EVALUATING THE INFLUENCE OF R&D INVESTMENT ON CORPORATE PROFITABILITY: A SECTORAL ANALYSIS

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Abstract

Purpose - This study examines how R&D expenditure affects corporate profitability, with a particular focus on Sri Lankan listed companies in the industrial and service sectors. It seeks to ascertain whether R&D spending has a major effect on profitability metrics like return on equity (ROE) and return on assets (ROA).

Design/Methodology/Approach - Twenty firms listed on the Colombo Stock Exchange (CSE) were chosen through the use of a purposive sampling technique. A quantitative methodology based on secondary data from 2020 to 2025 is used in the study. After adjusting for company size, leverage, sales growth, and asset tangibility, descriptive statistics, correlation, and regression analyses were used to investigate the relationship between R&D expenditure and corporate profitability.

Findings - The findings show that R&D investment and profitability metrics (ROA and ROE) have a favorable and statistically significant association. Businesses with more R&D expenditures performed better financially. Furthermore, whilst leverage had a negative effect on profitability, company size had a positive one. There was no discernible direct relationship between sales growth and tangibility. The results indicate that for businesses looking to improve financial results, R&D spending should be seen as a strategic long-term investment.

Research Limitations/Implications - The study is restricted to a five-year observation period and a small sample of Sri Lankan enterprises. Without additional verification, the results could not apply to all industries or economies. Larger cross-industry samples, longitudinal designs, and an examination of the moderating impacts of corporate governance on R&D efficiency should all be included in future studies.

Originality/Value - By offering actual data from a developing economy context specifically, Sri Lanka where few studies have been conducted on the relationship between R&D expenditure and profitability, this paper closes a sizable research gap. For businesses looking for long-term competitiveness and profitability in emerging markets, it emphasizes the strategic significance of consistent R&D investment.

Keywords:

R&D Investment, Corporate Profitability, Innovation, Emerging Markets, Firm Performance, Return on Assets (ROA), Return on Equity (ROE), Colombo Stock Exchange (CSE)

1. Introduction

The term R&D is widely linked to the concept of corporate or governmental innovation and becoming the prominent term in business world. Great companies invest in innovation. Those that roll the dice on research & development tent to generate bigger profits. The R&D is typically not performed with the expectation or goal of immediate profit. Instead, it is focused on long term profitability for a company. R&D expenditures and patents are important means to improve an enterprises capacity in technological innovation, and are also drivers for sustainable development of a country. In today's competitive landscape, firms' investments in innovative activities have become one of the most important factors that allow for their sustainability. In the information age of the 21st century, timely and adequate investment in knowledge and innovation will provide firms with a competitive advantage. Since the 1980s, when the globalization process gained momentum, the companies that have played a leading role in bringing innovation to their industries have increased their market share and provided added value to their economies.

A number of published studies show that such firms are able to provide benefit both to themselves and to their economic systems with these innovative investments. During the last few decades scholars have increasingly stressed the importance of research and development (R&D) in the manufacturing sector. Technology-based companies in this sector put forth large expenditures for R&D in order to maintain their competitive advantage and ensure their future viability (Lee et al., 2011). This implies that due to increasing competition, firms 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 (Ehie and Olibe, 2010). Innovativeness is one of the fundamental instruments of growth strategies to enter new markets, to increase the existing market share and to provide the company with a competitive edge (Gunday et al, 2011).

Companies have become more motivated to carry out R&D as a result of the fact that most of the world`s economies have embarked policies reforms on market-oriented liberalization aimed at promoting economic performance (Salim and Bloch, 2009). Additionally, the spillover effects from R&D are beneficial not only to firms but also to economies. Therefore, corporate R&D activities as well as public R&D activities will produce R&D spillovers that will eventually yield benefits to the entire society (Bednyagin and Gnansounou, 2012).

Due to the rising costs of R&D and the increasing dependence of companies on technology for competitive advantage, managers seek evidence of the impact of R&D on performance. Past studies have documented that a firm's R&D investment consistently and positively affects its market value (Chauvin and Hirschey, 1993; Bae and Noh, 2001). Corporate R&D investment also plays a vital role in a firm's future growth (Bae and Noh, 2001). As firms and industries continue to evolve, R&D has increasingly become a critical element of firm success and survival (Jimenez and Sanz-Valle, 2011; Bell, 2005) and sustainable competitive advantage (Johannessen, 2008; Mumford and Licuanan, 2004). Taking 883 firms in the United States during 1957-1965 as sample and using Cobb-Douglas production function, Griliches (1980) found that R&D was positively correlated with operating performance.

Then, Jaffe (1986), Hall (1993) and Klette (1996) used similar methods to study the same subject; they all supported the conclusions of Griliches (1980). The evidence, 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. In the last few decades a large number of studies have attempted to map the channels and mechanisms through which new knowledge is transformed into better performance (Hashi and Stojcic, 2013). The evidence from this literature is inconclusive thus calling for further research. There are different the definition of R&D. Generally, scholars accept the definition of R&D put forth by the Organization for Economic Cooperation and Development (OECD, 2008): ''R&D comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.''

R&D is the basis of innovation and the key to improve the core competence of listed companies. Increasing R&D activity has been considered key to innovation (Cardoso and Teixeira, 2009). R&D capability is a source of innovation (Wang et al, 2013). As noted by Mone et al. (1998), innovation capability is the most important determinant of firm performance. Another study by Renko (2011) shows innovativeness is a key determinant of return on assets. Moreover, R&D is also known as innovation cost because it is the cost of discovering new knowledge concerning the manufacturing processes of a company, its products and its services (Khazabi, 2008). R&D expenditures were used as a proxy for innovation inputs (Zhong et al, 2011.

R&D innovation efforts are the most important activities of high-technology firms; that is, R&D investments are one of the most crucial elements to scientific and technological progress (Verma and Sinha, 2002). Innovation is a key element for firms to be successful and competitive in the long run in the knowledge-based economy (Sum, 2013). Although the effect of research and development (R & D) expenditures on profitability and stock returns has been investigated in studies such as those mentioned above, we have not encountered the usage of co-integration tests and error correction models to examine the relationship between the variables in both the short- and long-term, and we have not found a study using data that cover such a wide interval of time. Therefore, to contribute to the literature in this study, we plan to answer the question "To what extent does R&D expenditure affect firms' profitability?"

Over the previous years, numerous studies on R&D and profitability have appeared. Each of the R&D and profitability theories are not designed to be general rather they are conditional theories. Most of these studies are based on data from developed countries' firms and very few studies provide evidence from developing countries. Even though research studies related to the area of R&D and profitability, those that are concerned in the financial system of developing countries are few. This study, therefore attempts all its best to contribute to the literature by assessing the effect of R&D on profitability of selected listed companies in Sri Lanka. There is a limited empirical research papers in Sri Lanka. It is predominant to understand impact R&D on profitability. Therefore this study fills the stated gap by identifying the impact of R&D on profitability.

Based on the research problem, the findings of past researchers and through a literature review, the following research question is formulated. "To what extent R&D effect profitability of a firm? And the primary objective is to find out relationship between R&D expenditures and profitability of the listed companies in Sri Lanka.

The scope of the study restricted to the sample listed companies in Sri Lanka which are listed on Colombo Stock Exchange. There are 290 listed companies in the CSE but this study consists of 20 listed companies. In other words, the reason why this study is delimited to listed companies in CSE which are emerging and flourishing in Sri Lankan economy where the literature on R&D and Profitability. Since listed companies in CSE are emerging and flourishing in the Sri Lankan economy assessing the effect of the R&D on profitability will help concerned parties innovate

actions that can fortify their competitive position in the industry. This study, therefore, apart being a step for the researcher's educational career, has the following importance. First, the result of the study is important to external investors and shareholders, professional managers, lenders and policy makers. Because, External investors and shareholders able to know the effect of the companies R&D on profitability and to observe firm's performance before making the decisions. Professional managers consider these effects of R&D on profitability to establish the optimal financing vehicle that helps to achieve the firm's objectives and Lenders find the results in evaluating the firm's performance before giving loans.

And also this study benefits to the academicians who may have an insight into the management thinking and their perception of the firm's performance. Last, but not least the study notably contributes to other studies to be made in different economic sectors by providing the picture of the effect of R&D and profitability of selected listed companies in Sri Lanka by serving as a reference point.

