



School of Business,
Economics and Law
GÖTEBORG UNIVERSITY

**Accounting for Research and Development Cost
–Its influence on the earnings and stock prices of
companies**

Roshan Bhandari, Samleyin Aloysius Galabe
and Kenfack Mathias Ngucko

Graduate Business School

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Supervisor: Thomas Polesie

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ABSTRACT

Despite the increase in the global trend in R&D cost especially in the manufacturing and pharmaceutical industries, the two main standards setting bodies still maintain controversial treatment of this intangible. This thesis has as purpose to explore the relationship existing between R&D cost, Earnings and stock price of manufacturing and pharmaceutical companies.

With the help of a developed model, the authors use primary and secondary data collected, to clearly demonstrate this relationship using simple correlation and regression analysis. Questionnaires were sent to all four companies and the answers gotten from interviews were reviewed. The results supports a direct correlation between R&D cost and earnings and an indirect correlation between R&D cost and stock prices as postulated in our model. The variables are highly influenced by the lag period. It was realized that R&D spending is vital for the survival of this companies with that of pharmaceuticals being inevitable. Besides the economic benefits, investment in R&D cost is relevant for maintaining competent human resource, and goodwill appreciation. The consensus pharmaceuticals are arriving at in their discretionary treatment of this intangible is something really interesting.

Key words: FASB, IASB, R&D Cost, Earnings, Stock price, Lag period

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ABBREVIATIONS

FASB	Financial Accounting Standard Board
GAAP	Generally Accepted Accounting Principles
IASB	International Accounting Standard Board
IAS	International Accounting Standards
IASC	International Accounting Standard Committee
IFRS	International Financial Reporting Standards
R&D	Research and Development
SFAS	Statement of Financial Accounting Standard

Chapter one

1. Introduction

This chapter provides the background of “Accounting for Research and Development Cost: Its influence on Earnings and Stock Price of companies”. It also presents the problem statement, the purpose, significance of study and the delimitations. An outline of the rest of the thesis then follows in order to facilitate the reading.

1.1 Background of study

For companies to remain competitive the underlying value of the firm based on its intangibles such as research and development (R&D) associated with cash flows and future benefits, is desired in order to strengthen its position by creating, maintaining and enhancing sustainable advantages that leads to future profitability (Ballester et al, 2003). There is thus, the need for investment in R&D to raise the position of the firm among its competitors. Such investments ensure that companies could be able to operate into perpetuity with regards to the going concern convention. Operating according to this convention will mean balancing the economic environment by meeting the laws of demand and supply. The needs and wants of consumers are constantly changing as their demand for improved and new products continue to evolve. Consequently, to satisfy the needs of the consumers, companies are allocating substantial amount of their running budget to R&D activities to improve and manufacture new products. These new products enable companies to be the first in emerging markets, giving them an advantage in existing (matured) markets and guarantee future cash flows.

From the vista of investment theory, R&D cost (expense) exhibits certain characteristic that makes it different from ordinary investment (Hall, 2002). The first characteristic comes in the perspective that half or more of R&D spending is the wages or salaries of highly skilled and knowledgeable engineers or scientists that are endowed with the ability of fostering the entity with innovations. Their efforts create an intangible asset; the firm’s knowledge base from which profits of future years are going to be generated. Because the knowledge is not systematic but rather tacit, it is embedded in the human capital of the

firm's employees and shall be lost if they leave or are fired (Hall, 2002). As part of the resource base of the firm disappears when such workers leave or are fired, firms tend to smooth or even their R&D spending over time, in order to avoid losing workers endowed with a reasonable amount of knowledge. This is a fact that has a very important implication for R&D investment. Thus, R&D spending at the firm's level typically behaves as if it has a high adjustment cost (Lach et al, 1998). According to Hall (2002), this adjustment cost has resulted to two consequences; the first one being substantive resulting to a high equilibrium rate of return to R&D cost so much that it can cover adjustment cost. The second effect which is closely related to the first is the cost of capital being weak in the short run due to the slow response of R&D investments to cost changes.

The importance of R&D investment may not be overemphasized but its impact has caught the attention of both the private and the public sectors. In the private sector, there has been a proliferation of investments in R&D activities. About 20% of total revenue especially for pharmaceutical companies is being allocated yearly as investment budget signifying the importance such companies attached to R&D activities. In this sector, investments trend varies across industries with the pharmaceutical industry ranked first, followed by the IT-industry, the automobiles and so on. The service industry is not left out with respect to their R&D investment trend as a substantial amount of their budget is allocated to improve their services. At company level, leading research investors amongst US companies include Ford, General Motors, DaimlerChrysler, IBM, Microsoft and Intel. Unfortunately, the decreasing market share of US car makers due to financial constraints will lead to a decline in available funding for R&D investments. Elucidating on the R&D figures invested by the leading companies in specific sectors reveals the world's leading automobile and pharmaceutical companies, Toyota and Pfizer Inc. investing \$ 6.4 billion, and \$7.4 billion respectively. These figures correspond to 4% and 18.71% of total operating expenditure respectively in the 2005 financial year (Toyota and Pfizer, 2006). Recently, companies are using investments in R& D as their new strategy for success and as such, they are obliged to invest only in profitable R&D activities which may be costly for the company. In the automobile industry, the recently produced hybrid cars of Toyota

are a major factor for the company's dominance. This product advantage has prompted General Motors and BMW to form an alliance to catch up with Toyota (Financial Times, 2006)

In the public sector, governments of many countries have turned to realise the important role which R&D investment plays in their economy. This role is basically knowledge driven as it aids them to improve their place or maintain a favourable rank. They strive to examine what should always be done to support and encourage R&D investments. This has led to the continuous rise of spending in R&D spending on a global basis. This is mostly evident in industrialised nations as investment in R&D has increased from an average of 1.5% of Gross Domestic Product (GDP) in 1980 to more than 2.2% today. The US continues to lead global trend in terms of investment in R&D amounting to a value of about \$265B in 2005. In terms of R&D investment as a percentage of GDP, it is ranked 2nd (2.6%) behind Japan (3.2%). Investments by these governments in R&D have been feeding research projects in universities and private corporations. Historically, R&D funds were spent at scientific labs but today many projects are going to companies and their subsidiaries overseas. Due to low costs and large talent pools which include a number of new graduates with scientific degrees, the nations of China and India in particular are attracting more research funds invested by US and European companies. A recent study by European Union Commission found that total spending on research in the 25 nations of European Union amounted to 1.9 % in 2003 which was below that of US and Japan. China has one of the fastest growing research budgets in the world, and by 2020, the government's goal will be to invest 2.5% of GDP annually in research, which will cause China to be ranked 3rd in the world. Chinese government invested 29.4B USD in R&D in 2005. This amount constituted 1.5% of GDP. Indian Government invested 4.9B USD in R&D which constituted 0.77% of GDP in R&D. In 2001, Sweden, Finland, Iceland and Japan were the only four OECD countries in which R&D to GDP ratio exceeds 3% above OECD average of 2.3% (Plunkett Research Ltd, 2006).

The Government of some countries go further to support private sector R&D investments by introducing grants programme while providing an increase in funding for

technological sector as part of its commitment to the course (Cullen, 2000). This grant approach is usually opted for particularly because it is seen as a better, safer and fairer than tax concessions. Evidences have indicated that R&D expenditures are adjusted on short notice to help achieve budgeted targets as in pharmaceutical industries that had explicit policy approval of R&D expenditures with projected successes in hitting the target rate of return for the year (Susan and Robert, 1994). If the return was projected to be greater than budgeted, more would be spent on R&D programmes. If it were expected to be less than planned, R&D expenditures would be lower. Subvention of R&D investment projects in the private sector by the government is relevant as part of the efforts to maintain a steady economic trend.

1.2 Problem Statement

The controversial treatment of R&D cost still persist today with the two main standards setters still following two different ways of reporting accounting for R&D cost. The FASB (Financial Accounting Standard Board) chooses to expense on the basis of uncertainty of future earnings. Paragraph 50 of SFAS 2 (Statement of Financial Accounting Standards) states that the relationship between current research and development and the amount of resultant future benefits to an enterprise is so uncertain that capitalisation of any research and development costs is not useful in assessing the earning potential of the enterprise (Kothari et. al, 2002). On the contrary, the IASB (International Accounting Standards Board) ascertains that future benefits are certain, requiring capitalising after assessment of R&D cost. Being aware of the postulations of the standards setters, and the apparent idea of the impact of R&D on their going concern, profitability and market value, corporations are still intensifying their activities on Research and Development. This aspect of business is very strategic especially in the pharmaceuticals, manufacturing, IT and automobiles companies as their existence is threatened without substantial investment in R&D. These corporations strongly believe investments in R&D attract continuous economic benefits especially in the long run. The benefits to corporations can be of various forms notwithstanding the fact that the supposed economic benefit might not be utilised. To have a good grasp of this situation, answers to the following two research questions are imperative.

- Does R&D cost contribute in anyway to the earnings of the firm and to what extent is its contribution?
- What is the responsiveness of share price to changes in R&D costs?

1.3 Purpose of the study

The aforementioned questions can best be comprehended through the purpose of this research study which encompasses the following.

- Exploring the relationship between R&D costs and operating earnings.
- Determining the influence of R&D costs on the share price of a company.

1.4 Significance of Study

Much has been written about the impact of intangibles and R&D costs in particular on key company indicators such as earnings and stock price especially after the implementation of IAS 38 in 2004 by the IASB. This study will be beneficial to companies as it brings out the effect of investment in R&D on these key company performance indicators. This can be a valuable tool for companies in making decisions regarding allocation of investment funds. Besides, this study could be of help to those involved in the convergence project regarding the global accounting treatment of R&D cost decision to be taken by 2008.

