OPEN ACCESS
Finance & Accounting Research Journal
P-ISSN: 2708-633X, E-ISSN: 2708-6348
Volume 6, Issue 5, P.No. 792-800, May 2024
DOI: 10.51594/farj.v6i5.1160
Fair East Publishers
Journal Homepage: www.fepbl.com/index.php/farj

Impacts of R&D and advertising intensities on ROE and Tobin's Q of selected US IT firms

Matiur Rahman[1], Jeanne-Claire Patin[2], & Michael E. Roach[3]

[1]Professor of Finance, College of Business
McNeese State University, Lake Charles, LA 70609, USA
[2]Assistant Professor of Accounting, College of Business
McNeese State University, Lake Charles, LA 70609, USA
[3]Assistant Professor of Accounting, College of Business
McNeese State University, Lake Charles, LA 70609, USA

*Corresponding Author: Matiur Rahman
Corresponding Author Email: mrahman@mcneese.edu

Article Received: 10-01-24 **Accepted:** 15-03-24 **Published:** 22-05-24

ABSTRACT

This paper investigates the effects of advertising and R&D intensities on ROE and Tobin's Q of five selected US IT firms. These companies are selected for complete availability of data over 1986-2019. Data are obtained from COMPUSAT. The time series and the cross-sectional data have been combined together to create a homogenous panel within the same IT sector. The data distributions appear to be near-normal. ROE is mildly negatively correlated with both advertising and R&D intensities. Tobin's Q is mildly positively correlated with them. In both cases, the effects are mixed. For ROE, the net effect is negative in term of the sum of the slope coefficients. Likewise, it is positive for Tobin's Q.

Keywords: Advertising, R&D, Pooled OLS, ROE, Tobin's Q.
JEL Classifications: G10, G30, G39

INTRODUCTION

Spurring innovations of R&D expenditures contribute to job creation and economic development. By embracing creative destructions of various innovations, IT firms vastly

increase profits. Innovative activities include procurement of new materials, new products, discoveries of new markets, and adoption of new organizing methods, among others. The future growth opportunities and profitability are discernably higher for innovative firms relative to non-innovative ones. Thus, the innovative firms are able to harness excess stock returns (e.g., Schumpeter, 1912; Baumol, 2001).

R&D investments are reflective of financial investors' firm valuations and respective stock prices. To add, R&D investments impact firm performance in terms of expected profits and cash flows. In efficient financial markets, investors evaluate a firm based on its expected cash flows. So, its value should be equal to the present value of the expected stream of cash flows. The impacts on performances of selected firms in this sector would likely vary due to the differences in their policy choices and business strategies. In addition, the degree of success of R&D investment depends on the pace of product commercialization and the implementation processes. The decision of the intensity of R&D investment is based upon the expected future returns. R&D investment in intangible assets contributes to the long-term growth of a firm. However, its accounting treatment has also a direct impact on a firm's financial performance. When R&D costs are expensed in the period they were incurred, the net income as well as the profitability ratio (ROE) for that period declines. If R&D costs are deferred to future periods, the current period's net income and profitability ratio (ROE) might not decline but another profitability ratio (ROA) might decline. A successful investment in R&D results in an innovative product or service enabling a firm to differentiate itself from other competitors within the industry.

Tobin's Q (Tobin, 1969) represents a long-run equilibrium measure capturing both risk and return dimensions (Petro and Elgar, 2004). It reflects the market expectations of less quantifiable dimension of performance in intangible assets of a firm relative to its total tangible assets. Tobin's Q is equal to 1, when total market value of assets equals a firm's book value. It is greater than 1, when the market value is greater than the book value. This suggests that the market value reflects some unmeasured or unrecorded assets of the firm. On the other hand, when Tobin's Q is less than 1, the market value is less than the book value. This suggests that the market may be undervaluing the firm. In general, investors take R&D announcement positively in the high-tech firms even when they report operating losses in the period of R&D announcements. Long-term focused shareholders believe that a firm gains intrinsic value by investing in R&D extending to future growth potentials.

