

Does research and development have a market value?

1. Background

The accounting for R&D is pretty crude. Unless strict conditions are met, the expenditure is expensed. This arises largely because the uncertainty surrounding the valuation of the expenditures. But does this mean that R&D is of no value to the company? A number of papers investigate this for the UK:

Green, Stark, and Thomas, "UK evidence on the market valuation of research and development expenditures", Journal of Business Finance and Accounting, March 1996, volume 23, pp191-216.

Akbar and Stark, "Deflators, net shareholder cash flows, dividends, capital contributions and estimated models of corporate valuation", Journal of Business Finance and Accounting, March 1996, volume 23, pp191-216.

There is also an US based study which some theoretical light on the value of R&D:

Shi, "On the trade-off between the future benefits and riskiness of R&D: a bondholders' perspective, Journal of Accounting and Economics, 2003, volume 35, pp227-254.

We summarise these papers in turn.

2. Green, Stark, and Thomas

The paper is based on a residual income valuation model of the company.

$MV_t = BV_t + \text{Present value of future residual income (RI)}^1$.

On the assumption that RI_t declines at a constant rate over time, the valuation equation becomes

$$MV_{i,t} - BV_{i,t} = \beta \cdot RI_{i,t} \tag{1}$$

If RI is measured before current and future R&D expenditures, then the value of R&D can be added to the right hand side of equation 1.

$$MV_{i,t} - BV_{i,t} = \beta \cdot RI_{i,t} + \sum_{z=t}^{\infty} \gamma_z \cdot R \& D_{i,z}$$

¹Recall that $RI_t = \text{Earnings}_t - R_f \cdot BV_{t-1}$.

If then R&D expenditures can be assumed to grow at a constant rate, the valuation equation reduces to

$$MV_{i,t} - BV_{i,t} = \beta.RI_{i,t} + \gamma.R \& D_{i,t} \quad (2)$$

In addition to RI and R&D, other controlling variables are added to equation 2, based on previous US studies such as the market share for each company year.

A constant is then added to the equation, all components are scaled by MV, and then another constant is added. The results based on 662 company-year observations for 1990-2 are given in their Table 3, and reproduced below.

	$\frac{MV_{i,t} - BV_{i,t}}{BV_{i,t}} = \alpha_0 + \alpha_1 \frac{1}{BV_{i,t}} + \frac{\beta.RI_{i,t}}{BV_{i,t}} + \frac{\gamma.R \& D_{i,t}}{BV_{i,t}} + \text{controlling variables}$		
	β	γ	R^2
Estimate	4.77	4.84	0.92
White t value	(9.42)	(48.5)	

In their Table 4, they re-run the tests but with outlier observations removed. They are given below.

	$\frac{MV_{i,t} - BV_{i,t}}{BV_{i,t}} = \alpha_0 + \alpha_1 \frac{1}{BV_{i,t}} + \frac{\beta.RI_{i,t}}{BV_{i,t}} + \frac{\gamma.R \& D_{i,t}}{BV_{i,t}} + \text{controlling variables}$ estimated with outlier observations removed		
	β	γ	R^2
Estimate	3.67	4.15	0.30
White t value	(7.14)	(2.47)	

Both sets of results show that R&D is valued by the market. The authors claim that the results show that R&D is treated as if it were capital expenditure.

3. More recent results: Akbar and Stark

This paper is also based on UK data. The valuation model they use is also based on Ohlson and is as follows.

$$MV = a_0 + a_1BV + a_2E + a_3R \& D + a_4D + a_5CC \quad (3)$$

where

BV = book value
 E = earnings
 R&D = research and development expenditure
 D = dividends
 CC = capital contributions

The sample used is UK companies quoted on the London Stock Exchange between 1990-2001.

They estimate equation 3 in a number of ways by scaling all the components with a number of company specific deflator variables such as: sales; the number of shares; market value; and book value. The results they give are not seriously affected by which scaling variable they use, and some of the findings are illustrated below using book value as the deflator.

$MV = a_0 + a_1BV + a_2E + a_3R \& D + a_4D + a_5CC$							
	a_0	a_1	a_2	a_3	a_4	a_5	R^2
Estimate	2410.58	0.99	0.70	9.24	16.65	-1.76	0.24
White probability value	0.00	0.00	0.00	0.00	0.00	0.00	
All variables are scaled by book value. The number of observations is 13,256							

These results show that the coefficient on R&D is positive and significant, indicating that R&D expenditure is valued by the market.

