THE EFFECT OF R&D EXPENDITURE (INVESTMENTS) ON FIRM VALUE: CASE OF ISTANBUL STOCK EXCHANGE

Pinar Başgoze[1], H. Cem Sayin[2]

[1] Hacettepe University, Department of Business Administration, Ankara, Turkey. Email: pinaran@hacettepe.edu.tr.
[2] Anadolu University, Faculty of Business Administration, Eskişehir, Turkey. Email: hcsayin@anadolu.edu.tr.

KEYWORDS

R&D, firm value, stock returns, frirm size.

ABSTRACT

The relationship between Research and Development (R&D) and creating value has been widely discussed in the past. Most of the studies revealed that there were positive relationships between R&D investments and firm value. The research has shown that R&D investments create value for firms due to their competitive advantages for the firm, when they are used as a differentiation strategy that creates new products of processes that are hard to be easily imitated by the competitors and that this creates brand equity. This study tested the ability of R&D investments to explain returns using single and multiple variable regression models. It was observed that (*i*) there were positive and strong relationships between the intensity of R&D investments and returns and (*ii*) firm size, contrary to expectations, was not related with returns.

1. INTRODUCTION

Maximizing future returns of stockholders is one of the principle aims of enterprise management. In this case, it was reported that the enterprises that maximize their market capitalization will be considered to have fulfilled their aims instead of those that make more profit or higher sales revenue. The expected future value of a company's stock reflects firm value and this value mostly depends on the marketing activities of the enterprise (Osinga et al., 2011). Marketing and advertising expenditure made by enterprises can be considered as an investment instrument that will increase the value of the enterprise in the long term (Joshi and Hanssens, 2010). In financial terms, marketing expenditure will enhance future sales, profits and thus the cash flow of enterprises (Graham and Frankenberger, 2000). Similarly, the positive effect of marketing expenditure such as R&D and advertisement on intangible assets like brand equity can also grant a competitive advantage to the enterprise and increase of the value of the enterprise in financial terms.

The relationship between R&D investments and creating value has been analyzed in the past. Most of the studies revealed that there were positive relationships between R&D investments and firm value. The evidence has shown that R&D investments create value for firms due to their competitive advantages for the firm when they are used as a differentiation strategy that creates

new products or processes that are hard for competitors to imitate and that create brand equity[1] (Chauvin and Hirschey, 1993; Chan et al., 2001; Morbey, 1988; Bae and Kim, 2003).

Thus, the aim of this study was to determine the effect of marketing activities on firm value. In this context, through the comparison of this study with one or several sectors and in previous studies carried out abroad, the study analyzed the contribution of R&D investments on creating firm value over the stock values of 40 enterprises that are listed on the Istanbul Stock Exchange (ISE). This study presented proof that R&D and firm value are positively correlated over a 5-year period, from 2006 to 2010.

The literature on the effects of R&D investments on firm value will be reviewed and the hypotheses of the study will be formulated in the following section. The next section will define statistical methods that were used to test the data and hypotheses and final part will discuss the results and their managerial effects.

2. LITERATURE REVIEW

2.1. R&D Investment, Firm Size and Firm Value

Investment in R&D is, in real terms, an investment in intangible assets that contribute to the growth of a firm in the long-term. Therefore, market capitalization of a firm reflects the current value of the intangible assets, as much as that of the tangible assets (Chan et al., 2001). Successful R&D investments results in a new product or service that enables the firm to distinguish itself from other firms. Much of the previous research has shown that (Chan et al., 2001; Bosworth and Rogers, 2001) there is a positive correlation between R&D investments and stock price returns in the following period.[2]

Morbey (1988) found that there was a relationship between R&D investments and the performance of many US firms. Furthermore, the study emphasized that R&D expenditure should be increased if they cause an increase in sales (Morbey, 1988).

In a study carried out in the USA, Germany and Japan, it was determined that US firms made more R&D investments than their Japanese and German rivals. Investments in research and development play a more important role in innovations and the future progress of US firms when compared to those of Japanese firms. It was concluded that, with regard to German firms, the abovementioned relationship was positive, however without a significant coefficient. On the other hand, it was reported that there was a similar relationship between German and Japanese firms in terms of R&D expenditure and market capitalization. In conclusion, research conducted across all three companies revealed that there was a positive relationship between R&D expenditure and market capitalization (Bae and Kim, 2003).