1.5 Delimitations

In this piece of work, we used two manufacturing and two pharmaceutical companies though this was not the original idea. For the manufacturing companies, we chose to use only the B shares because they are the most tradable and are what is reported in the financial statement. Furthermore, we limited our sample size to four companies collecting data for just ten years because of the limited time available for this study. We equally had problems reaching the chief finance officers of the various corporations. We however interviewed well informed senior staff. On the contrary, the results were not all that good.

The pivot of digression of useful information and analysis is mainly the lag period existing between R&D expenditure and earnings. The lag period we had for many of the companies was not the best one and a much better result would have been provided if we had data for the long time frame that really mattered. Also, the published account of many of the companies was not very consistent. Reviewing proceeding and current year's data to compare the figures published sometimes showed completely different figures. Besides the partial disclosure exhibited by some of the companies such as AstraZeneca, some of them published in currencies that required the authors to convert to a standard currency as found in the case of Nobel Biocare. All this required an exchange rate for the year that the accounts were prepared. The authors had to get this independently and convert to the currencies that are found in the thesis. The limited time available was also problematic as we had to complete the assignment under pressure.

1.6 Organisation of the Study

Our thesis has been divided into five chapters. The first chapters introduce the subject of our thesis. This includes the background of the recent study, and purpose of our study. Chapter two provides an inside into literature review. It reflects on what other authors have discussed with respect to R&D cost and on what the international standard setters try to bring out. It includes the past study and findings of the past and current research on our thesis topic till date. The third chapter outlines the way the thesis is conducted. The fourth chapter provides the description of the companies used, profile of those interviewed, responses for our questions and finally analyses of the data using the statistical tools. The final chapter will reflect on the summary, conclusion and recommendation of our study including suggestions for further research.

Chapter Two

2. Literature Review

This chapter covers an overview of the basic concepts relating to accounting for research and development cost. An exploration of the content shall close with a critical examination of the theoretical framework on which the research is based.

2.1 What is Research?

Research is an original and planned investigation undertaken with the prospect of gaining new technical knowledge and understanding (Stolowy and Lebas, 2004). This implies it is an active, diligent and systematic process of inquiry aimed at discovering, interpreting, and revising facts (Wikipedia Encyclopaedia, 2006a).

The original pronouncement of FASB as amended in the 2005/2006 edition defines research as a planned search or critical investigation aimed at discovery of new knowledge with the hope that such knowledge will be used for in developing a new product or service or a new process or technique or in bringing about a significant improvement to an existing product or process (FASB, 2005).

Research activities are broadly categories into two; *basic* and *pure* research (Epstein and Mira, 2005). Pure research is experimental or theoretical work undertaken primarily to acquire new scientific or technical knowledge for its own sake rather than directed towards any specific aim or application. It involves the advancement of knowledge and the theoretical understanding of relations among variables. Basic research provides the foundation for further and sometimes applied research, though researchers involved in it difficultly obtain funding as there is no guarantee of short term practical gain. Applied research on the contrary, is an original or critical investigation undertaken in order to gain new scientific or technical knowledge and directed towards a specific practical aim or objective (Wikipedia Encyclopaedia, 2006a). Research of this nature are usually carried out by either an academic or industrial institutions though most often an academic

institution such as universities usually carry out specific applied research programs funded by industrial partners interested in the program. According to Stolowy and Lebas (2004), the following are typical examples of research activities:

- Activities carried out for the purpose of acquiring new knowledge.
- The search for, evaluation and final selection of applications of research findings, or other knowledge.
- The search for alternatives for materials, devices, products, process, systems or services.
- Formulation design and evaluation and final selection of possible alternatives for new or improved materials, devices, products, processes, systems or services.

2.2 What is Development?

Development refers to the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, process, systems or services prior to the commencement of commercial production or use (Stolowy and Lebas, 2004).

Also, the pronouncement of the FASB in the 2005/2006 edition also gives the quoted definition of development as the translation of research findings or other knowledge into a planned or design for a new product or process or for a significant improvement to an existing product or process whether intended for sale or use (FASB,2005).

Example of development activities according to Stolowy and Lebas (2004) includes the following:

- The design construction and testing of pre-production or pre use prototypes and models.
- The design of tools, jigs, moulds and dies involving new technology.
- The design, construction and operation of pilot plant that is not at a scale economically feasible for commercial production.

- The design, construction and testing of a chosen alternative for new or improved materials, devices, products, processes, systems or services.

Association of research and development comes in cases of identification of the cost element. This implies those research costs that will definitely attract future benefits will be identified as development costs as per the pronouncement of IASB.

2.3 Recognition and Measurement of R&D Cost

The International Accounting Standard, IAS 38 – *Intangible Assets*, requires enterprises to recognise R&D whether purchase (externally generated) or self created (internally generated) at cost if and only if it will attract future economic benefits, and the cost of the asset can be measured reliably. The recognition of the R&D intangible entails the effort undertaken by standard setters, academicians and researchers to assign a value to the intangible asset that would properly reflect its economic or fair value. Because entities engage in R&D activities which can lead to successful new development and in turn, bring economic benefits to the firm (Shortridge, 2004), it is important this intangible asset be recognised. Also, because entities struggle to survive with the going concern convention by continuously investing in growth and profitability schemes, R&D cost will always be regarded as a necessary cost to incur (Stolowy and Lebas, 2004). Besides, accurate measurement of R&D will enhance comparability between accounting measures like earning and net assets among R&D intensive and non R&D intensive firms which could be an aid to investors (Chambers et al, 2002). Recognition will enable the valuation of this intangible asset so that their amount could be reported with much accuracy in all parts of financial and non financial components of the annual statement (Stolowy and Lebas, 2002).

Recognition is often done at the fair value of the intangible asset. Fair value is the amount that a firm will pay for the asset at the acquisition date in an arm's length transaction between knowledgeable willing parties based on the information available to both parties (Alexander et al., 2004). Recognition of this intangible is essential so that it will be easier to determine the portion of expenditure relating to each level of individual achievement for proper capitalisation (Epstein and Mira, 2005). The recognition of this intangible is

very similar to other intangibles because they are mostly recognised at their cost of creation. Investors have always considered the economic value of R&D cost when they lobby to set their stock prices which are very vital for sustainable advantages that will lead to future profitability (Ballester et al, 2003). It is therefore very reasonable to treat the proportion of current R&D cost that will definitely contribute to a firm's future material and economic benefit with absolute care. This has called for its recognition and measurement so that shareholders could get the appropriate return of their investment in the business corporation. Ballester et al, (2003) still holds that 40% of the difference between the market and the book value of equity is the proportion accounted for by cumulative R&D asset and investors always consider this proportion to generate a reasonable amount of future benefit. Thus, firms turn to differ in their R&D activities which is mostly a compliment of profitability because parameters that should remain identical for all firms as far as R&D is concerned are violated.

Though there is no single indicator that captures the measurement of R&D cost, the indicators could provide useful information from which we can make good decisions about a company's R&D (Li, 1997). Expenditures in R&D cost are often persistent when their percentage on sales starts declining; it is viewed as a red flag indicator to a business unit (Penman, 2003). Thus, the usefulness of summary accounting measures such as earning and book values will depend greatly on their ability to serve as indicators of value that will facilitate decisions (Lev and Sougiannis, 1996). Because the degree of uncertainty associated with the output of R&D tends to be greatest at the beginning of a research program or project, an optimal R&D strategy will definitely be needed so that a static framework of recognition could be analysed (Hall, 2002).

In-process R&D cost also known as internally generated R&D is R&D generated by an entity rather than being acquired through a business combination or some other process of transaction (Epstein and Mira, 2005). Though it is pretty much difficult to separate in-process R&D from internally generated goodwill, IAS 38 condones only the recognition of this intangible to the extent that the expenditure could be compared to the research phase of an R&D scheme (Penman, 2004). IAS 38 further recognises that development

stage is further advanced towards its employment to the greatest possible advantage of the research phase and thus is sometimes complementary for a successful R&D scheme (Epstein and Mira, 2005). The standard ascertains that an enterprise should be able to identify and demonstrate that this intangible asset will be able to generate future economic benefits for the entity and upholds the recognition of the intangible asset during the development phase only if it will be able to exhibit the following characteristics;

- **Identifiability:** This criterion expects the project concerned to be clearly identified with detail description of the products, process, and expect the R&D work and expenditures accrued to be well defined with the outcome having a fix application.
- **Evaluation:** This entails distinctively evaluating the respective cost to be allocated over time, being able to determine the cost to be appropriated and measuring the expenditure attributed to the intangible asset during its development.
- **Technical feasibility:** There should be proof of existence of technical feasibility of the product or process to complete the intangible asset so that it will be available for sale or personal use.
- **Commercial success:** Corporations have to demonstrate that each project has a serious chance of commercial success at the date of closing of financial statements. Besides, the new product or process should have a clear market potential and the enterprise is expected to demonstrate a market exist for the capitalised asset in which it can subsequently be sold or utilised for personal purpose.
- **Future economic benefits:** The asset should be able to generate future economic benefits over several years by either generating revenue or reducing costs.
- **Financial feasibility:** Corporations are expected to substantiate that the development process can be completed financially with resources available or expected to be available for both the completion of the R&D work and for the marketing of the product or process if it is intended for sale.
- **Intension to complete:** Finally, companies are expected to attest their intention to complete the intangible asset for usage or to be sold.

December 2002 saw the IASB disclosing the ED (Exposure Draft) of Revised IAS 38 proposing that acquired in-process R&D should be recognised as an asset. The ED also stated that the subsequent expenditures related to in-process research or any development expenditure which was incurred after the acquisition of that project shall be accounted for following the general rule of capitalisation or expensing of the R&D asset. This is the document that introduced the fair valuation of intangible assets (Ballester et al, 2003). It should be noted that, the fair value applies only in the absence of an organised market and is almost irrelevant in an active market. (Alexander et al, 2004). Since no organised market exists for in-process R&D, there may be necessary methods of valuation which shall be required to approach the treatment of investments in R&D. The IASB has approached this point by identifying the applications of techniques developed by certain entities in the regular sales and purchase of their intangible assets, should be applied for the purpose of the valuation of R&D. The analysis of in-process R&D is therefore very essential for standard setters as well as users of financial statement which will be used to assess the logical consistency of the conservative accounting standards limiting the recognition of the R&D intangible asset (Zarowin, 1998). It is worth noting that, when an internally generated intangible asset meets the recognition criteria, the determination of the cost follows the same principle of an acquired tangible asset (Epstein and Mira, 2005). Such costs which include the allocation of incremental administrative and overhead costs comprise the cost of creating, producing and preparing the asset for what it shall be intended.