Marketing intensity is a firm's effort to create, promote, and maintain its brands for distribution from production points to consumption points. Marketing intensity is not to be considered exclusively as an expense in the current period since its effects last for the subsequent periods to the benefit of the shareholders. The effect of marketing intensity on the firm value is thus to be assumed positive. As observed, its positive effects prevail over negative effects. Most prior studies have reported net positive effects. However, the net negative effects may result in when investors weigh the cost of expenses on marketing intensity more than the increase in profits and sales (Edeling and Fischer, 2016). To note, a firm's financial performance is a joint function of R&D investment and advertising expenditures in an increasingly competitive market environment.

The net effects of R&D and advertising expenditures are mixed. If advertising can bring higher returns than R&D activities, credit-constrained firms prefer advertising for short-term

gains. They thus reduce the R&D efforts, though advertising and R&D are complements. Advertising generally improves sales, and the reputation of a firm. Advertising may be more efficient for R&D-intensive firms providing less costly goods or services. Advertising may also generate additional cash inflows that may help finance long-term investments in R&D. Based on the above analyses, a positive relationship between R&D and advertising expenditures is expected (e.g., Askenazy et al., 2016; Fogg-Meade, 1901).

The primary objective of this study is to investigate the impacts of R&D and advertising intensities on ROE and Tobin's Q for selected five US IT companies (Apple, Microsoft, Intel, HP, and Oracle) using pooled annual data spanning over 1986 – 2019. These companies have been selected primarily for complete data availability for this sample period. Moreover, they largely belong to the Magnificent Seven constituting 30% of S&P 500 Index Value and are included in the Top-20 best managed firms according to the Wall Street Journal. The balance of the paper is organized as follows. Section II briefly reviews the related literature. Section III outlines the empirical methodology. Section IV reports results. Section V offers conclusions.

BRIEF REVIEW OF RELATED LITERATURE

The relationship between R&D investment and its performance outcomes remain uncertain. As R&D investments are expensed, they reduce profitability in the year they are made (Eberhart, et al., 2004). According to the real options approach, firms invest in R&D in order to create the possibility of growth and performance in the future ([e.g., Bowman and Hurry, 1993; de Andres, de la Fuente and Velasco, 2017, 2021)]. Whether they can exercise these (real) options may depend on a number of contingency factors such as their prior experience with R&D. Ahuja and Novelli (2017) pointed out that R&D investments can also be value-destructive, due to escalating commitment and the length of the feedback cycle that leads to overinvestment in R&D. Whether R&D investments will generate positive returns, how long it will take and how uncertain they will remain (Cuervo-Cazurra and Un, 2010).

Furthermore, the relationship between R&D investments and performance may well be a reciprocal one. Investing in R&D requires resources, including financial capital (e.g., Galunic and Rodan, 1998; Garriga, et al., 2013; Monteiro et al., 2017). Empirical evidences suggest that well-performing firms have greater resources to invest in R&D. So, performance may precede and predict R&D investment (e.g., Guldiken and Darendeli, 2016; Patel and Chrisman, 2014). Investing in R&D may create real options for future firm performance. The past and current performances may also create a resource base for investing in R&D. Disentangling their reciprocal relationships is a challenging task. Their indirect nature, the influence of multiple contingency factors, and the possibility that their direction and strength may vary over time complicate the issue.

Firms invest in R&D in order to create knowledge that enables them to upgrade existing products or to develop new products, services, or business processes (Leiponen, 2012). By doing so, they seek to differentiate themselves from their competitors (Martinez-Simarro et al., 2015). They help create the basis for future growth and performance, and maximize long-term firm value (Filatotchev and Piesse, 2009). For example, R&D has been found to enhance productivity (Aw et al., 2011), profits and firm value (Warusawitharana, 2015). Firms that spend more on R&D create greater technological resources (Heeley et al., 2006) and are more successful in product innovations (Aral and Weill, 2007). Fan et al. (2020) find

that firms facing economic diversity use R&D investments to adapt to the changing market conditions. They thus likely experience stronger returns on R&D investments. They also generate a larger number of patents (e.g., Artz et al. 2010; Bogner and Bansal, 2007; Cardinal and Hartfield, 2000) and greater incidence of highly cited patents. Patents per se do not necessarily exert positive influences on performance outcomes (Arora and Fosfuri, 2003). However, their inimitability characteristic is positively related to future firm profitability (Markman et al.,2004).