In a study that analyzed the effects of R&D expenditure on the market capitalization of a firm (Chauvin and Hirschey, 1993), it was found that research and development investments was an

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[1] Brand equity refers to the positive difference in which a customer agrees to pay more for a product than other products because he/she knows and is familiar with the product brand (Simon and Sullivan, 1990).

[2] In many studies, R&D investments were measured as a percentage of sales, total assets or total market capitalization. The use of R&D investment can be an indication of the firm size and therefore, it can conceal the real relationship between firm performance and R&D investment. This study used a R&D intensity variable (R&D expenditure as a percentage of net sales) to measure R&D investments.

important determinant for the market capitalization of firms just like cash flow, growth, risk and market share. The results of the study that was conducted in manufacturing and non-manufacturing firms demonstrated that the market capitalization of both types of company was affected by R&D expenditure. According to the same study, the effectiveness of R&D expenditure can show variations according to firm size (Chauvin and Hirschey, 1993).

Similar to other studies in the literature, in a study carried out in Australia (Bosworth and Rogers, 2001), it was found that there was a positive and significant relationship between firm value and R&D expenditure. Conolly and Hirscey (1984) found a complicated relationship between R&D, market structure and profit-based market capitalization. The reason for this was believed to be the positive effects of R&D on profit and the negative integration of R&D and intensification.

In addition to these studies in the literature, there is a positive relationship between R&D intensity and firm performance (Hsieh, Mishra and Gobeli, 2003). Furthermore, according to a previous study (Hsieh, Mishra and Gobeli, 2003), R&D investment affected market capitalization two times higher than investment in tangible assets.

According to another study (Szewczyk, Tsetsekos and Zantout, 1996) there was a significant relationship between the announcement of research and development expenditure and market price reactions to it. This relationship was found to be positive in high-technology firms, while the same relationship was found to be negative in low-technology firms. Based on the data in the literature, it is observed that R&D expenditure has significant impacts on firm value. The following hypothesis can be produced in light of the above discussions:

H1: There is a positive relationship between future stock returns of a firm and the R&D intensity of that firm.

3. METHODOLOGY AND DATA

The data concerning the stock return of the 2006-2010 period of 40 companies listed on the ISE, in addition to data on R&D expenditure and market capitalization/book value were used in the study. Data was collected from the database on the official website of the ISE (www.borsaistanbul.com). The availability of all data belonging to the 2006-2010 period was the principle criteria in selecting the firms whose data was used. This limitation arose due to the fact that there is no reliable database in Turkey and that it is not possible to access all data concerning the firms. Furthermore, financial institutions such as banks and insurance companies were not included in the study due to their different financial structures.

Simple and multiple regression methods were used in the analyses. In this context, two models were used to explain stock returns. The models were constructed based on the models developed by Ho et al., (2005) that test the effect of R&D expenditure, advertisement expenditure, market capitalization-book value (mc/bv) and firm size variables on stock returns. The models are presented below:

Model 1:

$$HPR_i(\tau) = \alpha_0 + \alpha_1 RDI_{i,t-1} + \varepsilon_1 \tag{1}$$

The stock returns of a firm in a certain period are affected by various criteria. While some of these factors are internal, some of them are external. A review of the literature on measuring the effect of R&D on stock price reveals that mainly two factors were checked. These factors are firm size (Chauvin and Hirscey, 1993) and sector intensity (Chauvin and Hirscey, 1993; Acs, et.al., 1994).

In a previous study (Chauvin and Hirscey, 1993), it was observed that the effects of R&D expenditure on firm value varied according to firm size. Thus, it can be beneficial to consider firm size as an effective factor on the effectiveness of R&D expenditure. Similarly, Acs et.al. (1994) analyzed the interaction between firm size and R&D and found that R&D studies played a more creative role in large firms when compared to small firms. The study showed that the effects of R&D expenditure varied according to firm size.