Limitations of the Study are It was only carried out at listed companies in Sri Lanka.**,** The data was collected from the Colombo Stock Exchange (CSE) website as it was the secondary data, which had already been obtained and was in the public domain, unlike the primary data which is first-hand information., The findings of the study are limited within only one sector and 20 companies. And the data representing the period of 5 years (2020-2025) were used for the study.

2. Literature Review

In this literature review, the focus is on previous research that has been done on R&D expenditures and firm's profitability. An overview of the concepts is discussed based on that the researcher develops the integration between the basic concepts. This theoretical background will then build a foundation for the consequent empirical research and analysis of the situation in Sri Lanka listed companies. This chapter includes operating & capital expenses, the accounting treatment of research and development expenses, consequences for earnings measurement, a financial analysis of R&D expenses, a reclassification of R&D expenses, the effect on assets and capital R&D expenses and profitability relevancy theories and review from other related research papers. Most valuation models begin with a measure of accounting earnings to arrive at cash flow estimates.

When using accounting earnings, researcher implicitly assumes that the income is obtained by netting out only those expenses that are operating expenses, i.e., expenses designed to generate revenues in the current period. Expenses that are intended to provide benefits over multiple periods are assumed to be considered as capital expenditures, and these expenses are depreciated or amortized over multiple periods. In addition, when computing profitability measures such as return on equity and capital, this research sticks with this assumption that operating income measures income generated by assets in place. In this paper, researcher examines the accounting treatment of research and development expenses, and the effects of the treatment on operating income, capital and profitability. We argue that research and development expenses should be treated as tax-deductible capital expenditures, for purposes of valuation, and this can have significant effects on operating income, capital and expected growth measures for firms with substantial research expenses.

The operating income for a firm is estimated by netting out all operating expenses from revenues. When valuing a firm, we usually begin with after-tax operating income and then reduce it by the reinvestment needs of the firm. The reinvestment needs cover any investments that the firm needs to make to generate future growth, and include both capital expenditures and working capital investments. The distinction between operating and capital expenditures is critical for tax calculations, and is important in determining both the amount of capital on a firm's books and how its profitability is measured. In this paper, researcher will consider the accounting treatment of research and development expenses as operating expenses, and argue that it is not appropriate to do so, at least for valuation purposes.

R&D and Innovation

In order to remain competitive in the 21st century, companies must continue to innovate, generating new products, streamlining the production process, improving delivery, and refining the customer interface. Investment in R&D is key. Certainly, even companies synonymous with innovation – Apple, Alphabet and Amazon for example – can only maintain their status through substantial investment. However, spending is not a prerequisite for innovation. The health sector fails to place o the technology – dominated innovation list. The same can be said for the automotive industry, which occupies a number of the top spending spots, but can only lay claim to one of the world’s most innovative companies.

With the world's largest corporate investors racking up a combined R&D bill in excess of $680bn, there is no question innovation costs. But, as Elon Musk's outfit has illustrated, the correlation between investment and innovation is not quite as simple as one might assume. There's no storage of literature mapping the relationship between R&D investment and economic growth on a national scale, but we should not assume the same holds true at a corporate level. Indeed, industry commentators have repeatedly asserted there is no significant parallel between the amount a firm invests and its subsequent financial performance. That said, a failure to invest does tend to have a negative effect. Of course, the level of R&D intensity varies across different industries, with some, such as healthcare, requiring far higher levels of investment. One thing that does remain certain, however, is that investment into R&D in no panacea for poor performance. Companies must develop innovations that are not necessarily the most advanced or the best available, but which meet the specific needs of the market.

The most important thing, according to Harvard Business School professor Gary Pisano, is to have a coherent innovation strategy that closely aligns with the overall strategy of the business. To allow the best ideas to flourish, there must be structures in place to dictate how a company identifies, develops and allocates funding to the ideas that resonate with its overall goals. This ultimately provides scope for the trade-off decisions that allow innovations to move forward, shaping systems that can be molded or improved overtime according to each company's needs. Crucially, this will also help to resolve interdepartmental tensions, namely between those focused on developing new ideas and those responsible for maintaining or developing relationships with clients in the short term.

Operating and Capital Expenditures

Accounting statements classify all expenses into three categories – operating expenses, financing expenses and capital expenses. Operating expenses are expenses that, at least in theory, provide benefits only for the current period; the cost of labor and materials expended to create products which are sold in the current period would be a good example. Financing expenses are expenses arising from the non-equity financing used to raise capital for the business; the most common example is interest expenses. Capital expenses are expenses that are expected to generate benefits over multiple periods; for instance, the cost of buying land and buildings is treated as a capital expense.

Operating expenses are subtracted from revenues in the current period to arrive at a measure of operating earnings from the firm. Financing expenses are subtracted from operating earnings to estimate earnings to equity investors or net income. Capital expenses are written off over their useful life (in terms of generating benefits) as depreciation or amortization. The distinction between operating and financing expenses may not be significant for tax purposes, since both are tax deductible, but the distinction between operating and capital expenses affects taxes. Operating expenses are deductible in the period in which they are made, whereas capital expenses are written off over the useful life of the investment. The distinction also matters for purposes of asset and capital measurement. Operating expenses create no assets and affect capital only indirectly through retained earnings. Capital expenses, on the other hand, create assets and consequently affect capital as well.

The Accounting Treatment of Research and Development Expenses

Capital expenditures are defined as those expenditures that are likely to create benefits over multiple periods. By this definition, investments in land, plant and long term equipment are capital investments, but so is research and development. In fact, a reasonable argument can be made that research and development expenses (R&D) are more long term than investments in physical plant and equipment at many firms, especially those in the pharmaceutical and high technology sectors. Thus, it follows that R&D expenses should be treated as capital expenditures. In reality, however, accounting standards in the United States require the treatment of R&D as operating expenses.

Consequences for Earnings Measurement

The treatment of R&D as an operating expense has the immediate effect of lowering both operating and net income. The tax deductibility of these expenses buffers the impact somewhat, and the net income and after-tax operating income are both reduced by the following: After-tax Effect of R&D expense on earnings = R&D Expenses (1 - marginal tax rate) For companies that end up with negative earnings as a consequence of research expenses, the after-tax effect will be even larger because the tax benefit has to be deferred until future periods. The treatment of research expenditures as operating expenses also implies that research expenditures create no assets. Thus, patents that emerge from internal research will not be shown as assets on the balance sheet. In contrast, patents acquired from third parties can be treated as assets.

A Financial Analysis of Research and Development Expenses

Research and development expenses are designed to generate future growth and should be treated as capital expenditures. In this section, we will consider how to reclassify research expenses and the consequences for reported earnings, capital and profitability.

A Reclassification of R&D Expenses

The first step in the reclassification of R&D expenses is to remove it from operating expenses and show it as a capital expenditure. The steps that follow are not as simple. First, the reclassified R&D expense becomes a capital expense and is no longer expensed. Second, capital expenses create assets, and R&D is not an exception. The after-tax R&D expense has to be cumulated over time to create an asset that we can loosely call the research asset. Third, like other assets, the research asset can lose value over time and hence may have to be amortized over its life. The amortization that is generated is not tax deductible, but it will affect operating income. The movement of R&D from the operating expense to the capital expenditure column can have profound implications for profitability measures and for projections of cash flows into the future.

The Effect on Assets and Capital

When we treat R&D expenses as capital expenditures, we have to maintain consistency and treat cumulated R&D expenses as an asset. The simplest way to do this is to cumulate the after-tax research and development expenses over time and create a research asset. This asset will then be amortized over time, with both the length of the amortization period and the amortization schedule being determined by the nature of the research expenses, and the estimated time until there is a payoff to the investment. Thus, for pharmaceutical companies where FDA approval can take as long as a decade, the research asset will be amortized over an extended period. In contrast, for high technology firms where the payoff is much sooner, the research asset will have to be amortized over a shorter period.

R&D Expenses and Profitability Relevancy Theories

The purpose of this paper is to analyze whether or not firms who invest more funds into research and development experience a higher profitability than those firms who spend less. The paper will use past literature to develop an appropriate and testable hypothesis. Schumpeter's theory of creative destruction will also provide support for the research question.

