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The effect of R&D investment on firm value: An examination of US manufacturing and service industries

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ABSTRACT

We examine the association between investment in research and development (R&D) and market value among US firms over an 18-year period covering 26,500 firm-years. We study the R&D investment–firm performance linkage in both manufacturing and service industries to evaluate differences in their relative contributions to firm value. Finally, we investigate the impact of a major economic disruption such as the terrorist bombing of the World Trade Center in New York on September 11, 2001 (popularly known as 9/11) on R&D investment relative to the performance of a firm. After controlling for firm size, industry concentration, and leverage, we find that R&D investment positively affects firm performance. More specifically, R&D investment in the manufacturing sector contributes more positively to firm market value than in the service sector pre-9/11. However, the service sector shows stronger R&D investment–market performance association post-9/11 than manufacturing firms. Consistent with the resource-based literature, the results show that investment in R&D contributes positively to firm performance for both manufacturing and service firms, despite major economic disruptions.

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1. Introduction

As technology and innovation seem to be synergistic, a great deal of attention has been given to the importance of assessing the contribution of R&D investment to firm performance. Hall and Bagchi-Sen (2007) used R&D intensity (percent of firm revenue expended on R&D) to measure commitment to innovation in US biotechnology firms. In an era of global competition, there is general agreement that technological competitiveness is vital for the economic well-being of a company. The decisions made by management today regarding R&D investment can influence the viability, growth, and competitiveness of an organization in future periods (Morbey, 1988). While R&D projects are typically associated with high uncertainty and no immediate payoff, these investments have shown to create future opportunities that are both profitable and capable of providing the company with distinct competitive advantage. Due to increasing competition, firms are systematically pushed to search for growth opportunities in the market and to get to market before their competitors. This implies that they should innovate at an extraordinary pace by developing and improving new products and services, and by generating ideas expressly intended to become commercially viable and profitable business ventures. The answer to all the challenges seems to rely on innovation, a by-product of R&D investment. The evidence, therefore suggests that R&D investment creates value for the firm because it provides competitive advantage through differentiation strategies that produces new and better products and services.

While research on the effectiveness of R&D investment is evident, little attention has been given to the differences in R&D expenditures between manufacturing firms and service firms, or differences in the subsequent impact on firm performance for each type of firm. Furthermore, the impact of disruptive economic events such as 9/11 on R&D expenditures has not been empirically examined. Anecdotal evidence has shown that companies tend to reduce their R&D expenditure after a major economic disruption. Large catastrophic events such as hurricane Katrina in 2005, the Asian tsunami in 2004, the September 11 attacks in 2001 (9/11), Mad Cow disease in the UK in 2001, and the Taiwan earthquake in 1999, although occurring rarely, can have severe consequences on firms' competitiveness on a global scale. Hendricks and Singhal (2003, 2005, 2009) and Rice and Caniato (2003) document that stock markets react very negatively to disruptions and that disruptions result in low profits and sales, and higher costs. This study adds to the literature by investigating the impact of the disruptive economic conditions created by the 9/11 attack in regards to R&D investment and its subsequent effect on firm value.

This study, therefore contributes to the extant literature in the following ways. The dataset covering 26,500 firm-years over an

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18-year period (1990–2007) is more extensive and recent than previous studies. Given the extensive dataset, the findings are more robust and add to our understanding of the valuation of US firms as related to R&D investment. Examining how R&D investments impact market value is of interest to both investors and managers because of the potential to estimate firm value and guide managerial decisions in R&D investment, respectively. Second, we examine the effect of R&D investment on firm performance for manufacturing and service firms to understand the differences in their relative valuation effects. We ask whether investment in R&D has a different valuation premium in manufacturing versus service firms. Finally, we examine the effect of major economic disruptions such as 9/11 on R&D investment in the quest for higher market performance. Compared to past studies that investigate the impact of R&D investment on firm value in manufacturing and non-manufacturing firms (Ho et al., 2005; Chauvin and Hirschey, 1993; Hall, 1993; Erickson and Jacobson, 1992), this study employs a recent dataset to examine the R&D investment–firm value linkage in a wide range of issues in service and manufacturing industries.

The next section presents the literature review. This is followed by Section 3 that develops the hypotheses. Section 4 describes the data collection, along with the pertinent predictor and explanatory variables used in the study. Section 5 gives the discussion of the results and finally Section 6 presents the summary and conclusion along with limitations and areas for further studies.