Recognition and valuation of R&D cost are two complimentary activities that go side by side. In-process R&D has grown enormously over the past decade (Shortridge, 2004) leading to the increase of the market value compared to the book value of the entity. In some cases, the difference has been attributed to the unrecorded value of the R&D activities (Boulton et al., 2000). Usually, the initial amount of the in-process R&D is recognised as an asset because of the nature of the intangible which has partly been expensed before its recognition. This is why IAS 38 has acknowledged the capitalisation and amortization of in-process R&D over the period of its economic utilisation (Epstein and Mira, 2005). The valuation model to be evidently used by experts, academics in

research studies and accounting professionals to estimate the economic or fair value of the R&D intangible asset will depend on the data available for them and to a certain extent, on the preference especially at the individual level. What ever the situation, that which shall always be highly recommended by the authors of this thesis is the market value of the intangible asset though the returns of the R&D investments sometimes decrease with the size and longevity of business entities. This is because earlier in the life cycle of smaller firms, they turn to concentrate more on the building of intangible R&D asset while already mature or bigger firms that have already benefited the aspect of R&D investment or from a different one, turn to pay a little less attention to that particular aspect of R&D expenditure (Ballester et al., 2003).

Since success in most entities is mostly dependent on its ability to continuously invest in R&D activities which prove to be successful, Shortridge (2004) argues that, R&D expenditures of successful schemes will be valued more than the R&D of non-successful schemes. This is because the market will value the R&D expenditures of the successful scheme but not that of the non-successful scheme being the trend to be followed by investors. Valuation of R&D will therefore be very necessary to explain the difference arising in a firm's current and market value (Sougiannis, 1994). As the market values expenditures of some firms differently from similar expenditures by other firms, it is therefore appropriate to capitalise a portion of the R&D expenditure (Shortridge, 2004). Lev and Sougiannis (1996) argues that because R&D expenditure is always associated with a firm's current market position, the valuation of this tangible asset by all firms should be similar especially as the successful development of a business strategy will depend greatly on the specification of functional areas like R&D (Aaker, 1995). Other studies have proven contrary to the argument raised by these former authors. Shores and Brown (2002) later divided firms into single-product developers and multi-use product developers. Single product developers were those firms that still had the exclusive rights to produce a product thereby still having a patent. Multi-use product developers were those that produce products that several other manufacturers also produced. The R&D expenditures of single product-developers could bring benefits for periods longer than those of multi-use product developers. This is because the former valued the R&D

expenditures differently which varied in economic value and scope (Hirchey et al., 1998). This finding did not include the non financial aspect of R&D expenditures which could still be a possibility of the market valuing the R&D expenditures of some firms more than others (Shortridge, 2004).

In practice, acquired assets are usually written off when investments in R&D are expensed (Penman, 2003). Usually, when recognised as an asset (capitalisation), it is reported in the balance sheet whereas when recognised as an expense, it is written down in the income statement. Stolowy and Lebas (2002) call this income statement in which R&D activities are presented income statement by function. They use three possibilities; firstly, R&D expenses are reported as a function, item or line. Secondly, R&D is identified and included in another function such as selling, general and administrative expenses such as in the French Generally Accepted Accounting Principles (GAAP). Thirdly, R&D becomes part of the cost of goods sold and is therefore expensed as incurred such as in the Swedish GAAP. Since expenditures in R&D turn to erode earnings, firms sometimes set up shell companies with their partners to carry out research (Penman, 2003). In this structure, the original company may do the research but the charges will be borne by the partnership R&D Company which will create revenue to offset the expenditure incurred in R&D. Successful R&D will then require that the investment in the shell be written off.

2.4 Accounting Treatment of R&D Cost

The accounting treatment of research and development costs has many interpretations and standards from the many national and international accounting and professional bodies with lot of divergence on its treatments. Conspicuous among these bodies by virtue of their members' size and allegiance, are the IASB that propagates Principle based accounting and FASB that enforces Rule based accounting (Bennett, et. al 2006). The stance of these two bodies greatly affects the accounting world.

2.4.1 Treatment according to IASB

In July 1978, the IASC (International Accounting Standard Committee) issued IAS 9, Accounting for Research and Development Cost; the first standard for R&D Cost (Milalan and Tomazewski, 2002). This standard states that R&D costs should be expensed. However, that part of R&D cost where distinction can be made as development cost may be capitalised only if specified seven criteria are met. Furthermore, when R&D cost fulfil those certain conditions of capitalisation it is recognised as an intangible assets. Once costs have been expensed during the development phase, they cannot later be capitalised. According to Bennett et al (2006), IAS 9 was superseded by IAS 38, issued in September 1998, but the IASC's approach to the accounting treatment for R&D cost did not change. This amendment brought the treatment of R& D cost under intangible assets i.e. IAS 38. IAS 38 is flexible comprising the mix of prudence and matching principle. Epstein & Mirza (2005) says this flexibility has no meaning in real practice as distinguishing research-like expenditures from development-like expenditures may not be easily accomplished. IAS 38 permits recognition of internally created intangible assets to the extent that the expenditures can be analogized to the development phase of research and development cost. Subsequent cost incurred on R& D should be recognised as an expense when they are incurred unless those costs will enable the asset to generate specifically attributable future economic benefit and those costs can be measured and attributed to the assets reliably.

Capitalised R&D cost acquired or created is initially measured at cost which includes items like purchase price, legal fees, cost for major improvements, alterations and betterments. For measurement subsequent to acquisition, both the cost and the revaluation models are allowed by IAS 38. An entity must choose either of the two to employ for a reasonable duration. The cost model entails measuring capitalised R&D at cost less any amortisation and impairment losses. Revaluation on its part involves writing down R&D at a revalue amount (based on the fair value) less any subsequent amortisation and impairment loss, only if fair value can be determined by reference to an active market. However, the standard acknowledged that it will be difficult to obtain fair value from an active market for development costs (Alexander et al, 2004). As such, the application of

the cost method by users will be generally accepted. Under this model, revaluation increases are credited directly to revaluation surplus within equity except to the extent it reverses a revaluation decrease previously recognised in the profit and loss account.

The IASB has also addressed the accounting for internally generated intangible asset with respect to the R&D phase in International Financial Reporting Standard (IFRS) 38. The exposure draft with relative to IAS 38 proposed that acquired in-process R&D should be recognised as an asset and its subsequent expenditures be related to the in-process research or development project incurred after the acquisition of that project shall be accounted for following the general rule of capitalisation. It should be noted that before the R&D intangible be capitalised, two of the seven requirements which it must fulfil are the intention to complete the asset for use or sale and reasonable certainty that the intangible asset will generate future earnings. These points are criteria that qualify the R&D intangible as a resource which is associated with earnings. This is why academicians and accounting experts went as far as ensuring the imminent adoption of the IFRS of the IASB by all European listed companies on a mandatory basis.

2.4.2 Treatment according to FASB

The accounting treatment of R&D cost under the Financial Accounting Standard Board (FASB) addressed by SFAS 2, Accounting for Research and Development Costs provides a view contrary to that of IASB. Before, 1974, the FASB had been following alternative R&D accounting and reporting practices of either capitalisation or expensing. The selective capitalisation method required prerequisites conditions to be fulfilled that are based on such factors as technological feasibility, marketability and usefulness. However, since 1974, FASB had been requiring the immediate expensing of R&D cost when incurred. As per FASB (2005), accounting for the costs of research and development activities conducted for other firms under a contractual arrangement is a part of accounting for contracts in general and is beyond the scope of SFAS 2. Consequently R&D generated from any contractual agreement will be sent directly to the profit and loss account. Furthermore, SFAS 2 does not apply to activities that are unique to enterprises in the extractive industries involve in prospecting, acquisition of mineral rights,

exploration, and related mineral development. However, R&D activities of other enterprises in the extractive industries that are comparable in nature to R&D activities of other enterprises come under the scope of SFAS 2. Example of such activities includes the development or improvement of processes and techniques employed in exploration, drilling and extraction.

The costs of intangible assets that are purchased from others for use in research and development activities and that have alternative future uses shall be accounted for in accordance with FASB statement No.142 - *Goodwill and Other intangible Assets*. However, the cost of intangibles that are purchased for a particular research and development project and have no alternative future uses, implying no separate economic values, are research and development costs at the time the costs are incurred as published by FASB (2005). The “alternative future use” concept is very important in deciding items to be capitalised or expensed. According to this rule, costs for materials, equipment, and facilities used in R&D activities are expensed as consumed, including depreciation over useful lives if they have alternative future uses, otherwise the costs of these items are expensed as acquired or constructed, never depreciated (Oliver, 2003). The FASB considered the uncertainty of future economic benefits of individual R&D projects and the lack of casual relationship between expenditures and benefits as reasons for not recognising it as an asset. Besides, FASB (2005) argues it is not appropriate to capitalise R&D cost on an aggregate or total enterprise basis because if research and development costs were capitalised, a meaningful method of amortization could not be developed since period of benefit could not be determined. In addition, if selective capitalisation were applied only to costs incurred after fulfilment of the particular conditions, only a portion of the total costs of a particular R&D project would be capitalised and amortised. Thus, the capitalised amount would not indicate the total costs incurred to produce future benefits; nor would the amount of periodic amortization of capitalised costs represent a ‘matching’ of costs and benefits. The SFAS 2 enforced by FASB upholds the cost method of valuing R&D at initial cost but rejects outrightly, revaluations subsequent to initial recognition (Milalan and Tomazewski, 2002).