The basis of this paper is derived from Schumpeterian economics. In Schumpeter's book, Capitalism, Socialism and Democracy, Schumpeter argues that innovation drives the economy under capitalism. Schumpeter describes this process as creative destruction. When new products are introduced that are of better quality than their predecessors, they eliminate the market for the original product and create a new market. Therefore, in industries where new products are introduced often, innovation is essential to each firm's survival. The creation of new products, and hence new markets, gives a firm a competitive advantage in the market and allows the firm to earn excess profits. Firms who consistently innovate can have persistent profits. As new markets are created, other firms will attempt to imitate the product in order to drive the excess profits down. The success of the imitation will depend heavily on restrictions to copy other firms' products. Those restrictions will typically come in the form of patents, and the characteristics of patents within the industry. If there are heavy restrictions, the firm who innovated should have a higher market value than they previously had, because they are now more profitable. Once patents expire however, the firm who originally invented the product will need to innovate further in order to remain competitive and keep their market value high. The need to continuously innovate drives competition in higher innovative sectors of the economy (Roberts, 2001).

Firms attempt to innovate by doing research. The amount of funds that are poured into research should reflect the success of the research projects. For example a research project with a 1 million dollar investment may come back with a good product. However, a firm who invests 10 million dollars into their research project should have a good chance at creating a better product than the other firm because it has more resources at its disposal. The positive correlation between profitability and acquiring patents has been shown in past literature (Rzakhanov, 2004). Therefore, if acquiring patents increases a firm's market value, and spending more funds on research and development gives firms a better likelihood to innovate, then spending more funds on research and development should increase a firm's market value and profitability.

As proposed by Chan (2001) there exists an element of risk when firms invest in research and development because of the uncertain profits that the research and development investments may bring. However, even with this uncertain outlook, theoretically, firms will still have a strong incentive to invest heavily in research and development because the reward of doing so should heavily outweigh the possible losses. The above discussion suggests that the greater intensity on research and development should increase a firm's innovation capabilities and therefore could possibly increase the firm's profitability.

Review from other related research papers.

The relation between firms' R&D expenditures and profitability has been subjected to several studies since the 1970s. Researchers have used different profitability indicators of firm's indifferent sectors to measure the effects of R&D activities on business performance and have attempted to determine the factors that directly or indirectly affect this relation. A reason why there are so many such studies the diversity of available statistical and econometric models. Each study is distinctive and different. Thus, because these models have individual hypotheses, they require different variables and shed light on different aspects of the relation (e.g., the long or short term, continuity of the relation, interactive latency).However, finding a direct relationship between R&D and future performance of a company could be quite questionable as it could take several years for the R&D projects generate revenue to the firm which now remains uncertain. Indeed, investment in R&D creates value, but it is always difficult for an investor to reliably estimate its impact on business results. This difficulty is due to the same characteristics of this investment (risk, time horizon, uncertainty ...).Indeed, the huge costs involved in R&D activities can generate either high levels of performance in case of innovation success is zero returns on failure. Despite the uncertainty of future benefits and assessment difficulties associated with investments in R&D, empirical research studying the link between spending R&D and company performance have continued to increase. During the last three decades, and even today a large literature attempts to identify the impact of R&D expenditure on the financial performance of a firm.

When examining the literature, studies indicating that there is a positive relation between R&D and profitability are relatively dominant. However, some studies indicate that R&D expenditures have no effect on the profitability of firms, such as those of Lee et al. (1994) .

Positive Relationship between the R&D Expenditure and profitability and other variables

R&D and Profitability

A large or increasing profit scale due to high revenues at a firm indicates that the firm is successful, and induces the firm to make active R&D investment. Moreover, a large profit scale and increased profits show that internal funds can be used for R&D investment. Kamien and Schwartz argue that the relationship between R&D investment and net profit differs in intensity depending on the firm. Venture businesses with high risk finance their own investments, making high ordinary profit crucial. This is because securing liquidity from profits generated by the firm itself can be the direct financing for R&D investment. This study sets up the following hypothesis to analyze the influence of the profitability [return on investment (ROI)] of pharmaceutical companies on R&D investment based on previous studies.A positive and significant relation between the costs, which indicate firm's R&D expenditures or R&D density, and the profitability indicators was found in studies by Capon et al. (1990), Hajiheydari et al. (2011), Ayaydın and Karaaslan (2014), Kocamis and Gungor (2014); between the R&D expenditures and price-cost range in workby Yoon (2004); and among R&D expenses, share earnings and asset profitability in work by Karacaer et al. (2009).

Eberhart et al. (2004) stated that a sudden increase in firms' R&D expenditures returned more than the usual during 5-year periods due to the weak reaction of the market and mispricing. Moreover, Thus, Wang (2009) explained the relation between R&D expenditures and firm performance as a reversed s-curve. Yang et al. (2014) determined that there is an s-curve relation between R&D expenditures and performance as a result of their research on firms in Taiwan. Ciftci and Cready (2011) suggested that when a firm grows, the positive relation between R&D density and future income also increases; however the fluctuation decreases. Peters and Schmlele (2011) confirmed that firms that engaged in R&D activity made more profits than those that did not. As one of the first researchers on this subject, Branch (1974) suggested that R&D expenditures affect the future profitability and are affected by the former profitability. Reynard analyzed the correlation between R&D investment and profitability. He considered that the appropriateness from the success of R&D investment generally encourages firms to conduct R&D activities, but that excessive R&D expenditure can be a burden to firms because it cuts their profits. Therefore, he argued that the optimal R&D investment be decided from the proportion of net profit to sales.

R&D and Firm Value/ Market Value/ Firm Performance

Connolly and Hirschey (1984) focused on 390 firms Fortune 500, and found the existence of a positive and significant relationship between the R&D expenditures and the firm's value. Similarly, Hongwei and Cheng (2006) analyzed the sample to 96 companies and figured out the positive impact of R&D investments on firms' market value.In the American context, Ben-Zion (1984) and Pakes (1985) confirm the existence of a significant positive relationship between R&D and the market value of a firm. This result was also confirmed by studies carried out in the context of the United Kingdom (UK) (Blundell, Griffith, & Van Reenen, 1999; Toivanen, Stonenman, & Bosworth, 2002). Similarly, the study of Bae and Kim (2003) conducted in three contexts, American, German and Japanese shows that the effect of investments in R&D on the market value of a firm is positive and significant for all countries and is stronger in the case of Japanese companies. Pazderka and Johnson (1993), using Canadian business panel data for different periods (52 firms for the period 1985-1987, 54 companies for the period 1986-1988, 47 companies for the period 1985 to1988), says the presence of a strong positive relationship between R&D and the market value of a firm.

Yew, Mira and Chee (2006) on US companies show that investment in R&D has a positive and significant impact on the growth opportunities of a firm as they are measured by the ratio of market value over book value of assets. Shah (2008) makes use of a sample of U.K. manufacturing firms over the period 1998 to 2002; his empirical findings provide strong support for a positive association between R&D expenses and market values. Rzankhanov (2004) focuses on biotech firms. His empirical findings provide support to the presence of a positive relationship between patents and market values. Moreover, his results document that biotech firms tend to be more successful in their R&D efforts and for that reason they are valued higher than firms that fail to display a strong R&D record. Pindado (2010) argues on how a number of idiosyncratic firms' characteristics could affect the association between R&D expenses and firm values. His empirical findings highlight that although firms' size and stock prices display a positive association with R&D expenses, there are specific factors, such as external financial dependence, capital intensity, labor intensity, and free cash flows that display a negative association with R&D expenses.

R&D provides evidence that R&D efforts influence firms' financial performances (Lin et al., 2006; Griliches, 1986; Jaffe, 1986). Henderson and Cockburn (1994) and Hagedoon and Cloodt (2003) stated that R&D efforts can demonstrate the innovative competences of firms and that these efforts have been found to affect firm performance, particularly in high-tech industries. Chan et al. (1990), and Doukas and Switzer (1992) examine relations between R&D expenditure and firm value to find out R&D expenditure has a positive and persistent effect on the firm value. Blundell et al. (1999), and Toivanen et al. (2002) research whether R&D expenditure has an effect on England firms, and find out the bigger the firms' market share, the bigger the effect of R&D expenditure. In particular, Blundell et al. (1999) use R&D expenditure as an input factor for innovation, and patent counts as an output factor for it. Toivanen et al. (2002) state R&D expenditure can be taken as the innovative driver increasing firm value, and assert intangible assets created by the R&D expenditure is the same as 'the storage of innovative knowledge'. Yang and Chen (2003) research the effects of R&D expenditure on the firm value in Taiwan. Reviewing these studies, it is assumed the future profitability, growth opportunities, and excessive stock return of the innovative SMEs is higher than the non-innovative ones.

