first is that the firm making the announcement will be the first to innovate, benefiting from first-mover advantages. The second signal is that counterparts will benefit without cost through intra-industry spillovers. The first signal represents unfavourable news to shareholders of counterparts, while the second signal represents favourable news to these shareholders. The abnormal returns to shareholders of counterparts must be the net effect of both signals.

In our event study based on a sample of 151 announcements of plans to increase R&D expenditures during the period 1980 to 1997 by companies listed on the JSE, we find that the announcing firms earn a statistically significant two-day abnormal return of 1,194 percent. Counterparts suffer a statistically significant two-day abnormal return of -0,563 percent. We conclude that the signal that the announcing firm will move ahead in the R&D race and benefit from first-mover advantages dominates the signal that counterparts benefit freely from the technology spillovers.

The cross-sectional analysis of the standardized cumulative abnormal returns to counterparts upon announcement identifies the standardized cumulative abnormal return to the announcing firm as the only statistically significant exogenous variable. The ordinary least squares estimates of the coefficients of the reduced-form model support three conclusions. First, the counterpart loses even when the announcing firm does not gain from the announcement. Second, the counterpart gains only when the standardized cumulative abnormal return to the announcing firm exceeds 1,85. Third, the counterpart loses more than the announcing firm when the standardized cumulative abnormal return to the announcing firm is negative.

The results of the analysis provide a justification for the voluntary disclosure of a firm's plan to increase R&D expenditures. Such a disclosure leads to a positive abnormal return to announcing firms and a negative abnormal return to counterparts. Even when such a disclosure represents unfavourable news to announcing firm shareholders, it becomes strategically beneficial, since counterparts lose substantially more.

Companies making R & D announcements could endogenize the costs associated with the dissemination of information by making the costs to depend upon the information's content. Companies making R & D announcements could reduce the spillover effects by providing a "bad news" signal which may influence the level of production and marketing effort of rival firms that are competing in the product market. Companies making R & D announcements should also give proper consideration to the strategic competition prevailing in the industry so that the appropriate signal in the announcement could minimize the spillover benefits to competitors.

A widespread concern is that investors are unduly concerned with short-term performance and that company managers have a tendency to underinvest in long-term investments such as R&D in order to maximize short-term profits. This investigation has not provided any evidence to suggest that the JSE fails to recognize the valuation-relevance of R&D expenditures. The market appears to make attempts to capitalize R&D expenditures, despite their accounting treatment in which such expenditures are mainly expensed as

incurred. As a consequence, the JSE does not appear to be simply fixated on earnings, at least not in the case of R&D expenditures. Given this observation, the accounting treatment, therefore, appears not to hinder the South African market in attaching a value to R&D expenditures.

Today's corporate strategists have a considerable challenge to meet the demands of a wide variety of constituents. One very important constituent is the stock market. Recently, the stock market has been characterized as misguided and even irrational, supposedly forcing managers to make strategic decisions that are not in the best long-term interests of their companies and the total economy. The findings of this study indicate that the stock market does not penalize management for making well-conceived long-term strategic decisions. In fact, it rewards them for doing so. Moreover, it appears that managers do not have to forsake other important constituents, such as customers, as they contemplate strategic investments. The evidence indicates that the capital markets act rationally and that firms investing in R&D projects are rewarded by higher market values.

Announcements of planned increases in R&D apparently reveal new information that has a positive impact on share value. The response to R&D announcements tend to be positive even for firms that simultaneously experience an earnings decline. Investors look beyond the short-term earnings impact of major strategic investments when valuing a firm's share price. Like current cash flow, growth, risk, and market share, R&D expenditures constitute key determinants of the market value of the firm. The market tends to regard R&D expenditures as alternative forms of investment in intangible capital that contributes to shareholder value. In sum, the evidence presented in this study is consistent with the hypothesis that announcements of plans to increase R&D expenditures are, associated with an increase in the wealth of shareholders. This result supports the conclusion that investors tend to regard higher R&D spending as an indication of better growth opportunity and incorporate this improvement into their valuation of the firm.

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