Despite the tough stance taken by the FASB, the expensing-all rule for R&D expenditures has an exception as spelled out in SFAS No.86 - *Accounting for the Costs of Computer Software to be sold, leased, or otherwise marketed*. This standard allows firms that develop software for external use to capitalise the later portion of the development cost after technological feasibility is established (Shi, 2002).

Based on the variations in treatment of R&D cost, it is evident that there is a lot of subjectivity in determining the value of capitalised R&D reported in the balance sheets of corporations. However, the action of each corporation depends on the prevailing operational results of the entity. Corporations may account for R&D in a manner quite different to the prescription of IASB and FASB for their personal gains.

2.5 Shortcomings of the Dual Treatment of R&D Cost

The divergent treatment of R&D expenditures by the two main standard setters especially IASB has resulted to a lot of consequences in the short and long run. Many companies' management tailor their accounts to attain their desired objectives rather than preparing financial statements that show a true and fair view. In the short term, managements do adjust their accounts by manipulating the capitalisation process depending on what they want to achieve. The objectives of this manipulation could be to reduce their tax burden, boost short term earnings or to look into the 'the horizon and myopia problem' (Chengs, 2004).

Corporations complying with the IAS 38 enacted by the IASB purport the expensing option during the treatment of R&D expenditures when their main objective is to reduce the burden of taxation. Virtually, all industrial firms treat R&D as current expense to gain the tax benefits (Johnson, 1967). Some firms have consistently been investing in R&D because they keep enjoying government incentive such as tax shields that enables them to expense R&D particularly for tax purposes (Scholes and Wolfson, 1997). Thus, the process of tax-favoured investment increase by the present value of the tax savings, less the anticipated costs that resulted from higher demands making R&D tax-shields to be value relevant (Sougiannis, 1994).

Managers may reduce R&D spending in order to create opportunities to boost short-term performance (Bushee, 1998). This kind of adjustment occurs in two folds and is elaborated thus;

- The CEO approaching retirement (Dechow and Sloan, 1991) - *the horizon problem* and,
- The company faces a small earnings decline or a small loss (Baber et. al, 1991) - the earning benchmarking *myopia problem*.

CEOs facing the horizon problem usually prefer with bias, the capitalisation of R&D expenditures so as to reduce expenses and increase earnings. This is evident as most CEOs stock option compensation schemes granted by the compensation committee are a function of the earnings they made during their reign. A similar application is employed by chief executives when their corporations attain earnings figures below targeted result or in some cases a loss. The consequence that awaits them at the shareholders' meetings usually serve as a catalyst for such window dressing. The requirement by SFAS 2 of 1974 published by FASB requiring the full expensing of R&D expenditures makes R&D vulnerable to cuts by managers' burden as a pressure to achieve short term targets (Robert and Susan, 1994).

The control of R&D expenditures, aimed at managing stock price, and going concern via earnings constitutes the long term effect of the dual method of treating R&D. An independent analysis of the possible effect of R&D expenditures on earnings and stock price constitutes the subject matter of this piece of work as treated in the subsequent paragraphs.

2.6 The Harmonization (Convergence) Process

Different authors have different definition of the term *harmonisation*. Even the European commission has not been able to explicitly define harmonisation (Nobes, 1992). Harmonisation in the accounting context means, the process of increasing the compatibility of accounting practices by setting limits for the degree of variation (Nobes, 1992). So far, this has been the most appropriate definition relative to the authors. As

mentioned earlier, the divergence between the Rule (FASB) and Principle (IASB) based accounting on so many accounting issues has an adverse effect on international comparison and competition as the different approaches distort results.

The essence of the convergence effort is to ensure comparability of financial statements both in the United States and European Union while at the same time eliminating a variety of differences between IFRS and U.S. GAAP. Also, the project will help to eliminate the requirement for European companies listed or to be listed in the United States, from preparing another set of financial statements based on the U.S. GAAP. This is usually the perquisites for foreign companies interested to be listed in the largest capital market. Projects falling under the heading of short term convergence are limited to those that will address differences outside the scope of a major project for which convergence around a high-quality appears to be achievable in the short term, usually by selecting between existing IFRS and US GAAP. The short term convergence project with respect to R&D will be to improve IAS 38 by incorporating aspects of US GAAP in particular, aspects of SFAS 86 – *Accounting for the Costs of Computer Software to Be Sold, Leased or Otherwise Marketed* (FASB, 2006). Thus, in October 2002 the FASB and IASB outlined a number of standards for convergence among which is the standard regarding the accounting treatment of R&D costs (Johnson, 2002). The final outcome of the deliberations is still going to be made public by 2008 (IASB Homepage, 2006). In reality little progress has been achieved towards the convergence of US GAAP and IFRS accounting standards for R& D activities.

2.7 R&D Cost and Earnings

A number of authors have carried out research in the recent past aimed at determining if firm's investment in R&D can affect any amount of profit so as to establish a correlation between R&D and earnings using different approaches. Firm may invest in R&D to enhance the earnings with a belief of a positive correlation between the two variables. Robert and Susan (1994) examined the changes in R&D expenditures when earnings vary from analyst prediction and found evidence of a direct relationship between the variables. R&D can be adjusted to improve firms' success in meeting their current earnings (Robert and Susan, 1994). Managers have motivation to increase profit by initiating demand with

investment in R&D. Since there is risk and relatively long time horizons associated with R&D, borrowing or the issuance of new equity securities is an unlikely source of funds for the support of R&D projects. Companies may show initiation to take this risk when they see any form of compensation from future earnings. The study of Branch (1974), with construct of a relationship as R&D being independent variable and profit and sales growth being dependent, strongly support that R&D activity tends to increase both profit and growth. Ravenscraft and Scherer (1982) have also both given evidence of a positive relationship between R&D and profitability. Since R&D projects are long term, time is a critical variable in measuring returns to R&D. Mansfield (1971) claims of about three years on an average, to complete an R&D project. Most Econometric studies have assumed a constant rate of decline in the effect of R&D on profits as the length of lag increase as cited by Ravenscraft and Scherer (1982) in the work of Mansfield (1968) and Branch (1974).

R&D intensity is being felt differently among various industries relative to their structure, method of operation and product line. The impact of R&D is greater in consumer good industries as they need innovations to continuously satisfy the desires of customers. Furthermore, R&D has a stronger profit impact in mature or declining life cycle industries. However, R&D has smaller profit effect for business that pioneers their market and has recently experience a major technological change. Zarowin (1999) has found that there are considerable benefits of R&D investment in various firms though these benefits are subjected to variations across firms. This was done by estimating a firm-specific R&D asset form regressions of operating income on their previous R&D expenditure data. He concluded that it will be better and important to estimate the R&D asset at the individual firm level even though the estimated parameters may be subjected to some degree of estimation errors.

Though SFAS No 2 outlays the absence of an association between R&D expenditure and subsequent benefits, Sougiannis and Lev (1996) presented evidence that indicates the association between R&D expenditures and subsequent earnings in general by estimating a relationship between the two factors for a large cross-section of R&D intensive firms

like electrical and electronic industries. This relationship has proven to be statistically significant and economically meaningful couple with the fact that R&D research in economics and related areas is growing extensively. The stimulation keeps coming from the role of innovations especially in the theory of economic growth. The authors went further to support their findings and purports of a significant correlation between R&D and subsequent earnings by quoting Dukes (1997) who has examine investors perception of R&D and report that they adjust reported earnings for the full expensing of R&D.

Ballester et al (2003) have also found a significant proportion of R&D expenditure ranging between 80 to 90 percent to have future economic benefits. They supported their theorem with documented evidence that investors attribute to R&D expenditures as market participants continuously behave as if R&D periods have been amortised over a relatively longer time frame. Their result has to an extent shown some amount of diversity with the size of the entity. It was found that R&D is correlated with size and profitability in different proportions because smaller firms turn to reap significant benefits earlier in their life cycle than larger and more mature firms. This was because the smaller firms in the early stage of development concentrate in building the R&D intangible asset while the larger and more mature firms have already been able to reap the benefits of prior efforts in their profits. The outcome of a survey of 99 companies in the U.S. provided the expected outcome and thus reinforce and extended prior research findings by adding credibility to the proposition that earnings is greatly affected by R&D expenditures. However, the authors mentioned other factors that affect earnings significantly like compensation plans, provisions for bad debts, import relief investigation, labour contract negotiations and management buyouts. In all, their conclusion was focused on the fact that the earnings derived by an entity from its investments incurred in the R&D expenditure are subjected to significant benefits and contributes a lot in the entity's survival with respect to the going concern.

Many R&D intensive firms have few tangible assets so that their prospects are tied to the success of new, untested technologies and hence are highly unpredictable. With some taking up large expenditures on the onset, the research project still proof to be far from

assured. The earnings attributable to intangible assets are much less certain than the earnings derived from traditional tangible assets (Boone and Raman, 2004). The market has always given insufficient credit to those firms that spend heavily on R&D but realise no significant benefit though they face strong pressures to cut R&D and improve on earnings. The reluctance of the managers to cut down the investment has often been the confidence that they show in the investment that may possibly yield returns (Chan et al, 2001).

A high relationship can exist between R&D cost and income when expensing rather than capitalising because the size of the correlation coefficient was much significant in the expensing phase than in the capitalising phase. The minimum difference on relationship of alternative treatment could not guide accountants for a better treatment thus the choice of accounting treatment of this intangible should remain at the discretion of its management because there is no empirical evidence to portray the superiority of one method over the other (Johnson, 1967).