The relationship between investment in R&D and company performance contribute positively to the company's performance (Sougiannis, 1994; Canibano, Garcia-Ayuso, & Sanchez, 2000). However, to the extent that some leaders may tend to undertake investments in R&D activities in order not to improve the performance of the company but rather to preserve their place at the company's head. R&D investment is beneficial to businesses as it allows them to achieve improved performance and a higher valuation by the market (Lev & Sougiannis, 1996; Eberhart, Maxwell, & Siddique, 2004; Chan, Lakonishok, & Sougiannis, 2001).

Jaffe (1986), Cohen and Klepper (1996) found that R&D expenditures are strongly correlated with performance at the firm level. Griliches (1986) highlighted the significant relationship between a firm's R&D expenditures and that firm's productivity. On the basis of a sample of Japanese manufacturing firms in 1982, Goto and Suzuki (1989) find that the growth of productivity is positively related to the growth of R&D investment in a firm's core activity. Similarly, Wakelin (1998) finds that R&D intensity had a positive and significant effect on productivity growth. Morbey and Reithner (1990) and Del Monte and Papagni (2003) found a positive relationship between R&D activity and sales growth in their empirical study of Italian mnufacturing firms.

Privately financed R&D expenditures are often considered one of the key factors that explain efficiency at the firm level. Similarly, O'Mahony and Vecchi (2009) found that firms' investments in R&D capital, specifically R&D and human capital, have a significant impact on their productivity and performance.Xin et al. (2010) found that technologically innovative products have a statistically significant positive effect on operating performance. Ehie and Olibe's (2010) research showed that after controlling for firm size, industry concentration and leverage, R&D investment positively affects firm performance. Gunday et al. (2011) revealed that product, organization and marketing innovations have positive effects on firm performance in manufacturing industries. Atalay et al. (2013) found that technological innovation has significant and positive impact on firm performance in Turkish automotive supplier industry. As seen earlier studies, many of these researches find a positive relationship between R&D intensity or innovations and firm performance, but there are also some studies indicating a negative link or no link at all (Capon et al., 1990 and Chandler and Hanks, 1994). Consequently, R&D efforts have the potential to provide competitive advantages that result in improved firm performance.

R&D is a source of future economic profit for different country firms or industries (e.g. Griliches, 1986; Jaffe, 1986; Henderson and Cockburn, 1994; Hagedoon and Cloodt, 2003; Lin et al., 2006; O'Mahony and Vecchi, 2009; Ehie and Olibe, 2010), there is a strong possibility that R&D can result in higher economic profits. Basing on the above mentioned theoretical and empirical findings in the literature, R&D intensity has a positive impact on firm performance.

R&D as an Advertisement Expenses

Later, Ben-Zion (1978) developed a model on the effect that the deferred amount has on the advertisement and R&D expenditures and determined there to be a positive relation between profitability, and R&D expenditures. Morbey (1988) confirmed that an R&D expenditure that is above a certain threshold value will reveal a strong relation between firms' R&D expenditures and the growth rate of the sale in the following years and determined a slight correlation between R&D density and an increase in profitability. Apergis and Sorros (2014) stated that the effect of R & D expenditures on profitability is greater in the energy sector, especially renewable energy firms. Chauvin and Hirshcey (1993) stated that R&D and advertisement expenses have major and consistent effects on the cash flows of firms and those very large firms should approach these expenses as ways of providing cash flow rather than costs.

R&D and Time and Place

In addition, the writers stated that if firms are involved in R&D activity in other countries, rather than only in their own country, the effect of R&D on profitability is doubled (Peters and Schmlele, 2011). Moreover, Sahar and Yalali (2014) determined that the positive effect of R&D expenditures on profitability reached its maximum level in the 4th year of expenditures. The time lags are a major concern in the data and analysis. First of all a research may take a few years to complete. After completion, it may take a couple of years to start showing results (Griliches, 1979). This may be one of the most important reasons to check variation over time and to research more than 5 years of firm level data. Some of the studies use 15 years of data.

Capitalization and amortizing R&D Expenses & SME

Nissim and Thomas (2000) expressed that capitalizing and amortizing R&D expenditures rather than expensing them make it easier to match the expenses with their advantages. Shin and Kim (2011) stated that R&D activities of small and midsize firms increase the firm value and that capitalized R&D expenditures have a greater effect on the firm value than do those expensed. Jefferson (2006) finds that the returns to industrial R&D appear to be at least three to four times the returns to fixed production assets. There is a direct positive correlation between R&D expenditures and economic growth. Lv & Sougiannis (1996) found that the useful life of R&D varies from 5 to 9 years, while Aboody & Lev (2001) conclude that the estimated duration of the benefits from R&D projects is seven years and most of the operating income benefits are generated in 3 years from the R&D investment.

Johnson (1967), as referred in Sougiannis (1994) also Newman (1968) and Milburn (1971) used cross – sectional correlation for regression analysis and the relationship they observe between R&D and future benefits was not significant. Sougiannis (1994) explains that the results for the previous studies may be due to the econometrics techniques used, the sample size being too small and the quality of the R&D data. As mentioned in Sougiannis (1994), Benzion (1978), Griliches (1981), Hirchey (1982), Hirschey and Wergandt (1985) and Shevlin(1991) studies found a significant relationship between R&D Expenditures and market value, bringing to the conclusion that the capitalization and amortization of R&D would be a better accounting treatment than expensing.

Kim and Lee applied existing models, such as the Reynard and Wallin and Gilman models, to Korean data with a sample of 152 individual listed firms between 1985 and 1989. They tested empirically which model is more suitable for Korean firms. They found that the significant variables for R&D investment are one-year and three-year lagged R&D investments. In particular, they found that one-year lagged R&D investment strongly affects the current R&D investment. They also suggested that sales and net profit are significant explanatory variables, although the correlation effects differed between industries.

R&D as an Innovation and SME

Zhong and Zhou (2012) do the same work with a stochastic frontier model, and obtained the same conclusion with data of China market. According to market performance indicator perspective, Tobin's Q, Hall, Thoma and Torrisi (2007) found positive and significant association as well. Also and Koellinger (2008), evaluated e-commerce companies in Europe. In his research, he found that companies engaged in internet-based innovations illustrate greater performance than firms which do not invest in R&D. Vaccaro, Parente and Veloso (2010) determined the effective use of information management tools to develop new products and services, positive effect on companies' performance. R&D and implementation of new technologies, for products development and innovative production processes, are used in order to provide differentiation that can yield competitive advantage and lead time over rivals (Mansfield, 1968; Baily, 1972). Hence, the firm invests in R&D and innovation to achieve market share and monopolistic profit. Hall (2000) states, that more than 50% of the R&D spending is associated with salaries and wages of highly educated scientists and engineers. Their efforts create an intangible asset (know how), from which profits in future years will be generated. Low investment in R&D reduces innovation and knowledge creation, which in turn reduces productivity as well as investments in both physical and human capital (Rogers, 2005). R&D has generally been ignored, partly due to data availability problems. Sougiannis (1994) notes that most of the results that show no significant relationship between R&D and future benefits, may be due to sample sizes, research design, statistical techniques and quality of the R&D data used. Studies in research intensive industries show that R&D investments give above average returns (Grabowski, 1978). A business unit with higher productivity is generally more profitable.

There are many other factors that influence performance, that we should take into consideration in order to check the importance of innovative intangible capital stock. The future growth opportunities and profitability of the innovative firms are higher than the non-innovative ones, and their excessive stock return is higher than the non-innovative ones too. Grabowski and Muller (1978) and Branch (1974) present similar results that the innovative SMEs with high R&D intensity show high future growth opportunities and profitability against

The non-innovative ones, so the possibilities of excessive stock return are high either. Grabowski and Muller (1978) research relations among R&D expenditure, intangible assets, and profitability of American firms, and find out that innovative SMEs with high R&D intensity achieve approximately 20% more profitability. Branch (1974) examines relations between R&D Expenditure and profitability of American firms to find out R&D expenditure have a positive and significant effect on profitability and sales volume at the 1% level, and argues R&D expenditure has a positive effect on future profitability. Wolfe (1994) states innovation has an important role in the competitiveness and efficiency of a firm. Gopalakrishnan and Damanpour (1997) assert the most basic form of firm innovation is technological innovation, and innovation performance is achieved by R&D expenditure. Abbey and Dickson (1983), Capon et al. (1992), Kelm et al. (1995), Paolio and Brown (1978), and Robinson (1990) use R&D expenditure as the proxy variable for innovation performance.