In addition to these factors, the study checked the potential effects of *market capitalization-book value and previous year return* variables.

Model 2:

$$\text{HPR}_i(\tau) = \alpha_0 + \alpha_1 \text{RDI}_{i,t-1} + \alpha_2 \text{LNSIZE}_{i,t-1} + \alpha_3 \text{MBV}_{i,t-1} + \alpha_4 \text{HPR}_i(t-1) + \varepsilon_2 \qquad (2)$$

Model 1 is used to test the relationship between R&D expenditure and stock returns, while Model 2 is used to test the effects of mc/bv ratios and firm size on returns, in addition to R&D expenditure.

The variables in the models are presented below:

$\text{HPR}_i(\tau)$, return of *i* stock in τ period;

$\text{RDI}_{i,t}$ is the ratio of R&D expenditure of firm *i* at the end of *t* year to net sales;

$\text{LNSIZE}_{i,t}$ is natural logarithm of total market capitalization of firm *i* at the end of *t* financial year;

$\text{MBV}_{i,t}$ is the market capitalization/book value ratio of firm *i* at the end of *t* financial year.

The first model is a single variable regression model, while the second model is a multiple variables regression model. The dependent variable for all models was stock return ($\text{HPR}_i(\tau)$). R&D intensity, which was used as independent variable, was measured as the ratio of total net sales to R&D expenditure. Firm size was determined by taking the natural algorithm of total market capitalization of the firm at the end of the financial year (LNSIZE).[3] The established regression model was separately operated for all firms in the sampling.

As mentioned earlier in the text, the study used 5-year data belonging to the 2006-2010 period. Data on annual accounting information, net sales, the shares of shareholders and R&D expenditure were obtained from financial tables published on the ISE. The stock prices of the firms in the sampling were obtained from daily data files compiled by the ISE. For each year, only the firms with available R&D expenditure and stock price data that were needed to make necessary calculations were included. The accounting data for the firms at the end of *t* financial year was matched with stock price at the end of the subsequent year to calculate stock return in a certain period. This was preferred to provide the availability of financial tables of the firms in *t* financial year by the public and to prevent any bias (Ho, Keh and Ong, 2005).

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[3] The advantage of using total market value (market capitalization level) at the end of the financial year is that firm size is an objective market criterion. The use of net sales or total assets as the criterion of firm size would not be reliable because they can be affected by the accounting policies practiced by the firm. The use of total market value as the criterion of firm size is the most common approach in research on finance and accounting.

The *Market Capitalization/Book Value* ratio was calculated using the end-year accounting data of the firm. On the other hand, market capitalization was calculated using the accounting data for the firm at the end of the financial year.

Table 1: Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Median	Standart Deviation
HPR	200	-.60	-.32	-.4828	-.4836	.06233
RDI	200	.0000	.0840	.005976	.003550	.0096259
MBV	200	.00	25.25	2.6938	1.7650	3.02471
LNSIZE	200	28.90	35.92	31.7556	31.3810	1.68501
HPR$_{t-1}$	200	-.64	-.24	-.4798	-.4800	.07118

Information concerning the independent variables (R&D intensity, market capitalization-book value ratios and firm size) from the previous year was used while constructing the models.

The reason for this was that, in Turkey, the firms listed on the stock exchange announce their financial tables for the current year starting from the April of the subsequent year and thus the investors have to analyze the data of previous year while investing in the aforementioned firm.

4. FINDINGS

Pearson correlation coefficients that show the relationships between the dependent and independent variables in the model are presented in *Table 2*. The shaded areas in the table express the variables with a high probability of linearity. The Pearson test results show that there is a strong, positive relationship between firm size and market capitalization-book value ratio.