2.8 R&D Cost and Stock Returns

As the market value of a firm's share reflects the value of all its assets, the link between the asset values and stock prices could be readily seen or understood especially if the assets are non current. Stock returns are associated positively with both unexpected reported earnings as well as unexpected R& D spending (Boone and Raman, 2004). A relationship could be established between the stock prices and intangible investment if the market value of companies is set as a function of future expected earnings and cash flows (Ballester et al., 2003). It may be tempting to believe that increase in a firm's R&D expense would decrease the profit. As a result, the stock price of company would also decrease. In the SFAS No.2 issued by the FASB in 1974, it is required that R&D spending be expensed immediately. With everything being constant, an increase in R&D spending will trigger a decrease in reported earning. Boone and Raman (2004) cites the work of Hand (1990) indicating that some stocks may be mispriced at particular times because the price may be determined by less informed marginal investors who are fixated and don't adjust reported earnings for accounting effects. However, an increase in R&D

cost may increase the stock price of the company. It is because an increase in R&D spending represents good news for investors given the potential or future benefits from the higher R&D spending (Boone and Raman, 2004). Consequently, capital market interprets an increase in R& D spending as good news.

According to Zantout and Tesetsekos (1994), disclosure of R& D expense in the financial statements caused the positive response in the stock market. They also found that when the announcing firm earns a relatively large positive abnormal return at announcement its rival also earns a positive abnormal smaller return. Zantout and Tesetsekos (1994) cites the work of Spence (1984) who considers R&D spill over as completely free and perfect substitutes for own R&D. The announcement of increase in R&D expenditures signal that the firm is moving ahead in the race to be the first to innovate and benefits from first mover advantages. In addition, the announcement of plan to increase the R&D expenditures results in simultaneous upward revision in investors assessment of the market value of the announcing firm and a downward revision in their assessment of the market value of rival firm Zantout and Tesetsekos (1994). The net change in the value of the firm reflected in its periodic abnormal stock return depends on the projects net present value. The net present value of cash flow from the research and development project can favourably impact on the stock price of the firm. But, the association between R&D cost and return depends upon the longevity of benefits arising from its activities (Bublitz and Ettredge, 1989). If advertising and R&D outlays constitute expense just as other ordinary expense, a negative partial correlation coefficient of association with cumulative abnormal return should be absorbed as Bublitz and Ettredge (1989) has done by citing the work of Hopwood and Mckcown (1985). They found that R&D cost is long lived whereas advertising is short lived as R&D has long term effect on the abnormal return. Bublitz and Ettredge (1989) have thus suggested that R&D cost should be capitalised.

The impact of R&D spending on the shareholders return is affected by the duration and type of company. In the short term, firms' announcements of plans to increase R&D expenditures results to an increased in the stockholders share price. This increase is as a result of the believe by investors that the net present value of future earnings and cash

flows will be higher as a result of the increased expenditure (Nystrom and Mank, 2001). This holds true for high technological companies while for low technological ones, increases in R&D investments results to diminishing future returns from the planned research. On the contrary, firms especially in the computer industry face a reduction in their R&D intensity indicating a negative possible relationship between R&D cost and stock price (Nystrom and Mank, 2001). This emanates from the high level of spending by firms on R&D. Doukas and Switzer (1992) found that the impact of R&D increases on stock returns is greater as the size of the firm increases because the stock prices could reflect the capitalisation of R&D expenditures over the accessed economic life.

There have also been proposals that stock prices do not fully incorporate the value of R&D capital probably because of the short time experience investors have as they fail to anticipate the rewards from long-term investments such as R&D (Hall and Hall, 1993). Under pricing may also drive investors to accept financial statement that seem promising at face value without adjusting for long term investments (Porter, 1992). Certainly, investor's passionate concern for technological stocks in recent years reflects their belief that R&D intensive technology stocks are undervalued because they expect more return than that reflected. Many other observers have suggested that investors overestimate the benefits from R&D and as a result, valuations attached to R&D intensive stocks are excessive (Chan et al, 2001). If it is the case that many firm's R&D investments are not profitable but investors systematically overlook this possibility, over valuation may arise. Likewise, the average return on stocks that do R&D is comparable to return on stocks with no R&D. The absence of any difference is consistent with the notion that the market price on average incorporates fully the benefit of R&D spending.

Chapter Three

3 Methodology

This chapter describes thoroughly the process in which we are going to conduct our research study. The designed structure of the research shall be explained comprehensively. Also, the various types of data and the method of collection shall be explained while reasons for choosing a particular method among the various alternatives would be given. Further discussion shall include suggestions of possible sources of errors.

3.1 Scientific Approach

Generally, there are two major approaches of conducting a scientific phenomenon; the deductive and the inductive approaches. Perry (1998) identified these approaches by looking at their differences on a sequential appearance in the body of a research work.

A deductive approach represents an exemplary pattern in which the researcher uses past theory and arguments to base his facts and draw conclusions. The hypothesis usually tested in this case is to examine the veracity of the assertion the author raised at the start of the thesis work. As the conclusion must be true if the arguments are positive, it is sometimes referred to as inferences. Associated with this point is the fact that the conclusion may be of no greater generality than the frame of study. In an inductive approach, the research body is believed to support the conclusion but do not ensure it (Wikipedia, 2006c). This approach represents a possible model in which the researcher obviously finds a field of interest after making observations. The examination of the analysed data generates a theory that usually induce the conclusion thus, inductive reasoning.

As it is often impossible to separate both approaches in a research study (Perry, 1998)), the authors shall utilise both of these scientific approaches throughout their piece of work. Both approaches, with the help of their insurmountable nature, shall provide us with

reasonable insights which we can readily analyse our data. Also, the purpose of our study is to create awareness of the relationship existing between investments in R&D cost and future earnings resulting to its influence on stock prices. The validity of this awareness shall be done by expantiating on the various business domains using relevant economic models and statistical approaches. We shall as well utilise questionnaires that shall be answered by our targeted companies to give us in-depth knowledge and appropriate response to our findings.

3.2 Research Design

A research design is a way to set up an investigation in a research study. It is the basic plan that guides the research procedure in both data collection and the analysis of the final result (Kinnear and Taylor, 1996). This process is going to be laid out in our research framework which specifies the type of information to be collected, sources of data to be used and the data collection procedure. A good data ensures that the collected data is in line with the purpose of the study and that the information collected is of a correct form.

The authors intend to utilise both retrospective and prospective studies in their research as well. A retrospective study reflects on past behaviour while a prospective study looks at future behaviour. In this case, the retrospective study will reflect the company's investment in R&D while the prospective study will portray the behaviour of the company's profit and stock prices in relation to the R&D investment. Also, longitudinal and cross sectional studies shall be made use of. A longitudinal study studies a few subjects for a long period of time while a cross-sectional study involves many subjects measured at once (Wikipedia, 2006b).

Tegstam and Weiner (2000) recognise two types of research that is also going to be taken into cognisance by the authors. These are exploratory and conclusive research. In an exploratory research much information as possible can be collected by the researcher within specific limits. This approach requires flexibility to create linkages with much information as possible. Interviews with our target companies shall help in supplying

insights into the study. A conclusive research provides information which helps in the evaluation and selection of an action plan as well as its course. This stringent approach makes the research more formal by using detailed questionnaires and a formal sampling plan. The approaches are surveys, experiments, observations and simulations (Tegstam and Weiner, 2000). In this stage also, answers to the research questions will start to be provided. A conclusive research sometimes turn out into two separate parts; descriptive and casual type of researches. The descriptive research describes relationships or conditions that are already laid down or are being observed. The casual-research is designed to gather facts or verifications of cost-effect (investment/earnings) relationships present at the moment. It requires a well plan and systematic design that will minimise unambiguous conclusions regarding causality. An example of such a research is the interview research as it seeks to understand the cause to the prediction relating to the variable.

3.3 Rational for Choice of Companies

The choice of Volvo AB, Svenska Kullagerfabriken (AB SKF), AstraZeneca and Nobel Biocare AB for the collection of data is not by chance as each corporation has something peculiar to offer to constitute our data. Writing on a highly deliberated R&D topic at the level of standard setters, especially at this moment when FASB and IASB are endeavouring to reach a convergence on R&D cost Accounting by both standard setters. Evidently, there is bound to be differences in the operating profit figures. These companies provides us with the opportunity to collect data from annual accounts prepared using different standards, presumably due to the different accounting treatment used by the standard setters. Thus, the data collected will not only help to determine the impact R&D cost has on profit but it will also help to determine if the method of accounting matters. Besides, both companies are leaders in their various domains and are full disclosure company thus; they have significant investment in R&D as the companies strive to remain market leaders for their respective sectors. As a result we were expecting to see clearly what this has on the earnings of the corporation.

Lots of documented materials show that pharmaceutical companies depend mainly on their investments in R&D for their survival. Besides, AstraZeneca and Nobel Biocare invest substantially in R&D activities recording 15.8% and 4.4% respectively as percentage of their total revenue for the previous year. This corresponds to 19.2% and 5.3% of their total expenses for AstraZeneca and Nobel Biocare respectively. Their data will also help to determine and if possible, substantiate on the impact that R&D has on earnings and stock prices especially in the pharmaceutical industry. Moreover, beside R&D cost, the choice of this company was as a result of the need for inters company comparison within and across industries.

3.4 Data Collection

It is imperative that the data collected in a research work affects its outcome. We shall rely on interviews to get the research to its focus. Its data collection process shall require that we must be adaptive, flexible and listen attentively to get a good grasp of the issue under cover.

According to Tegstam and Weiner (2000), a research method can either be quantitative, qualitative or triangulation (a mixture of both methods). Quantitative research requires the use of quantitative or numerical data which are often analysed using statistical methods. It is mostly used when the questions are: How often? How much? How many? Hence the findings are expressed in numbers and analysed in a quantified way or in cases where the authors intend to quantify their result. This method can help in the prediction of the total population from the available sample. A qualitative data is used when the research intends to find out a specific pattern in the area being investigated. It should be noted that this approach does not intend to provide scientific or statistical accuracy of the data.