R&D and Tobin's Q

In this context, several studies found a positive correlation between R&D spending and Tobin's Q (Hirschey & Weygandt, 1985; Chung & Jo, 1996; Agrawal & Knoeber, 1996; Bosworth & Rogers, 1998; Chen & Yang, 2003). Similarly the study of Cockburn and Griliches (1988), based on a sample of 722 US companies, showed the existence of a positive correlation between Tobin's Q and R&D. However, this relationship is still strongly influenced by sectoral effects.

R&D and yields on securities

Canibano, Garcia-Ayuso and Sanchez, (2000) also showed a significant positive relationship between yields on securities and R&D. Bloch (2003), on a sample of Danish companies; found that intensive enterprises in R&D emit higher dividend yields than those with no R&D activities.

Negative Relationship between the R&D Expenditure and profitability

A different strand in the literature points out that as R&D expenses increase, returns volatility follows the same path (Chan, 2001; Shah, 2008; Ehie, 2010). According to Chan (2001), returns show no differentiation for firms that spend highly or not on R&D, implying that R&D expenses do not affect a firm's performance. Chan (2001) concludes that with respect to firms with low R&D spending, in case they decide to spend more they may experience higher returns volatility.

Yeh et al. (2010) confirmed that the positive effect of R&D expenditures on firm performance continues, to a certain extent. Above a certain rate, R&D expenditures have a negative effect on profitability.The study of Casta, Escaffre and Ramond (2007) carried on businesses owned by European financial markets, shows that France, Britain and Germany, costs R&D generally have a negativeimpact on the operating result. Branch (1974) investigates seven industries and finds that changes in R&D expenses are significantly associated with firms' profitability, while Schoeffler (1977) determines that high R&D expenses are negatively associated with that profitability only in the case of rapidly growing markets. At the same time, R&D expenses turn to have a positive impact on the firms' performance only in the case that those firms have already established a strong position in the market and/or in their sector.

Donelson and Resutek (2012), on the other hand, are opposite to this view. They say that the level of research and development and the changes in it are not related to the profits. From the perspective of an investor, R&D costs are thought of as an expense whereas in reality, these are the investments which will generate future revenues in the form of profits. Cooper (2008) contradicts this view and explained that, in accounting, a positive relation is present between R&D investments and firm earnings but finance predicts a negative relationship between them.

3. Research Methodology

The purpose of this chapter is to describe the research methodology of this study. Since the central part of research activity is to develop an effective research strategy or design. Generally research methodology focuses on the research process and the kind of tools and procedure to be used, the design of the methodology was based on prior research into these relationships. This chapter will outline geographic profile, demographic profile, organizational profile, data collection, sampling design, conceptualization, operationalization, research hypotheses, method of analysis, correlation analysis, regression analysis, definition of key concepts and variables, dependent variable, independent variables. With this background knowledge, the present, chapter provides the methodology used in this study.

Geographic Profile

Sri Lanka is an island in the Indian Ocean, formerly called Ceylon, located in Southern Asia, Southeast of India, in a strategic location near major Indian Ocean sea lanes.It is also known as the Island of Serendipity. Srilanka lies just above the equator between 5°55'N and 9°55' N and between the eastern longitudes 79°42' and 81°52'. It has a total area of 65,610 km2, with 64,740 km2 of land and 980 km2 of water and its full length from Point Pedro in the North to Dondra Head in the Southern coast is about 432km. Its coastline is 1,340 km long. Its full breadth from Colombo in the Western coast to Sangaman Kanda point in the Eastern coast is about 224km. Sri Lanka with its tear- dropped shape is dominated by the astonishingly varied features of topography, making it one of the most scenic places in the world. Three zones can be divided by its distinguished elevation: the central highland, the plains, and the coastal belt. Sri Lanka's climate includes tropical monsoons: the northeast monsoon (December to March), and the southwest monsoon (June to October). Its terrain is mostly low, flat to rolling plain, with mountains in the south central interior. Sri Lanka is divided into 9 provinces and 25 districts.

Demographic Profile

Sri Lanka may seem like a small island lying southeast of India. However, it has a significant population of 20.95 million in 2025 (down from 21,481,334 in 2020), with the most dense areas lying in the urban areas such as the capital, Colombo, and other large cities that are also the industrial and economic hubs of the country. It is growing at a rate of 0.913% annually and houses people from many different ethnicities and religions, which gives the country a multi-cultural and multi-ethnic identity. Sri Lanka hosts a dynamic age

structure that includes a very large age bracket of 25-54 year old individuals dominating the country. Around 42.6% of the population lies in that age bracket. Even though Sri Lanka is a developing economy,such a large working population is allowing it to pursue development projects and create a large number of jobs that can utilized by its inhabitants. This is not only helping many people to support their families, but is also helping Sri Lanka's economy grow steadily in the last few years.

Moreover, the median age of people in Sri Lanka is estimated to be 31.1 years, with the median age of men being 30.1 years while females have a median age of 32.2 years. Furthermore, Sri Lanka has a high life expectancy of 75.94 years, with a male life expectancy at 72.43 years and female life expectancy at 79.59 years. This is also why 9.1% of the country's population is in the 54-65 year age bracket, while 8.1% of its population is above the age of 65. An estimate of the number of deaths each year in the Sri Lanka lies at 5.96 deaths per a population of 1000 people.

Organizational Profile

The Colombo Stock Exchange is a company limited by guarantee, established under the Companies Act No. 17 of 1982 and is licensed by the Securities & Exchange Commission of Sri Lanka (SEC). The CSE is a mutual exchange and has 15 full members and 13 Trading Members licensed to trade both equity and debt securities, while seven members are licensed to trade in debt securities only. All members are licensed by the SEC to operate as stockbrokers. All members are corporate entities and some are subsidiaries of large financial institutions.

At present the CSE functions as a market operator and through its fully owned subsidiary, Central Depository Systems (Pvt.) Limited (CDS), acts as a clearing and settlement system facilitator. The CSE also oversees compliance through a set of rules, promotes standards of corporate governance among listed companies and is actively involved in educating investors. In the course of its operations, the CSE interacts with many customers and stakeholders which include issuers (such as companies, corporations and unit trusts), commercial banks, investment banks, fund managers, stockbrokers, financial advisers, market data vendors and investors. The Colombo Stock Exchange (CSE) has 290 listed companies representing 20 business sectors. For this study, 20 listed companies were selected from CSE.

Data collection

This research analysis is empirical where we used secondary data for the investigation. Secondary data is data that have been previously collected for some other project rather than the one at hand but found useful by the researcher. The data will extent from the comprehensive income statements, cash flow statement and financial position of the listed companies in Colombo Stock Exchange (CSE) database. In addition to these scholarly articles from academic journals, relevant text books and the internet search engines were also used, specially, the data of the listed companies in the sample were collected for the year 2020-2025.

Sampling Design

Sampling design is a definite plan for obtaining a sample from a given population. It refers to the technique or procedure the researcher would adopt on selecting items for the sample (Kothari, C.R.,2004). Jankowicz (2000) describes sampling as a deliberate choice of a number of people, the sample who are to provide data from which you will draw conclusions about some larger group, the population whom this represents. Sample is a subset of a population, while population is a body or any collection of items under consideration (Collis and Hussey, 2003). The Colombo Stock Exchange has 298 listed companies under 20 business sectors. The sample of this study composed 20 listed companies in the CSE.