However, there are a number of unusual features in their results.

1. When market value is used as the deflator², the R^2 for the equation is *negative*.
2. The value of the coefficient on earnings is 0.7 which seems to indicate that earnings are not regarded having any life beyond the current accounting period. Perhaps this arises because of the presence of dividends in the model and that the market relies on dividends to a great extent and on earnings to a much lesser extent.

4. Do these results mean that R&D expenditures should be capitalised? The results of Shi.

I - BACKGROUND

These results above, and much US evidence in a similar vein might suggest that R&D expenditures should be capitalised. However, an important paper by Shi casts some doubt on this.

Shi argues that R&D expenditure affects not only the expected value of company cash flows but

² The results are reported in their Table 3 and Table 4, but are not reproduced here.

also their riskiness. This seems straight forward. But he quotes the finance theory literature to say further that *both effects* (the mean effect and the variance effect) have a positive impact on equity firm value when the company has debt in its capital structure. The intuition is that increased riskiness of a company gives the potential for gains, but the fact that equity holders have limited liability restricts the extent of their losses. Therefore, he claims that the fact that R&D has a positive impact on company value may be driven either by its expected value or its riskiness. If the latter, then the case for capitalising R&D as an asset would be far less compelling.

Shi investigates this with evidence from the bond market, since the effect of R&D expenditures on debt prices is different from their effect on equity prices. For debt holders of companies that engage in R&D, the mean and the variance effects on future cash flows work in opposite directions. R&D that is expected to generate positive cash flows have a positive effect on debt prices, since as company cash flow increases, the interest payments are more secure.

However, R&D that increases the variance of company cash flows is just bad news for bond holders. Bond holders cannot participate in the gains when R&D goes well since payments to them do not vary with company performance. However, if R&D performs poorly and company performance declines, bond holders lose since payments to them are riskier. Therefore bond holders like the mean effects and dislike the variance effects of R&D expenditures.

This gives an opportunity to identify which effect is the strongest.

II - THE MAIN IDEA

The study examines the issue by testing whether R&D expenditures increase or decrease bond ratings and risk premiums. If R&D makes bond ratings less favourable and increases risk premiums, then this is evidence that the variance effect of R&D outweighs the mean effect.

III - VARIABLES USED

Bond rating (the 'rating')	1 (top rating) to 5 (bottom rating)
Risk premium (the 'premium')	The yield to maturity on the industrial bond minus the yield to maturity on US Treasury bonds of the same maturity.
R&D	Annual expenditure, scaled by end of year market value of equity
DE	The ratio of the book value of debt to the book value of equity
CONV	takes a value of 1 if a convertible bond, 0 otherwise
LOGMVE	The log of the market value of equity stock. This variable proxies, <i>ceteris paribus</i> , for default risk and marketability.
LOGSIZE	The log of the size of the bond issue, which has two opposing effects. As a measure of marketability it will make the bond more attractive. However, the larger the bond issue the greater the likelihood of default, making the bond less attractive.

IV - RESULTS

The overall results indicate that R&D increases the premium and the rating. The Table 3 tests these variables against combinations of explanatory variables including the current R&D expenditure. All the results except one³ indicate that both the premium and the rating are adversely affected by the level of R&D. A typical result from Table 3 is given below.

Significant variables which explain the RATING of industrial bonds, issued 1990-93 by companies in R&D intensive industries.				
Explanatory variables	R&D	LOGMVE	LOGSIZE	N
Coefficient	2.31	-0.71	0.34	132
2 tailed P-value	0.005	0.0001	0.001	

The result shows that:

- R&D increases the RATING (makes the bond less attractive);
- the size of the outstanding equity (LOGMVE) decreases the RATING (makes the bond more attractive); and
- the size of the bond issue (LOGSIZE) increases the RATING (makes the bond less attractive).

V - CONCLUSION

This evidence suggests that investors view R&D as being a measure of risk rather than a measure of expected cash flow.

A key condition for R&D to be capitalised in accounting statements is that the expected benefits should be capable of being reliably estimated. The results therefore question whether R&D expenditures should be capitalised, since the uncertainties surrounding them dominate any expected increase in future cash flow.

³This exception is when the rating is regressed against R&D alone.