Some authors caution that the performance effects of R&D should not be overestimated. Market and technological uncertainty reduce the value of R&D in the initial years of investment (Oriani and Sobrero, 2008). Investing in R&D as a growth strategy also faces a tradeoff in term of immediate cash outflows in the pursuit of subsequent performance, though they may or may not materialize (de Andres et al., 2017, 2021). In their analysis of U.S manufacturing firms from 1973 to 2004, Coad and Rao (2010) find that an increase in R&D expenditure is only weakly associated with growth in the subsequent periods. If the intended growth does not occur, firms may not recoup the R&D investments. Aral and Weill (2007) find R&D investments to be negatively correlated with Tobin's Q. Li and Tallman (2011) report mixed results in this context. Two meta-analyses found that more than 20% of the studies on the relationships between marketing intensity and the firm value show negative or non-significant relationships (Conchar et al. 2005; Edeling and Fischer, 2016).

In a sample of manufacturing companies, Lustgarten and Thomadakis (1987) evaluated the market structure and the specialization of the company in three periods and obtained positive and significant relationships between the intensity of advertising and the firm value. In the first period between 1964 and 1967, the authors observed a negative and non-significant relationship. They explained this result stating that a large number of near-zero values were found for this sample period. To note, the values were either very small or not reportable.

Similarly, Chauvin and Hirschey (1993) confirm the relationship between the intensity of advertising and the value of the firm for companies of different sizes and industrial sectors. They find negative values in two industrial sectors, namely, restaurants and transportation equipment. They measure the value of the firm through the capitalization value of the company in the stock market, and used sales raised to 1.5 as a deflator of the dependent and independent variables. They justify its use because it is the ratio that minimizes the "log-likelihood", without an adequate conceptual or methodological deficiency.

Barth et al., (1998) relate the valuation of sample of brands with the firm value. In one of the models presented, they obtain a negative relationship between the intensity of advertising per share and the value of the share in the stock market. However, in other models, they find positive values. The authors suggest that these negative values are explained by the investors' perception of advertising. Marketing intensity as a part of expense does not necessarily generate future benefit. In the same vein, Krasnikov et al., (2009) find a negative relationship between the firm value, measured as Tobin's Q, and the quotient of the firm's advertising spending. However, the relationship is not statistically significant. The authors' explanation of the negative values is in term of possible sub-optimal level of advertising efforts. Expenses beyond the optimal level lead to diminishing financial returns. Furthermore, businesses lack the right tools to determine the optimal level of marketing spending. Therefore, business would likely be over-investing in advertising.

Heiens et al., (2007) found that the relationship between advertising and firm value is negative, though not significant. The authors opine that firms advertise to increase sales and market shares with no tangible long-term effects. Heiens et al., (2007) also found the relationship between advertising and firm value negative, though insignificant. The effects of intensity of marketing on the value of the firm are mostly positive. However, 21 out of 88 studies on this topic show inverse relationship. The authors explain that it happened because investors consider marketing intensity exclusively as an expense in the current period with no effects in the subsequent periods. Another explanation is that the net effect of marketing intensity on the firm value should be positive in most cases because the positive effects surpass the negative effects. In contrast, Edeling and Fischer (2016) report net negative effects. In the meta-analysis of Edeling and Fischer (2016), it was also noted that 23% of all relationships studied were either negative or insignificant.

EMPIRICAL METHODOLOGY

This study uses pooled data for selected five US IT companies over the sample period for 1986-2019. First, descriptive statistics are computed to describe data distributions of variables. Second, simple correlation coefficients are calculated. Finally, the estimating pooled OLS regressions are specified as follows:

$ROE_{it} = \alpha_o + \sum_{i=0}^{n} \beta it\, RDI_{t-i} + \sum_{i=0}^{k} \varphi_{it}\, ADI_{t-i} + e_{it}$ ------(1)

$TBQ_{it} = \alpha_1 + \sum_{i=0}^{n} \pi it\, RDI_{t-i} + \sum_{i=0}^{k} \Omega_{it}\, ADI_{t-i} + u_{it}$ ------(2)

Where, ROE = Rate of return on equity, RDI = R&D intensity, e and u are error terms, ADI = Advertising Intensity, TBQ = Tobin's Q, t = Time subscript, i = 1, 2….., n and k are the selected lags. βit and πit are expected to be positive, if RDI (R&D expenditure ÷ Total asset) to be effective. φ_{it} and Ω_{it} are expected to be negative, if ADI (Advertising expenditure ÷ Total sales) is effective. A low ADI suggests that advertising campaign helped spark strong sales relative to the money and resources used to advertise. The relevant data are obtained from COMPUSTAT. RDI and ADI are authors' own calculations.