Name of the companies which are selected for the study are given below:

NO	Company Code	Company Name
01	CARC	CARSONS CUMBERBATCH
02	CBEV	CEYLON BEVERAGE
03	DCTS	DILMAH CEYLON TEA SERVICES
04	CHEM	CHEMANEX
05	DIPP	DIPPED PRODUCTS
06	HAY	HAYLEYS
07	KEEL	KEELLS FOOD
08	CHEM	CHEMICAL INDUSTRIES (COL.) PLC
09	TOKY	TOKYO CEMENT
10	CONF	CONVENIENCE FOODS LANKA
11	LOIN	THE LION BREWERY CEYLON
12	LGAS	LAUGFS GAS
13	RWST	RAIGAM WAYAMBA SALTERNS
14	E-CHAN	E-CHANNELING
15	REGN	REGNIS
16	LTIL	LANKA TILES PLC
17	SWIW	SWADESHI INDL.WORKS
18	CETS	CEYLON TEA SEVISE PLC
19	PRIN	PRINTCARE PLC
20	DAPO	DANKOTUWA PORCELAIN

Conceptualization

After review of literature, the researcher has developed a conceptual model. A conceptual framework developed in this chapter provides a framework to understand the effects of the hypotheses regarding the relationship between R&D Expenditures and profitability of the listed companies in CSE. The conceptualize the dependent and independent variables were based on many other models. Used by different researchers over the years. This research design choice of this study analyzes determinants of on listed companies in Sri Lanka. In this manner the following diagram depicts the research conceptualization of this study.

Here profitability is dependent variable and R&D Expenditures and control variables, such as firm size, leverage, sales growth, tangibility, and year dummies.

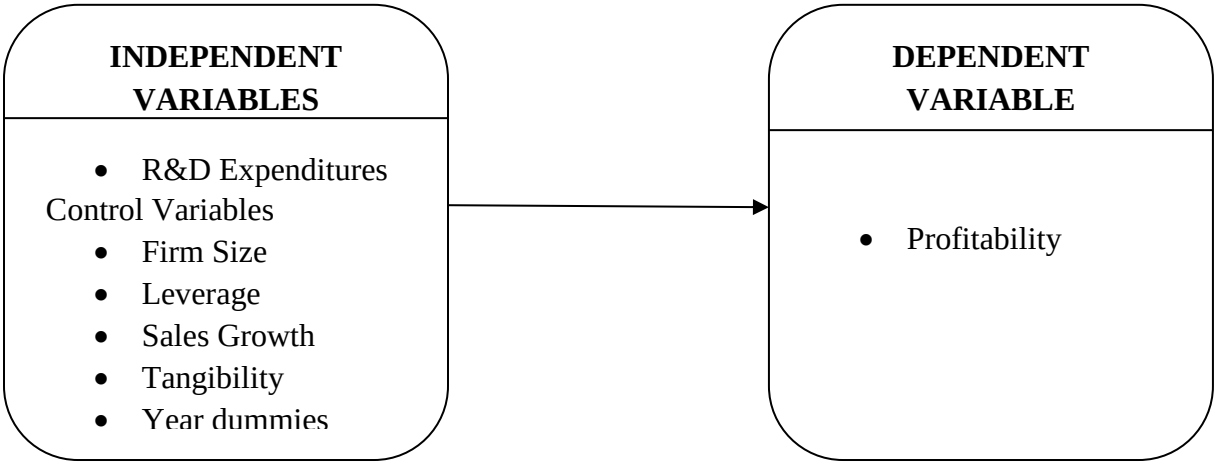

Figure: 3:1 Conceptualization

Source: Developed by researcher

The conceptualization shows the relationship between R&D expenditure and profitability.

3.7 Operationalization

Operationalization is the process of strictly defining variables into measurable factors. The process defines fuzzy concepts and allows them to be measured, empirically and quantitatively. It determines how the researchers are going to measure the concept. Operationalization of the variables are given below.

Table: 3.1 Operationalization

Concepts	Variables	Indicators	Measurements
Dependent Variable Profitability	Profitability	Earnings after interest & tax to total equity	$\frac{\text{Earnings After Interest \& Tax}}{\text{Total Equity}}$
Independent Variable R&D Expenditure and control variables	R&D Expenditure	After-tax Effect of R&D expense on earnings	$\frac{\text{R\&D Expenses}}{\text{Total Assets}}$
	Leverage	Total Debt to Total assets	$\frac{\text{Total Debt}}{\text{Total Assets}}$
	Firm Size	Value of Total Assets	Log(Total Assets)
	Sales Growth	Changes in revenue	$\frac{\text{(Current Year Revenue – Previous Year Revenue)}}{\text{Current Year Revenue}}$
	Tangibility	Fixed assets to Total assets	$\frac{\text{Fixed assets}}{\text{Total Assets}}$
	Year Dummies	Control for timing	Year dummies for the years of 2012-2016

Research Hypotheses

A hypothesis can be defined as a tentative explanation of the research. Hypotheses are formulated based on the conceptualization of this research. Following hypotheses is developed for testing in the study.

H_1: There is a positive relationship between R&D Expenditure and profitability.

Method of Analysis

Statistical analysis is fundamental to all experiments that use statistics as a research methodology. It is a very useful tool to get approximate solutions when the actual process is highly complex or unknown in its true form. Statistical analysis involves both descriptive and inferential statistics.

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data.

Inferential statistics infer from the sample to the population. They determine probability of characteristic of population based on the characteristics of sample. It helps assess strength of the relationship between independent and dependent variable. It includes two techniques.

- Correlation Analysis
- Regression Analysis

Correlation Analysis

The correlation is one of the most common and most useful statistics. The correlation coefficient is a measure of linear association between two variables.When comparing the correlation between two items, one item is called the "dependent" item and the other the "independent" item. The goal is to see if a change in the independent item will result in a change in the dependent item.

The correlation coefficient can range between ±1.0 (plus or minus one). A coefficient of +1.0, a "perfect positive correlation," means that changes in the independent item will result in an identical change in the dependent item (e.g., a change in the indicator will result in an identical change in the security's price). A coefficient of -1.0, a "perfect negative correlation," means that changes in the independent item will result in an identical change in the dependent item, but the change will

be in the opposite direction. A coefficient of zero means there is no relationship between the two items and that a change in the independent item will have no effect in the dependent item.

In this study correlation co-efficient analysis is used to find out the relationship between,

- R&D Expenditure and Profitability
- R&D Expenditure and Leverage
- R&D Expenditure and Firm Size
- R&D Expenditureand Tangibility
- R&D Expenditureand Sales Growth
- R&D Expenditure and Year dummies

The formula for the correlation co-efficient is:

$$r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

Where,

r = correlation co-efficient

x = independent variable

y = dependent variable

n = no of firms

Regression Analysis

Regression analysis is a statistical tool for the investigation of relationships between variables. The technique involves developing a mathematical equation that describes the relationship between the variables. It is used to predict value of one variable on the basis of their variable. This study includes more than one independent variable and therefore multiple regression analysis used to drive conclusion.

“Multiple regression” is a technique that allows additional factors to enter the analysis separately so that the effect of each can be estimated. It is valuable for quantifying the impact of various simultaneous influences upon a single dependent variable.

The regression models to be estimated to test the hypotheses are:

Model 1

$$DE=\beta_0+ \beta 1RD + \beta 2LEV+\beta 3TA + \beta 4FS + \beta 5SG + \beta 6YD + \varepsilon$$

Model 2

$$LDTA = =\beta_0+ \beta 1RD + \beta 2LEV+\beta 3TA + \beta 4FS + \beta 5SG + \beta 6YD + \varepsilon$$

Where,

$\beta 0 + \beta 1 + \beta 2+ \beta 3+ \beta 4+ \beta 5 +\beta 6$ = Regression Coefficient

DE = Debt to Equity Ratio

LDTA = Long Term Debt to Total Assets Ratio

RD =R&D Expenditure

LEV=Leverage

TA = Tangibility

FS = Firm Size

SG = Sales Growth

YD = Year Dummies

ε = Regression Error

Definition of Key Concepts and Variables

In this study, the researcher has used one dependent variable (Profitability) and six explanatory variables such as R&D Expenditure, leverage, tangibility, firm size, sales growth and year dummies from most prominent and recent empirical studies. The selection measures for dependent variable and independent variables are detailed as follows.

Dependent Variable

This study explains the profitability as dependent variable. Profitability is a measure of earning power of a firm. The earning power of a firm is thebasic concern of its shareholders. Profitability is measured in several accepted ways and in this study; profitability can be measured by return on equity

$$\text{Profitability} = \text{Return on Equity} = \frac{\text{Earning After Interest \& Tax}}{\text{Total Equity}}$$

Independent Variables

There are Six main primary factors that will be used as independent variables for influence on profitability. Such as R&D Expenditure, Leverage, tangibility, firm size, sales growth and year dummies

1. **R&D Expenditure**

   The treatment of R&D as an operating expense has the immediate effect of lowering both operating and net income. The tax deductibility of these expenses buffers the impact somewhat, and the net income and after-tax operating income are both reduced by the following:

   After-tax Effect of R&D expense on earnings = R&D Expenses (1 - marginal tax rate)

   For companies that end up with negative earnings as a consequence of research expenses, the after-tax effect will be even larger because the tax benefit has to be deferred until future periods.