3.4.1 Types of Data

Generally there are two main types of data in the analysis of a research study. This are categorised into primary and secondary data. Primary data is data obtained by a study

personnel himself or through his agents adopting any suitable method such as contacting and interviewing or circulating a questionnaire. Primary data is relatively much more expensive to collect. Secondary data is that which is not originally collected but rather obtained from published or unpublished sources. Secondary data can either be internal or external secondary data. Internal secondary data is available within the organisation and external secondary data is provided by sources outside the organisation. The advantage of using secondary and primary forms of data sources is that it saves time and cost.

Data used in this study are mainly secondary in nature, related to Volvo AB, AB SKF, AstraZeneca AB and Nobel Biocare AB. So, the publication of Volvo AB and AB SKF is the main source of data. Sources that have been used to collect the necessary secondary data include the audited financial statement of the targeted companies. Also, in our course of conducting interviews which is also our primary sources of data, internal secondary data from the companies shall be used. This will enable us get a good understanding of how R&D investment affect the benefits and the company's stock prices. We intend to achieve this through structured interviews using predetermined questionnaires arranged in a sequential order of understanding. Our choice of structured interviews is because certain issues shall be required to be covered by all respondents.

3.5 Terms of the Model

In this thesis, a number of concepts have been used and is being defined thus:

Research and development cost (R&D): It represents current year uncapitalised amount plus the amortized value of previous year capitalised amount (for corporations that do capitalise R&D costs).

Profit/Earnings: In the model, it represents operating profit. It is the net income before tax excluding financial income and expenses like interest expense and income.

Stock Price: It is the mean value of average high and low daily price for a particular year.

3.6 Model

Investments made in the Research and development is long-term. As such, the expenditure incurred in current year can only bring benefits after a few years. There is lag time on expenditure made and output obtain. This actually refers to the time period existing between the cost invested and the benefit realised from the R&D spending activity. According to Branch (1974) there is a lag of 4 years between reducing an innovation to practice (getting benefits). Scherer (1965b) found 3.5 years as time interval between the input and output of research and development expenditure cited in the work of Branch (1974). Similarly, Mansfield (1971) says it takes about three years on average to complete an R & D project cited in the work of Ravenscraft and Scherer (1982). Moreover, according to the matching concept, the cost of a particular year should be charged to the benefit generated from that particular cost. In our model, we assume there is lag period of 3 years between the cost incurred and realisation of benefit for both manufacturing and pharmaceutical companies. Though the automotive product in manufacturing companies and the long term data range products of pharmaceuticals had a time lag that could not be covered because of our limitation in the time factor of data, we choose to use three years because they had many other R&D products that fall in this same lag range. Consequently, we relate the R&D cost of a particular year to the profit and Share price of 4th Year from the time the cost was incurred.

The Model

$R\&D_0 \xrightarrow{\text{lag time}} \text{Earnings of the 4}^{\text{th}} \text{ year}$

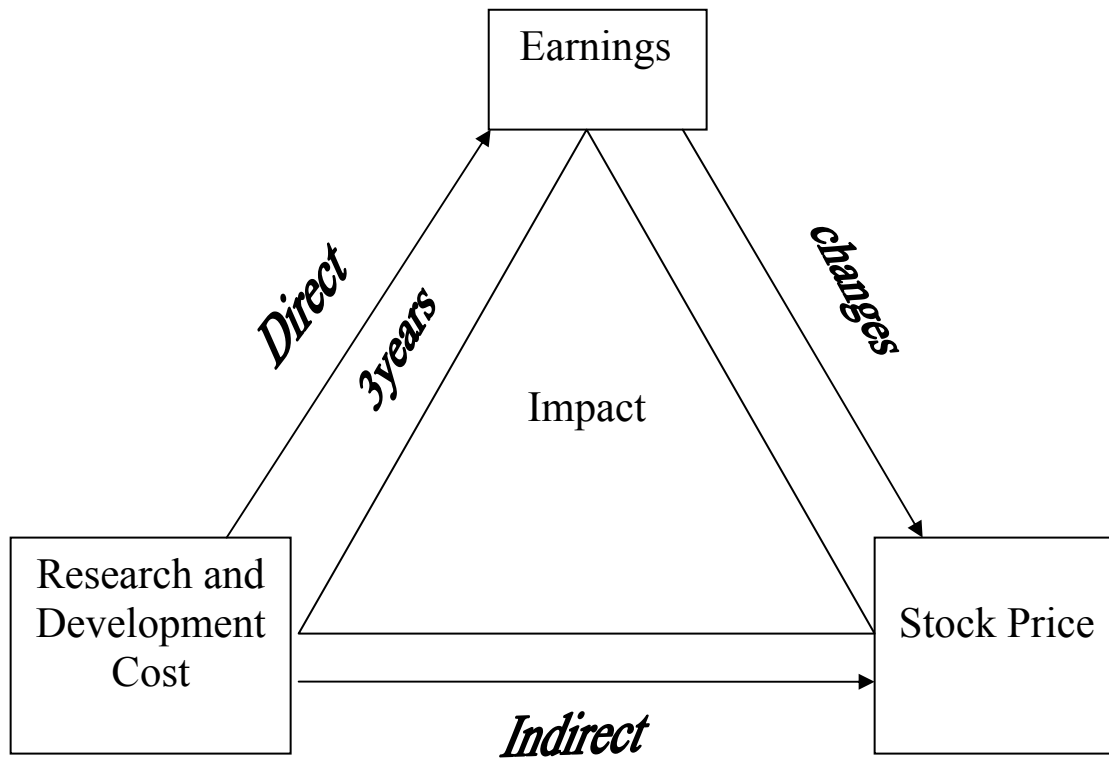
Where O= on current year and

4th year = the Earnings of the fourth year from the interval of R&D cost incurred.

According to this model, we are of the opinion that R&D cost has a direct influence on earnings. Therefore, increase in R&D cost is expected to generate an increase in earnings. This increase in revenue (a key indicator of company's performance), is expected to drive share price upward. As such, we postulate an indirect relationship exists between R&D expense and stock prices of corporations.

An illustration of this model is shown on Figure 1 on the page below.

Figure1



3.7 Tools used to analyse the Data

On the basis of data availability different statistical and financial tools have been used in accordance with reliability and consistency of data.

3.7.1 Statistical Tools

The modern theory of statistics is based on probability theory. The success of a financial company largely depends on the accuracy of statistical tools used in decision making on the distribution of profit, analysis of cash flow pattern and investment opportunity. So the relationship between different variables related to study topics have been analysed using various statistical tools which are as follows:

3.7.1.1 Coefficient of Correlation

Coefficient of correlation is a technique used to determine the relationship between two or more variables. In this study, simple coefficient of correlation was used to determine the relationship between R&D, Earnings and Stock price. The data related to the variable over different years will be tabulated and the relationship between them will be drawn out. To obtain coefficient of correlation we can use the following formula

$$r = \frac{N \sum XY - \sum X \cdot \sum Y}{\sqrt{N \sum X^2 - (\sum X)^2} \sqrt{N \sum Y^2 - (\sum Y)^2}}$$

Source: (Sthapit et.al, 2005)

- Where, r = the coefficient of correlation between variables X and Y
X = Research and Development Expenditure (independent variable)
Y = Earnings and Stock price (dependent variable)
 $\sum x$ = Sum of X series
 $\sum y$ = Sum of Y series
 $\sum x^2$ = Sum of Square of series X
 $\sum y^2$ = Sum of Square of series Y

N = Number of pairs of Observation

Where, Correlation coefficient lies between -1 and +1, i.e $-1 \leq r \leq 1$

$r = 0$ shows no relation between the variables.

3.7.1.2 Coefficient of Determination

It is a measure of the degree of linear association or correlation between two variables. It gives an idea as out of total variation in dependent variable(Y) has been explained by the independent variable(X). Thus, it is the ratio of explained variable to the total variation. Also the coefficient of determination is found by squaring correlation coefficient 'r' and converting it to a percentage.

3.7.1.3 Probable Error (P.E)

It is a tool for testing the reliability of the value of correlation coefficient (r). It is obtained as:

$$P.E = 0.6745 \times \frac{1-r^2}{\sqrt{N}}$$

Where,

r = the value of correlation coefficient

N = number of pair of observations

- a. If $r < P.E.$, it is insignificant, i.e there is no evidence of correlation.
- b. If $r > 6P.E.$, it is significant and thus the variables are correlated.

Source: (Sthapit et.al, 2005)

3.7.1.4 Simple Regression Analysis

The simple regression model is a model use to determine the relationship between two or more variables (Wooldridge, 2006). Regression analysis models the relationship between two variables, one being the responsive variable also called dependent variables,

explained variable or predicted variable and the other variable called independent variable, explanatory variable or control variable. The regression equation of Y on X is used to describe the variation in values of dependent variable (Y) for a given change in the independent variable (X).

$$Y = \beta_0 + \beta_1 X + \epsilon \dots\dots\dots\text{equation 4.1}$$

Source: (Kvanli et.al, 2002)

Where,

β_0 = is the y intercept which is a constant.

β_1 = represents the change in y variable for a unit change in X variable.

ϵ = is the error term or disturbance. It represents factors other than X that affect y.

The value of ' β_0 ' and ' β_1 ' are given by solving

$$\beta_1 = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2}$$

$$\beta_0 = \frac{\sum Y}{N} - \frac{\beta_1 \sum X}{N}$$

$\sum X$ = is the summation of independent variable

$\sum Y$ = is the summation of dependent variables such as Earnings and Stock Price

$\sum XY$ = is the summation of the product of dependent and independent variable

N = is the summation of the product of dependent and independent variable

3.7.1.5 Regression analysis of Earning & Research and Development expenditure:

$$Y = \beta_0 + \beta_1 x + \epsilon \dots\dots\dots\text{equation 4.2}$$

Where, X = R& D expenses which is independent variable.