2. Literature review

Past studies have documented that a firm's R&D investment consistently and positively affects its market value (Chan et al., 1990; Doukas and Switzer, 1992; Chauvin and Hirschey, 1993; Bae and Noh, 2001; Ho et al., 2005; Bae et al., 2008). Corporate R&D investment also plays a vital role in a firm's future growth (Bae and Noh, 2001). Increasing R&D activity has been considered key to innovation (Cardoso and Teixeira, 2009). In a study of the mobile phone industry in Finland, Walwyn (2007) reports a high multiplier effect for the role of R&D investment in increasing national competitiveness. Karlsson et al. (2004) made a distinction between research and development. They contend that a firm's research activities, distinct from its development activities, provide a vehicle for measuring the firm's productivity. Development, on the other hand, is the commercialization of those research activities. Both combined gives one a better assessment of the R&D investment.

As the debate on R&D investment–firm value association rages on, there have been other research studies that have found negative results. Hall (1993) finds that stock market valuation of R&D capital in US manufacturing firms collapsed precipitously between the periods 1979–1983 and 1986–1991. The author further indicates the expected rate of cash flow from assets by R&D investment was one quarter that of non-R&D investment. Erickson and Jacobson (1992) found that neither R&D nor advertising expenditures increase the market value of the firm more than other types of investments and expenditures. The authors substantiated their claim by stating that the positive correlation between R&D expenditures and stock market performance reported in previous research reflects the joint effect of firm profitability on stock performance and the level of discretionary spending.

Investment in R&D is considered as an investment in intangible assets that contributes to the long-term growth of the firm (Chan et al., 2001). In today's world, much of a firm's assets are less tangible because the need to gain market competitiveness through knowledge of consumer perception is greater than the need to do so through the acquisition of more tangible physical assets. Companies now derive more benefit from branding of their product and services and less from their physical infrastructure. Therefore, a firm's value depends more on their intangible assets. Successful investment in R&D results in an innovative product and services which enables the firm to enhance its intangible assets, thus differentiating itself from other firms.

The study adds to existing knowledge by utilizing a more current data sample than previous research, and by considering a substantially broader time period and more diverse set of firms. We provide evidence to examine whether the linkage between R&D investment and market value (measured as the product of share prices and common shares outstanding) are consistently positive over the 18-year period covering 1990 through 2007. First, we test the relationship between R&D investment and firm value across all firms in the sample. Second, we compare service and manufacturing firms to test differences in valuation. Finally, we investigate the role of a major economic disruption such as the bombing of the World Trade Center in New York on 9/11 and its effects on the R&D investment–firm performance association. Lee and Hancock (2005) reported that the terrorist attacks on 9/11 set off a chain of events that raised concerns about the agility of business processes in the case of unforeseeable global disaster. The increased cost of security since 9/11 has resulted in the redistribution of the general budget with subsequent cuts in research spending (Beyer et al., 2003). This study builds on related research by Chauvin and Hirschey (1993), Pantzalis (2001), and Ho et al. (2005). Each of these studies corroborates that increased expenditures in R&D coincide with positive share price announcements.

3. Hypotheses development

3.1. Role of R&D investment on firm value

The difficulty in making the connection between R&D investment and firm value continues to draw a great deal of interest. Osawa and Yamasaki (2005) outlined three factors that inhibit the linkage between R&D investment and firm value. These are having no definitive means to measure R&D results, time lag between initial R&D investment and the emergence of results, and lastly, appropriate indices not being adopted because of the absence of well-established concepts in respect to future project techniques, thereby undermining the pervasiveness of any measurement of R&D performance. Therefore, it becomes increasingly difficult to accurately quantify the total effects of cumulative investments in R&D as the time lag lengthens. As a general rule, firms that invest heavily in R&D are more likely to be profitable and successful. The industrial organization literature suggests that R&D intensity is an important determinant of firm profitability and, according to Hay and Morris (1979), high investment in R&D is generally a high risk–high return strategy that is attractive to shareholders in anticipation of better financial performance. The above discussion suggests that the focus on R&D may increase a firm's innovative capability and therefore, may enhance the ability of the firm to reap better performance in the marketplace. Accordingly, our initial hypothesis is stated as follows:

H1. Investment in R&D has a positive effect on the market value of a firm.

3.2. Effect of R&D investment in manufacturing and service firms

While there is evidence regarding the effectiveness of R&D investment, little attention has been given to difference between