2. **Leverage**

   Empirical studies generally agree that leverage decreases with profitability (Friend and Hasbrouck 1988, Friend and Lang 1988, Rajan and Zingales 1995). Profitable firms may not have a much need for debt financing, since they can finance with retained earnings. As proxies for profitability, this study employs two widely used definitions of profitability in order to provide a wider test of relationship between R&D Expenditure and profitability of the firm. Leverage is then defined as the ratio of total debt to total assets.

   $$\text{Leverage} = \frac{\text{Total Debt}}{\text{Total Assets}}$$

3. **Tangibility**

Collateral values of assets, also known as Asset Composition, are those assets that creditors can accept as security for issuing the debt. The tangibility of assets represents the effect of the collateral value of assets of a firm's gearing level. Tangibility is then defined as the ratio of tangible (fixed) assets to total assets.

$$\text{Tangibility} = \frac{\text{Fixed Assets}}{\text{Total Assets}}$$

The tangibility refers to tangible assets as proportion to total assets. A firm having high ratio of tangible asset has more collateral and hence more borrowing capacity, therefore a higher tangibility is likely to lead higher leverage.

4. <u>Firm Size</u>

Size is the measure of how large the firm's operational capacity is. Various studies have used a number of measures to capture the size of firms. Titman and Wessels (1988) andBenito (2003) use the log of total assets to measure size. In this study also size is measured by using total assets, as follows:

Log (Total Assets)

The effect of size is ambiguous as large firms may have greater agency problems because it is harder to monitor them, so they need to adopt better standards of governance to compensate. On the other hand small firms may have better growth opportunities and greater need for external finance, so they may present beater governance mechanism (Klapper and Love 2003).

5. <u>Sales Growth</u>

Different studies have used varying measures of growth (investment opportunities). Titman and Wessels (1988, used annual percentage increase in total assets as a measure of growth. In this study growth can be measured by the changes in revenue of the bank, finance, insurance companies every year.

$$\text{Growth} = \text{change in revenue} = (\text{Current Year Revenue} - \text{Previous Year Revenue})$$

High growth firms need more external funds to finance growth and would turn first to debt financing due to information asymmetry (Myers 1984) and higher flotation costsassociated with equity.

6. **Year Dummies**

Year dummies are a variable which equals 1 for a given year and 0 for all other years. It allows to control for time specific fixed effects i.e. shocks which impacts is restricted to a given time-period, affects or panel units and are not controlled by other explanatory variables.

4. Data Presentation and Analysis

Introduction

In this chapter, the researcher has presented and analyzed all data relating to this study. This chapter is devoted to study the impact of R&D Expenditures on profitability of the listed companies in Sri Lanka.The ultimate theme of this chapter is to present and analyze data which help to conclude the findings. The test using a sample of 20 listed companies from the Colombo Stock Exchange is described. This chapter mainly includes presentation of data, data analysis, hypotheses testing and summary. In this chapter, the information derived from the secondary sources. Furthermore, analyzed data, statistical analysis of findings and other relevant outputs are forwarded.

Data presentation

Under the data presentation part, the researcher have analyzed and presented all data collected from listed companies in Colombo Stock Exchange. The process of presenting data is necessary to understand the pattern of variables and find out its open features. In this research the collected data is presented in tabular and graphical form.

Data Analysis

The present study is undertaken to find out the impact of R&D Expenditures on profitability of the listed companies in Sri Lanka. Descriptive statistics, correlation and regression analysis are carried out to analysis of data.

Data and descriptive statistics

1) *Sample and data set*

The data used in this study are obtained from annual reports of individual companies listed on the Colombo Stock Exchange (CSE) for the period of 2020-2025. We use convenient sampling (based on availability of necessary data) to collect data from five sectors namely Manufacturing, Hotels and Travels, Food, Beverage and Tobacco, Chemicals and Pharmaceuticals, and plantation. To reduce the influence of potential outliers, we exclude observations in the one percent tails of each of the regression variables. We then benchmarked the trimmed data with descriptive statistics reported in other papers to ensure that the sample was representative of the population of non-financial firms listed on the CSE. Finally, After this screening and computing the variables, we end up with a panel of 150 firm-year observations for our empirical analysis.

2) Descriptive statistics

Table 2 presents descriptive statistics for the variables used in the analysis for our pooled sample. The pooled mean (median) return on assets *(ROA*) and return on equity (*ROE*)are 6.3% (-12.3%) and 10.7% (31.3%)respectively. The average level of cash held of our sample companies is 6.15%.

With respect to the control variables included in our regression model, the average size of the firms in our sample measured by total assets is about 6.06billion rupees. The leverage ratio is 39.7%, suggesting that about 40% of the sample firms' assets are financed by debt capital. The average (median) sales growth, measured as changes in sales, is 20.4 %. The average tangible assets of the firms proxied by the ratio of fixed assets to total assets are given by 39.86 %.

Table 4.1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Median	Min	Max
Return on assets (*roa*)	150	0.0657	0.0659	-0.1134	0.3585	0.0736
Return on equity (*roe*)	150	0.1920	0.1255	-0.2836	0.6350	0.1053
Research and development (rad)	150	0.0312	0.4360	0.0000	0.5261	0.0556
Firm size (*fsize*) (Rs. billion)	150	6.2600	10.9200	0.7900	90.482	6.0400
Leverage (*lev*)	150	0.4272	0.2061	0.0154	0.7530	0.3452
Sales growth (*sgrowth*)	150	0.2033	0.4314	-0.0889	8.5606	0.2015
Tangibility (*tang*)	150	0.3566	0.2431	0.0205	0.968	0.3564
Notes: This table reports summary statistics of the variables used in this study. All variables are defined in Table 3.1.						

Empirical results

Correlation analysis

Table 3 reports the Pearson correlation coefficients between variables. R&D Expenditure shows a positive and statistically significant correlation with firms' profitability measured by return on assets *(roa)* and return on equity (roe). This result is consistent with the findings of previous studies, for example Fresard (2010) and Palazzo (2011).Turning to control variables, firm size (*fsize)* has a significant positive correlation with return on assets *(roa)* and return on equity (roe). Sales growth (*sgrowth)* is not significantly associated with ROE and ROA. Total leverage exhibits a negative and insignificant correlation with both ROA and ROE. Finally, the ratio of tangible fixed assets to total assets *(tang*) does not have any significant association with ROA and ROE. Furthermore, Table 3 suggests that given that the observed correlation coefficients are relatively low, multi co linearity should not be a serious problem in our study.

Table 4.2 Correlation matrix

	roa	roe	rad	Fsize	lev	sgrowth	tang
roa	1.000						
roe	0.934*	1.000					
rad	0.527*	0.353*	1.000				
fsize	0.075*	0.425*	-0.254	1.000			
lev	-0.365	-0.089	-0.654*	0.52*	1.000		
sgrowth	0.058	-0.072	0.321	-0.042	-0.070*	1.000	
tang	0.04	-0.035	-0.093	-0.0265	-0.278	0.086*	1.000

Notes: This table reports Pearson correlation coefficients. *denotes significance at the 5% level or more. See Table 1 for definitions of all variables

Multivariate analysis

Table 4 presents estimation results of our regression model (1) using pooled OLS estimator, where the dependent variable is return on assets (ROA). ROA is regressed on R&D Expenditure and a set of control variables including firm size, leverage, sales growth, and tangibility and a set of year dummies.