For suitability of the application of pooled OLS to obtain linear and unbiased parameter estimates, the following standard assumptions to be in order: i) The regression model has linearity in its error term and coefficients; ii) The error term's population mean is zero; iii) There are no correlations between the independent variables and the error term; iv) Each observation of the term is independent of others and; v) The error term's variance is constant. Upon checking the above by plots, the pooled OLS is found suitable to obtain linear and unbiased estimates of the parameters. The results are reported as follows:

RESULTS

Table I
Descriptive Statistics

Variable	Mean	Median	Std Dev	Mean/ Median
ROE	3.155	2.25	5.581	1.402
TQ	3.012	2.186	2.393	1.378
ADV_INT_YR	0.024	0.02	0.018	1.200
LAG_ADV1	0.025	0.022	0.019	1.136
LAG_ADV2	0.026	0.023	0.02	1.130
XRD_INT_YR	0.105	0.111	0.05	0.946
LAG_XRD1	0.105	0.111	0.049	0.946

LAG_XRD2	0.105	0.11	0.048	0.955

As evidenced above, ROE depicts higher variability with higher mean relative to those of Tobin's (TQ). The current and lagged values of advertising and R&D intensities have uniformly the least variability. The respective mean/ median ratios are either close to unity or marginally above unity. Approximately, they thus indicate near-normal distribution of each variable.

Table I
Correlation Matrix

	ROE	***TQ***	***ADV_ INT_YR***	***LAG_ ADV1***	***LAG_ ADV2***	***XRD_ INT_YR***	***LAG_ XRD1***	***LAG_ XRD2***
ROE	1.000	-0.002	-0.152	-0.139	-0.129	-0.304	-0.290	-0.276
TQ	-0.002	1.000	0.080	0.017	0.039	0.289	0.279	0.271
ADV_INT_YR	-0.152	0.080	1.000	0.864	0.764	0.247	0.234	0.224
LAG_ADV1	-0.139	0.017	0.864	1.000	0.874	0.250	0.228	0.203
LAG_ADV2	-0.129	0.039	0.764	0.874	1.000	0.261	0.234	0.202
LAG_ADV3	-0.115	0.026	0.650	0.760	0.872	0.267	0.267	0.239
XRD_INT_YR	-0.304	0.289	0.247	0.250	0.261	1.000	0.955	0.919
LAG_XRD1	-0.290	0.279	0.234	0.228	0.234	0.955	1.000	0.949
LAG_XRD2	-0.276	0.271	0.224	0.203	0.202	0.919	0.949	1.000
LAG_XRD3	-0.280	0.254	0.273	0.240	0.213	0.897	0.916	0.946

Upon checking by plots, the pooled OLS is found suitable for this study to obtain linear and unbiased estimates of parameters. Thus, the estimated regression results are reported as follows:

As observed in Table II, the pairwise correlation coefficients in the first row for ROE are consistently negative and very low in magnitudes. In the Tobin's Q (TQ) row, they are positive and quite low. In other cases, they are positive and mostly low except a few. In an overall context, they likely suggest the presence of mild-to-moderate multicollinearity, posing no serious statistical problem.

Table 3
Regression Results

	ROE			**TQ**	
CONSTANT	4.920*	(0.097)		3.029***	(0.008)
ADV_INT_YR	-13.372	(0.806)		-13.855	(0.508)
LAG_ADV1	15.278	(0.814)		-30.828	(0.220)
LAG_ADV2	18.545	(0.720)		21.373	(0.283)
XRD_INT_YR	-48.560	(0.183)		30.160**	(0.032)
LAG_XRD1	1.501	(0.973)		1.120	(0.948)
LAG_XRD2	12.788	(0.711)		-14.768	(0.266)
N	160			160	
R^2	0.2585			0.4034	

p-values in parentheses

*p < 0.10, ** p < 0.05, *** p < 0.001

In the case of the estimating multiple regression (1), the impacts of advertising and R&D intensities in the current year are negative since the investments are expensed in this year. In other years, they are positive. However, they all are statistically highly insignificant in terms of the respective associated p-value. Taking the sum of the coefficients, the net impact of

advertising intensity on ROE deems positive. That of R&D intensity is seemingly negative. The numeric of R^2 at 0.26 shows that merely 26% percent of ROE is contributed by the above explanatory variables.