Y = Earning of the year which is dependent variable

3.7.1.6 Regression analysis of Stock price & Research and Development expenditure:

$$Y = \beta_0 + \beta_1 x + \epsilon \dots\dots\dots\text{equation 4.3}$$

Where, X = R& D expenses which is independent variable.

Y = Stock price of the year which is dependent variable

3.8 Evaluation of the Research

The Evaluation of a research project entails employing methods to determine its validity and reliability. Because most of the methods are usually complex and time consuming, our evaluation will discuss rather than determine the validity and reliability of our study.

3.8.1 Validity

Validity is concerned with the reader being able to evaluate whether the used instruments actually measures what it is supposed to measure. It is divided into internal and external validity. Internal validity is concerned with whether the researcher measures what is

supposed to be measured. Here, reference is made on how well the concept of the model matches with the operational or measurable definitions. Explanations are expatiated on rather than descriptions or explorations. External validity represents the fitness between reality and the measured value received. It extends to cover the generalisation of the research finding from a single case study to all the case studies covered in the research work.

In this aspect of validity, studies have been carried out on the behaviour pattern of earnings and stock prices of four companies when they invest in R&D cost. The basis of our generalisation will come from our decision in working with four companies, two each operating in a different production line; manufacturing and pharmaceuticals, in order to develop some comparative trend. The impact of R&D investment on the earnings and stock prices of these companies will elucidate if the results shall be applicable to all the companies, both companies on a separate production line or on individual companies irrespective of their production line.

3.8.2 Reliability

Reliability entails the measurement tool should provide reliable and consistent results besides being independent from the researcher. The objective of reliability is to enable different independent researchers arrive at the same result if the research is conducted independently by each one of them. According to Weidersheim (1991), a research has a high reliability if the measuring method measures exactly the aspects and facts that were set out to be examined. This implies the researcher should get the same result each time he performs the analysis.

Our research is conducted using designed questionnaires and interview guides. The sources of our information are reliable as we used the financial statements of the various companies that have been audited before publishing. We intend to get answers from our respondent couple with our knowledge of the company before commenting fully on the reliability though our intention is to handle all information with much prudence and

objectivity. We also intend to interview professionals who are skilled in the knowledge and practical aspect of accounting for research and development cost.

3.9 Possible Sources of Errors

Our intention of targeting four different companies is to reduce the amount of subjectivity that may arise in our research work. Possible errors might come up as the respondents that answered our questions were not the various company's CFOs. The pivot of digression of useful information and analysis is mainly the lag period existing between R&D expenditure and earnings. The lag period we had for many of the companies was not the best one and a better result would have been obtained if we had data for a longer time frame. Also, because of the partial disclosure of some of the companies, we are bound to be furnished with incomplete information. Substantiating this fact, stock values collected for AstraZeneca, was incomplete as values for 1996 to 1998 (i.e. before the merger) cannot be obtain while stock values for 1996 to 19998 for Nobel Biocare were extracted from the notes to the financials. Moreover, the calculation of the various figures had possibilities for arithmetic errors though the authors have tried to minimise this possibility. Moreover, some of the companies had published in several currencies which required the authors to convert to a standard currency. All this needed an exchange rate for the year that the accounts were prepared. The authors had to get this independently and convert to the currencies that are found in the thesis. Also, the published financial statements of many of the companies were not very consistent. Reviewing proceeding and preceding year's data to compare of the figures published sometimes showed completely different figures. We considered all sources of sample errors when interpreting our results.

Chapter Four

4. PRESENTATIONS OF DATA AND ANALYSES OF RESULT

In this chapter, overviews, answers, comments and the results of the interviews conducted with the representatives of the R&D departments are presented. The chapter continues with analyses of the data. To facilitate understanding by the reader, the authors are going to report the interviewee's response using both direct and indirect reporting methods. Also, graphs and tables shall be used to facilitate proper understanding of the results being analysed.

4.1 Background of the Companies.

In order to facilitate the analysis of the data collected, a number of questions were addressed to individuals in the respective companies. Their responses greatly depended on the type of company and the standards used by the company. However, we will proceed by giving an overview of the four companies.

AB SKF

AB SKF, leading global supplier of products, solutions and services in the area comprising rolling bearings, seals, mechatronics, services and lubrication systems. It was formed in 1907 by Sven Wingquist with its headquarter in Gothenburg, Sweden. The company also offers services like technical support, maintenance service, condition monitoring and training. The company whose A and B stocks are traded on the Stockholm Stock Exchange and its American Depository Receipt (ADR), on the OTC in the USA, has Knut and Alice Wallenberg foundation as its majority shareholder with 10.1% of the share capital amounting to 29.0% of the voting rights.

It operates its own sales companies in some 70 countries and has about 100 manufacturing sites worldwide and it's been supported by some 15000 distributors and dealers

worldwide. SKF employs some 38,748 employees in 2005, some of whom work in the 103 production sites that the company owns worldwide in its 150 subsidiaries. The company's business is organized into three divisions; Industrial, Automotive and Service divisions. Each division serves a global market, focusing on its specific customer segments. AB SKF effectively applied the IFRS as from January 2005 reporting operating profit worth SEK5.3 B generated from sales amounting to SEK49.3 B. The company has reported such encouraging results for the past three years and is striving to maintain this by continuously investing in R&D. In 2005, the company invested SEK 837M as compared to SEK784M in 2004 due to the company's strong belief that R&D positively affects revenue. The results of the Group's efforts in the area of research and development have led to a growing number of innovations that has created new standards and new products in the bearing world.

The Volvo Group

Established in 1927 with headquarters in Gothenburg Sweden, Volvo group the largest truck producer in terms of market capitalisation emerged from a small local industry to one of the world's largest multinational industry in the automobile industry truck division. The company is organised into 5 business areas using product differentiation and includes; Volvo Truck, Volvo Buses, Volvo Construction equipment, Volvo Penta, Volvo Aero. There is also the Volvo Financial Services that handles respectively, trucks, buses, marine power & industrial engines and systems, plane engines, and financial services to its customers. Volvo truck is the largest segment contributing 67% of the group's net sales and 62% of the group's net operating income. Several business units provide additional manufacturing development or logistical support. The largest business units are Volvo Power train, Volvo 3p, Volvo IT, Volvo Logistics, Volvo parts and Volvo Technology. The company's shares are listed on the Stockholm Stock Exchange and NASDAQ in the US with Renault holding 20.7% of the shares corresponding to 20.5% voting rights.

Currently, Volvo has approximately 82.000 employees, production facilities in 18 countries and sales in about 185 countries. Volvo Group experienced one of its best financial year in 2005 as it adopts the IFRS in its reporting. With net sales up by 14%

from SEK202, 171M to SEK203,191M as well as operating profit that increase by 32% from SEK9907M to SEK13.106M.

To ensure the company survive in the long term, the company is making significant investments in R&D for future competitiveness in the net generation of engines and trucks. It has implemented aggressive investments in product development and this has enabled it to maintain a high profitability. The company's investment in R&D has been on a percentage of net sales. In 2005, total R&D cost amounted to SEK7.6B (SEK7.6) and the R&D as a percentage of sales was 3.3 %(3.8%).

AstraZeneca AB

AstraZeneca International, a multinational pharmaceutical company was formed on the 6th of April 1999 through the merger of Astra AB of Sweden and Zeneca Group PLC of the UK. With corporate headquarters in London, UK and R&D headquarters in Sodertalje, Sweden, the company is present in about 100 countries in all the continents. The company shares are listed on the London, Stockholm and New York Stock Exchanges with the Capital Group Companies Incorporated, having majority ordinary shareholding with about 12.57% as of 31st January 2006.

AstraZeneca is one of the world's leading companies in the industry, involve in the discovery, development, manufacturing and marketing of high quality, effective prescription medicines. The company prepares its financial statements using the UK GAAP, and reported a \$6.5billion operating profits from sales that amounted to \$24billion in 2005. The company achieve this by employing some 65, 000 people world wide: 58% in Europe, 28% in the Americas and 14% in the rest of the world. Of the total number of employees, 12000 people are involve in research and development at 11 R&D centres in seven countries namely; Sweden, the UK, the US, Canada, France, India and Japan while 14000 people work in 27 manufacturing sites in 19 countries engaged in the production of a secure, high quality and cost-effective supply of the company's products. The company carries out research aimed at discovering medicines to fight diseases in the following key areas: oncology (cancer), cardiovascular, gastrointestinal infection,

neuroscience, respiratory and inflammation. The company's products include many world leading and a number of high potential growth products: Arimidex (cancer), Crestor (cardiovascular), Nexium (gastrointestinal disease), Seroquel (schizophrenia) and Symbicort (asthma and chronic obstructive pulmonary disease).

In order to achieve its objective, AstraZeneca spends over \$14 million every working day on research and development of new medicines that meet patients resulting to \$3.4 billion expenditure for R&D in 2005 i.e. about 14.1% and 52% of total sales and operating profit respectively.

Nobel Biocare AB

Nobel Biocare is the world leader in innovative esthetic dental solutions based on science. With a focus on the patient, Nobel Biocare is committed to providing dental professionals with the most advanced, root-to-tooth solutions that increase the awareness, conveyance and acceptance of the highest standards of dental care. The new Parent company Nobel Biocare Holding AG established in 2002 is domiciled in Switzerland with headquarters located in Zurich, Switzerland, and Gothenburg, Sweden has its shares listed on the Switzerland Stock Exchange and the Stockholm Stock Exchange (Stockholmsborsen). Nobel Biocare, initially known as Nobel Pharma AB whose current majority shareholder is Fidelity Fund of USA, was formed in Gothenburg, Sweden in 1981.

The company's production takes place at four sites in Sweden and the USA and has its own sales organization in 27 countries generating some 97 percent of the revenue. In order to achieve this result, the company currently employs some 1,900 workers worldwide and made some 154,650 EUR representing an increase of 60% over the previous year's profit. However, the most remarkable year for the company was the 2002 financial during which the company almost doubled its net profit from 20,200,000 EUR to 37,800,000 EUR.