Table 4.3. Relationship between corporate performance (ROA), R&D Expediture and firm characteristics

Variables	Coefficient
Rad	0.204***
	(2.900)
Fsize	0.057**
	(5.103)
Lev	-.951**
	(0.853)
Sgrowth	0.835
	(1.010)
Tang	-0.071
	(0.695)
Constant	.923
	2.54
Year dummies	Yes
Observations	150
Adjusted R^2	0.454
F test	56.5
P values	0.000

*See Table 1 for definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. ** indicates significance at the 1% level. The figures reported in parentheses are t-statistics.*

As can be seen in Table 4, firstly, the estimated coefficient on R&D Expenditure is positive and significant at the 1% level. This result provides support to our hypothesis H1, suggesting that there large R&D Expenditure is associated with higher profitability. That is, large R&D Expenditure allows firms avoid high cost of external financing and gives flexibility to firms to exploit the profitable investment opportunities. This finding thus is consistent with arguments of trade-off and pecking order theories but inconsistent with agency explanations for R&D Expenditure. This result is also consistent with the findings of previous empirical studies, for example Fresard (2010) and Palazzo (2011).

Looking at the control variables, we observe that firm size *(fsize)* is positive and significant at the 5% level, suggesting that large firms enjoy economies of scale, and face less asymmetric information problem and thus are able to obtain external financing at lower cost of capital. The coefficient of leverage (lev) is negatively related to firm performance at the 5% level, suggesting that the use of more debt capital in the capital structure is harmful to firm's financial performance.

The coefficient associated with sales growth *(sgrowth*) is not significantly associated with firm performance at conventional levels. This finding is consistent with the finding of Manawaduge et al. (2011). Finally, the estimated coefficient on tangibility is negative but not significant at conventional levels. Consistent with Manawaduge et al. (2011), this result suggests that Sri Lankan manufacturing firms do not efficiently utilize tangible fixed assets.

The adjusted R^2 suggests that 43.8% of the total variance of the performance (*roa*) is explained by the model.

Table4.4. Relationship between corporate performance (ROA), R&D Expenditure and firm characteristics

Variables	Coefficient
Rad	0.198***
	(3.980)
Fsize	0.015***
	(3.103)
Lev	-0.985**
	(0.213)
Sgrowth	0.961
	(.825)
Tang	-0.421
	(0.562)
Constant	0.963**
	(2.17)
Year dummies	Yes
Observations	150
Adjusted R^2	0.438
F test	45.6
P values	0.000

*See Table 1 for definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. ** indicates significance at the 1% level. The figures reported in parentheses are t-statistics.*

As a robustness test, we estimate our regression model 1 with return on equity (*roe)* as a dependent variable instead of return on assets, using the pooled OLS estimator. As we can see in Table 5, the results show that once again, coefficient on R&D Expenditure is positive and precisely determined, suggesting that R&D Expenditure is positively associated with profitability, in line with our hypothesis H1.As for the control variables, they show a similar pattern as in Table 4.

According to Modigliani and Miller's (1958) irrelevant theory, R&D Expenditure is irrelevant to the value of a firm under perfect capital market conditions. However, subsequent developments in

corporate finance theories with regard to transaction costs, information asymmetry, and agency costs and various other financial restrictions (Jensen and Meckling, 1976; Myers, 1977; Myers and Majluf, 1984) suggest that in the presence of market frictions, R&D Expenditure may affect profitability. This study examines empirically the relationship between R&D Expenditure and profitability of a panel of Sri Lankan listed companies, using the fixed effects estimator. The study uses 311 firm year observations over the period 2020-2025.

Controlling for unobserved firm heterogeneity and other firm characteristics, we document that R&D Expenditure positively affects profitability of firms in emerging markets as found in their counterparts in developed countries. Therefore, our study concludes that R&D Expenditure phenomenon of Sri Lankan listed firms is not explained bay agency theory but trade-off theory and pecking order theory.

Future research may expand this study by examining how corporate governance practices in Sri Lanka affect the R&D Expenditure of firms as well as the relationship between R&D Expenditure and profitability

5) Findings and Conclusion

Introduction

This research was carried out to find out the impact of R&D Expenditure on profitability of Sri Lankan listed companies. In this chapter, the findings of the study involve what results are found by the researcher after completion of the research. This chapter mainly includes findings, suggestions for future research and conclusion. It compares the results with hypotheses based on correlation and regression analysis.

Findings of the Study

In today's market conditions, firms are paying more attention to R & D expenditures every day to gain a competitive advantage. Although it is not possible to observe the direct effects of R & D expenditures (unlike the purchase of a fixed asset), statistical methods can help us measure their impact, especially on income statement items.

This study assumed that profit is one of the most important financial performance indicators, and it was designed to show the short- and long-term effects of R & D expenditures on firms' three most important profit indexes. This research has resulted in two major findings. First, R & D expenditures have no statistically significant effect on firms' gross profit, net operating income, or net income in the short term. Second, we conclude that R & D expenditures have a statistically significant, positive and strong effect on these profits in the long term.

According to our research, for each one-unit increase in R & D expenditures, the gross profit will increase by 10.19 units. This effect maybe the result of a sales increase due to customers seeing a new product, lower manufacturing costs due to a new technology, or the combined effects of both. As noted above, R & D expenditures also have a positive effect on firms' operating income in the long term. For each one-unit increase in R & D expenditures, the operating income will increase by 2.37 units. The reasons for the decrease in the effect of R & D on profits from 10.19 to 2.37 may include the following: because firms deduct R & D expenditures from gross profit when calculating net operating income, an increase in R & D expenditures will increase the expenses and cause operating income to be reduced. In addition, due to the increase in firms' sales, "general management and marketing, selling and distribution expenses" will also increase, thus weakening the effect of the R & D expenditures' contribution.

Similarly, we determined the long-term positive effect of R & D expenditures on the total net income. A one-unit increase in R & D expenditures results in a 1.39 unit increase in total net income. By examining these values, we conclude that the inclusion of non-operating gains and losses in operating income causes a decrease in the effect of R & D expenditures on profitability.

BIST manufacturing sector firms that prioritize R & D expenditures and are continuously investing in R & D can see results in the long term. Thus, when evaluating future profit levels, financial analysts can expect increased profits for firms that value R & D investments. Although this study's results support the literature on R & D profit relationships, this subject can still be examined in other studies. Different samples and econometric models could be used, and researchers could study related questions such as "How long are the effects of R & D expenditures likely to continue?" or "Do R & D expenditures have a greater effect on increasing income or reducing costs?

Suggestions for future research

- Further studies could also incorporate some other internal factors other than mentioned in this study.

- In this study, the researcher has mainly examined the factors that influence R&D Expenditure of Sri Lankan Listed companies. It might be an interesting and crucial to extend this research to other sectors of the economy in the country.

- This research study obtained data only the secondary data from the published data of Colombo Stock Exchange, but primary data not included in this study. So further research should also include the primary data.

- In this study, two statistical analyses are included such as correlation and regression. So it is better to include any recent methodology for future research.

- This study focused only fine year period (2020-2025) further study must include changes over long time period.

- Further research is necessary in order to obtain a better understanding of other borrowing practices.

- Further studies could also incorporate qualitative research as the present study only used quantitative research methodology.

Recommendations

This study analyzes the impact of R&D Expenditures on profitability of a firm. The results of the study states that the use of R&D Expenditure by Sri Lankan listed companies are significantly

high. Therefore Sri Lankan listed companies should stipulate standards to maintain a proper balance between debt to equity ratio.

In this study profitability, tangibility and non debt tax shield are statistically significant R&D Expenditure of Sri Lankan listed companies. Therefore, companies pay more consideration on profitability, tangibility and non debt tax shield.

Conclusion

According to Modigliani and Miller's (1958) irrelevant theory, R&D Expenditure is irrelevant to the value of a firm under perfect capital market conditions. However, subsequent developments in corporate finance theories with regard to transaction costs, information asymmetry, and agency costs and various other financial restrictions (Jensen and Meckling, 1976; Myers, 1977; Myers and Majluf, 1984) suggest that in the presence of market frictions, R&D Expenditure may affect profitability. This study examines empirically the relationship between R&D Expenditure and profitability of a panel of Sri Lankan listed companies, using the fixed effects estimator. The study uses 311 firm year observations over the period 2020-2025.

Controlling for unobserved firm heterogeneity and other firm characteristics, we document that R&D Expenditure positively affects profitability of firms in emerging markets as found in their counterparts in developed countries. Therefore, our study concludes that R&D Expenditure phenomenon of Sri Lankan listed firms is not explained bay agency theory but trade-off theory and pecking order theory.

Future research may expand this study by examining how corporate governance practices in Sri Lanka affect the R&D Expenditure of firms as well as the relationship between R&D Expenditure and profitability.

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