Table 2: Corelation Coefficients Between Explanatory and Dependent Variables

	HPR	RDI	MBV	LNSIZE	HPR$_{t-1}$
HPR	1.000	.258	.088	.112	.215
RDI	.258	1.000	.247	.209	.229
MBV	.088	.247	1.000	.418	.079
LNSIZE	.112	.209	.418	1.000	.096
HPR$_{t-1}$	.215	.229	.079	.096	1.000

Table 3 indicates the regression results of two models that were used to explain the returns. The results of Model 1, which used the relationship between R&D investments and stock returns, show that there was a positive relationship between annual stock returns and R&D investment intensity. The *F* value that shows the significance of the model is quite high (*F*=14.088). However, low Adj. *R*-sq (0.061) is significant in terms of suggesting that other variables apart from R&D investments can affect the stocks. Analysis of the obtained coefficient (α_1=1.669) and *t* statistics (3.753) values show that there is a linear and statistically significant (99% reliability level) relationship between R&D investments and stock returns. This finding is consistent with the data in the literature.

Table 3: Regression results

F value (Prob > F)	Adj. R-sq	α (t)	RDI (t) p-value	LNSIZE (t) p-value	MBV (t) p-value	HPR(t_1) (t) p-value

Model 1: $HPR_i(\tau) = \alpha_0 + \alpha_1 RDI_{i,t-1} + \varepsilon_1$

F value (Prob > F)	Adj. R-sq	α (t)	RDI (t) p-value	LNSIZE	MBV	HPR(t_1)
14.088 (0.0002)	0.061	-0.493 (-98.007)	1.669* (3.753) 0.0002			

Model2: $HPR_i(\tau) = \alpha_0 + \alpha_1 RDI_{i,t-1} + \alpha_2 LNSIZE_{i,t-1} + \alpha_3 MBV_{i,t-1} + \alpha_4 HPR_i(t-1) + \varepsilon_2$

F value (Prob > F)	Adj. R-sq	α (t)	RDI (t) p-value	LNSIZE (t) p-value	MBV (t) p-value	HPR(t_1) (t) p-value
5.092 (0.001)	0.076	-0.484 (-5.178)	1.357* (2.892) 0.004	0.002 (.681) 0.497	0.00004 (.026) 0.979	0.141* (2.305) 0.022

* *P<0.01

Regression results of Model 2, which was constructed to check the effect of firm-specific characteristics such as firm size, previous year returns and market capitalization-book value ratio are generally in parallel to single variables model. R&D investments maintained their relationship with the returns at a 1% significance level, like in the previous model (α_1=1.357 and t=2.892). However, contrary to expectations, no size effect was found. On the contrary, the α_1=0.002 and t=-0.681 values of the LNSIZE independent variable reveal that there is no relationship between the returns and firm size. The *F* statistics of the model was found to be significant at a 1% level. Inclusion of internal characteristics of the firm in the model enhanced explanation power of the model.

Although the Adj. *R*-sq value was found to be 0.076, this value is still not high enough. There is still an impression that there are other variables which affect the returns. The Durbin-Watson Statistics results that are used as an indicator of serial correlation generally took values close to 2 in all models.

5. CONCLUSION

This study was carried out to test the power of R&D investments to explain stock returns and thus their effect on creating firm value. The results of the study were generally consistent with data in the literature. Positive and significant (1% level) relationship between R&D expenditure and returns verifies the data in the literature. The aforementioned relationship was apparent in both single variable and multiple variable models. In terms of the analyzed models, the results show that R&D investments affect stock returns; in other words, they create value for the firm. On the other hand, although the effect of firm size on returns has been supported by various studies in the literature, the analyses identified no relationship between the variables. We believe that a larger sampling on the basis of firm size should be used to properly test this effect. Although the study yielded findings in parallel to the literature, the assumption that the contribution of R&D to the firm value was linear is a limitation of the study. Furthermore, the low number of firms with available R&D expenditure data hampers the generalizability of the results.

The inclusion of other variables (like advertising expenditure) that might be related with returns, apart from the explanatory variables used in the present study, will yield more reliable results in future studies. In addition, increasing the number of firms and using a longer period in future studies will be advantageous for the generalizability of the results obtained.

In conclusion, this study determines a significant relationship between stock returns and R&D intensity for the firms that are listed on the ISE. This finding is consistent with the data in the literature. The study found no relationship between market capitalization-book value ratios and stock returns, whose potential effects were analyzed.

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