In the case of the estimating multiple regression (2), the impacts of advertising intensity are negative for the two initial years, except the third year in the lag-structure with statistical insignificance, while the net impact is still negative. In contrast, the effects for the initial two years are positive with higher statistical significance for the current year. In the third year, it is statistically insignificant in terms of the associated p-value, likewise. However, the net effect is quite positive in terms of the sum of all the coefficients. R^2 at 0.40 also reveals relatively higher explanatory power of the same independent variables, compared to regression (1).

CONCLUSIONS

The pooled data distributions of ROE and Tobin's Q with their respective explanatory variables appear to be near-normal. The correlation coefficients with the associated independent variables are uniformly negative and mild. Those of Tobin's Q are uniformly positive and mild. Thus, both reveal very modest problem of multicollinearity. The regression results for ROE show net positive effect of both advertising and R&D intensities, though their individual numerical coefficients are statistically insignificant. The same is true for the net effect of advertising intensity on Tobin's Q. However, the net effect of R&D intensity on Tobin's Q is positive with statistical significance in one case. To mention a few, our findings are consistent with those of Heins et al. (2007), and Li and Tallman (2011). Both report mixed results.

References

Ahuja,G., & Novelli, E. (2017). Activity overinvestment: the case of R&D. *Journal of Management, 43*(8), 2456-2468.

Aral, S., & Weill, P. (2007). IT assets, organizational capabilities, and firm performance: how resource allocations and organizational differences explain performance variation. *Organization Science. 18*(5), 763-780.

Arora, A.M., & Fosfuri, A. (2003). Licensing the market for technology. *Journal of Economic Behavior and Organization*, *52*(2), 277-295.

Artz, K.W., Norman, P.M., Hatfield, D.E., & Cardinal, L.B. (2010). A longitudinal study of the impact of R&D, patents, and product innovation on firm performance. *Journal of Product Innovation and Management*, *27*(5), 725-740.

Askenazy, P., Breda, T., & Irac, D. (2016). Advertising and R&D: Theory and evidence from France. *Economics of Innovations and New Technology, 25*, 33-56.

Aw, B., Roberts, M., & Xu, D. (2011). R&D investment, exporting, and productivity dynamics. *American Economic Review*, *101*(4), 1312-1344.

Barth, M.E., Clement, M.B., Foster, G., & Kasznik, R. (1998). Brand values and capital market valuation. *Review of Accounting Studies*, *3*(1-2), 41-68.

Baumol, M. (2001). The free-market innovation machine, Princeton.

Bogner, W.C., & Bansal, P. (2007). Knowledge management as the basis of sustained high performance. *Journal of Management Studies*. 44(1), 165-188.

Bowman, E.H., & Hurry, D. (1993). Strategy through the option lens: an integrated view of resource investments and the incremental-choice process. *Academy of Management Review, 18*(4), 760-782.

Cardinal, L.B., & Hatfield, D.E., (2000). Internal knowledge generation: the research laboratory and innovative productivity in the pharmaceutical industry. *Journal of Engineering and Technology Management, 17*(3). 247-271.

Chauvin, K.W., & Hirschey, M. (1993). Advertising, R&D expenditures and the market value of the firm. *Financial Management*, 128-140.

Coad, A., & Rao, R. (2010). Firm growth and R&D expenditure. *Economics of Innovation and New Technology*, *19*(2), 127-145.

Conchar, M. P., Melvin R.C., & George, M. Z. (2005). Market valuation models of the effect of advertising and promotional spending: a review and meta-analysis. *Journal of the Academy of Marketing Science*, *33*(4), 445-460.

Cuervo-Cazurra, A., & Un, C.A. (2010). Why some firms never invest in formal R&D. *Strategic Management Journal*, *31*(7), 759-779.

de Andres, P., de la Fuente, G., & Velasco, P. (2017). Diversification, relatedness and growth options value: beyond a linear relationship. *Long. Range Plan, 50*(6), 840-861.

de Andres, P., de la Fuente, G., & Velasco, P. (2021). Exercising a firm's growth options: a portfolio approach. *Journal of Business Research*, *132*, 571-585.

Eberhart, A.C., Maxwell, W.F., & Siddique, A.R. (2004). An examination of long-term abnormal stock returns and operating performance following R&D increases. *Journal of Finance. 59*(2), 623-650.

Edeling, A., & Fischer, M. (2016). Marketing's impact on firm value: Generalizations from a meta-analysis. *Journal of Marketing Research*, 53(4), 515-34.

Fan, D., Rao-Nicholson, R., & Su, Y. (2020). When tough get going: performance of R&D in the adverse economic conditions. *Long. Range plan. 53*(3), 101867.

Filatotchev, I., & Piesse, J. (2009). R&D, internationalization and growth of newly listed firms: European evidence. *Journal of International Business Studies*, *40*(8), 1260-1276.

Fogg-Meade, E. (1901). The place of advertising in modern business. *Journal of Political Economy*, *9*, 218-242.

Galunic, D.C., & Rodan, S. (1998). Resource recombination in the firm: knowledge structures and the potential for Schumpeterian innovation. *Strategic Management Journal*. *19*(12), 1193-1201.

Garriga, H., Von Krogh, G., & Spaeth, S. (2013). How constraints and knowledge impact open innovation. *Strategic Management Journal*, *34*(9), 1134-1144.

Guldiken, O., & Darendeli, I.S. (2016). Too much of a good thing: board monitoring and R&D investments. *Journal of Business Research*, *69*(8), 2931-2938.

Heeley, M.B., King, D.R., & Covin, J.G. (2006). Effects of firm R&D investment and environment on acquisition likelihood. *Journal of Management Studies*, *43*(7), 1513-1535.

Heiens, R.A., Leach, R.T., & McGrath, L.C. (2007). The contribution of intangible assets and expenditures to shareholder value. *Journal of Strategic Marketing*, 15(2-3), 149-159.

Krasnikov, A., Mishra,S., & Orozco, D.(2009). Evaluating the financial impact of branding using trademarks: a framework and empirical evidence. *Journal of Marketing*, *73*(6), 154-166.

Leiponen, A. (2012). The benefits of R&D and breadth in innovation strategies: a comparison of Finnish service and manufacturing firms. *Industrial and Corporate Change.* 21 (5), 1255-1281.

Li, S., & Tallman, S. (2011). MNC strategies, exogenous shocks, and performance outcomes. *Strategic Management Journal*, *32*(10), 1119-1127.

Lustgarten, S., & Thomadakis, S. (1987). Mobility Barriers and Tobin's q. *Journal of Business*, 519-537.

Markman, G.D., Espina, M.I., & Phan, P.H. (2004). Patents as surrogates for inimitable and non-suitable resources. *Journal of Management*, *30*(4), 529-544.

Martinez-Simarro, D., Devece, C., & Llopis-Albert., C. (2015). How information systems strategy moderates the relationship between business strategy and performance. *Journal of Business Research*, *68*(7), 1592-1594.

Monteiro, F., Mol, M. & Birkinshaw, J., (2017). Ready to open? Explaining the firm level barriers to benefiting from openness to external knowledge. *Long. Range Plan*, *50*(2), 282-295.

Oriani, R., & Sobrero, M. (2008). Uncertainty and the market valuation of R&D within a real options logic. *Strategic Management Journal*, *29*(4), 343-361.

Patel, P.C., & Chrisman, J.J. (2014). Risk abatement as a strategy for R&D investments in family firms. *Strategic Management Journal*, *35*(4), 617-627.

Petro, F., & Elgar, E. (2004). Tobin's Q: general equilibrium, capital and macroeconomics, Massachusetts, USA: Edward Elgar Publishing Inc.

Schumpeter, J. (1912). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle, translated from the Germany by Redvers Opie (1961), New York: OUP.

Tobin, J. (1969). A general equilibrium approach to monetary theory, *Journal of Money, Credit and Banking*, *1*(1), 15-29.

Warusawitharana, M. (2015). Research and development, profits, and firm value: a structural estimation. *Quantitative Economics*, *6*(2), 531-5