Nobel Biocare is the trendsetter with the highest pace of launches in the dental industry. The company annually invests 4-5 percent of its revenues in Research and Development of new products. Nobel Biocare was first in the industry to receive FDA approval for Immediate Functions for all its products and all indications. During the last financial year, the company invested 17,071,000 EUR on R&D projects.

4.2 Presentation of Interviewees

Claes Rehmberg, AB SKF, November 3, 2006

In SKF, we met Claes Rehmberg. He is the Group Quality Director and works at the SKF headquarters in Gothenburg Sweden. Five years ago, he was working in the automotive department in the same headquarters.

Gustavsson Bo, Volvo Group, November 10, 2006

He is the current Head of Financial Reporting and Business Control for the Volvo Group and has been in this position for the past six years i.e. from 2000 till date. Before taking up this position, he worked at the Volvo cars company from 1996 to 2000 and at PriceWaterhouseCoopers where he rose to the position of audit partner

Rikard Olsson, AstraZeneca, November 6, 2006

In AstraZeneca, we met Rikard Olsson who is the Business Controller of Finance in the AstraZeneca R&D Mölndal, Sweden. He has been working with this company since 1998 and had previously held the position of Business Analyst in the Global R&D Planning and Control.

Jeppe Magnusson, Nobel Biocare, November 15, 2006

He is Vice President in charge of research and development and works at the corporate headquarters in Gothenburg Sweden.

4.3 Attitudes and Implementation of R&D investment by companies

We wanted to know based on their experience if investment in R&D affects their revenue and stock price. Just like theory propagates, all the company's representatives believe R&D investments affect their revenues and stock prices.

Claes Rehmborg, clearly acknowledge its impact, saying much of the impact is experienced in the long term rather than the short term. He says;

Maybe in a time frame of 5 years, nothing will be realized from the spending but in the long term period, some of the projects will be very nice that yield income much more than the cost invested. It is clear that if SKF do not invest in R&D, it will 'die'.

Bo Gustavsson was in favour of the company inclining strongly to R&D investment as to maintain its position globally. He reveals that R&D investments have a long term impact on the value of the company so that they maintain their product brand whose product cycle is the main R&D driver.

The case of AstraZeneca was a case with obvious answers as Rikard Olsson saw no future for the company if it waves aside investments in R&D. He states;

There is a very strong correlation existing between R&D investments, Revenue and stock prices. However, there is a difference in the time frame because R&D cost effect in the pharmaceutical business is realised in the long run.

Jeppe Magnusson of Nobel Biocare was so confident emphasising R&D cost affects both revenue and stock price. He mentioned stock analyst have so much interest in product pipelines when they evaluate pharmaceutical companies stock prices. He said;

'The fact that the stock analyst asks a lot of questions about the R&D project says directly it has a major impact on the evaluation of the company. Any body who

says new product innovation does not drive revenue does not know what he is talking about’.

Due to the importance companies generally attached to R&D investments, we wanted to know how the companies allocate funds to see through their R&D investments. The amount of funds allocated for the R&D investment in the various companies all centred on the proportion of sales revenue realised in the previous year.

Claes Rehmsberg said R&D investment in SKF is calculated as a percentage of turn over and the investment may increase as sales turn out to be promising. He traced the amount to the Annual Report which was SEK837 M.

The amount calculated in Volvo lies between 3.5% and 4% of the Group’s turn over. This percentage moves towards the ceiling percentage stated above in favorable years and turns towards the minimum in cases of loss.

In AstraZeneca, around USD3.5B is allocated for R&D and it is about 17% of the total sales. Each year, AstraZeneca spends between 15% and 20% of sales revenue to invest in R&D. The basis of calculating what will be spent on R&D depends on two things. The first one being the pipeline status in which more money is allocated if the future links to profitability seem promising. The second being the amount of sales realised in the previous year.

Jeppe Magnusson equally revealed Nobel Biocare invests about 5% of its yearly revenue in R&D investments.

Based on the standards issued by the IASB demanding the capitalisation of some R&D costs, we were interested to know from the companies if they do capitalised their R&D costs and how the ensure the conditions of capitalisation were met. SKF and Volvo Group have been doing well to capitalise part of their R&D investment that turn out to be

successful development since the mandatory implementation in 2005 by the IASB. It was a surprise for the authors to find the Pharmaceutical Company is bent on recognising its R&D investments as cost because the company's R&D is very vulnerable and there is no guarantee of getting future revenue. As the write-offs and profit are always volatile, it will be very difficult to see a trend in the underlying business.

The company is behaving this way because all big pharmaceutical companies have agreed not to capitalise their R&D investment as it is really detrimental to the companies. There is however going to be a discussion which is part of the convergence project that was mentioned in chapter two. Finally, AstraZeneca may do something about the capitalisation of its revenue in the future but as of now, all investments in R&D are recognised in the income statement.

Stating he wasn't vest with accounting issues, Jeppe Magnusson did not answer this questions because as he said, it was purely a finance question and out of his domain.

Based on theory, the relationship between R&D costs and Revenue is distanced by the existence of a lag period between them as reviewed in the theoretical framework of chapter two. We were inquisitive to know if this is practically applicable to our companies and especially, the lag period.

Claes Rehmborg pointed the lag period to exist in two frames, the short term with the automotive customers and long run with the standard customers. The automotive customers are the automobiles and this lag period ranges between 2 to 3 years. The standard customers are those that buy standard product day to day with the help of technical calculations done by SKF to give them the best choice. Their lag period is as long as 10 years and depends much on how SKF improves its efficiency and technology.

In Volvo, Bo Gustavsson revealed that the product cycle is the key to how long it takes for the company to benefit from its investments for specific item. He said it takes around 7-8 years for benefits to start flowing.

Rikard of AstraZeneca said it takes about 10 to 15 years for a successful drug to finally show up. The R&D investment will definitely generate revenue in the future but the difference lies in the time frame because the benefits being reaped as of now is R&D invested a very long time ago and maybe, in the 90s. He goes further to quote the lag frame by saying;

‘An average lag period separating the R&D investment and revenue is 12 years but the company is trying to reduce it to about 10 years.’

One has to bear in mind that the failure rate is really high because unlike in the automotive industry, in a pharmaceutical R&D investment, only one in a million actually materialises into medicine. To certain extent and in the last stage, only one in three becomes something. All this aspect makes R&D investment in the pharmaceutical industry very different from R&D in the automotive industry. There is thus much risk in pharmaceutical investments in R&D.

In Nobel Biocare care, Jeppe Magnusson revealed a launch project takes about 18 months to 2 years. It takes about two to three years for the company to start reaping benefits from their R&D investments although some projects, he said need up to 10 years before they are launched. A launched project has a very high conversion rate i.e. generating revenue.

4.4 Tables of Data

Below are the tables stating the values for R&D, Stock price, and Earnings for 10 years of AB SKF, Volvo Group, AB AstraZeneca, and Nobel Biocare AB.

Figures presented in millions of Swedish Kronor

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Research and Development Expenses	755	761	761	756	720	888	776	761	794	845
Earnings	2874	2949	-999	2520	3674	3634	4022	3299	4434	5327
Stock Price ¹	36,68	37,86	21,93	48,05	32,6	47,81	51,89	63,9	67,55	110,75

Table 1: Data for SKF

Figures presented in millions of Swedish Kronor

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Research and Development Expenses	3710	8659	10104	4525	4876	5391	5869	6829	7233	7557
Earnings	8271	8418	6679	33249	6154	-676	2837	2504	14200	18151
Stock Price ²	132,4	195,5	213,9	219,2	184,5	165,4	171,2	181	255,9	318,9

Table 2. Data for Volvo

Figures presented in millions of Swedish Kronor

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Research and Development expenses	13150,46	16567,73	19660,10	24150,99	26506,24	28642,59	29883,15	27905,82	27947,86	25251,60
Earnings	19963,75	19963,75	24978,59	22688,55	36722,10	40841,26	39006,81	33242,77	35054,25	48590,10
Stock Price				343,5	403,16	480,78	399,83	323,47	330,42	325,8

Table 3. Data for AstraZeneca

¹ & ² The value of stock price is not in million SEK.

Figures presented in thousands of Swedish Kronor

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Research and Development Expenses	69929	69519	78560	114979	120258	121924	126397	127683	159089
Earnings	113616	73759	219074	289607	363739	587401	812889	1100303	1512400
Stock Price	104	103,25	122	214,5	364	505	572	965,5	1554,5

Table 4. Data for Nobel Biocare

4.5 Analyses and Interpretations of Data

We will analyse our data base on both the figures we obtain from the company's annual report and the information we got from the interview with our target companies. Though there are general procedures that the company follow in establishing their R&D criteria like the allocation of R&D based on sales proportion, we will proceed by conducting individual analyses of each company in order to facilitate proper understanding. Comparing these individual analyses shall help to establish a clear trend.

4.5.1 SKF

The computed result of data presented in the table below reveals that correlation between R&D and earnings shows a weak positive relationship on both the lag period and yearly data. i.e. $r = 0.45$ and $r = 0.37$ respectively. This means that when the size of R&D increases earnings also increase slightly. The probable error is 0.20 and 0.18 on both the lag earnings and yearly data indicates the existence of a relationship between R&D and Earnings since $r > P.E.$ Furthermore, the coefficient of determination (R^2) between the two variables is 20% with the lag earnings, whereas it is 14% with that of yearly period. This means out of the total variation of earnings only 20% is due to R&D in the former case while only 14% in the later case. The remaining 80% (lag) and 76% (without lag) is due to other factors not relating to R&D expense. Similarly, the coefficient of regression

of 7.47 and 12.67 indicates a kronor spend on R&D will bring 7.47 and 12.67 kronor change in the lag earning and yearly earning respectively.

	Model	10 years data
Coefficient of Correlation (r)	0,45	0,37
R Square	20%	14%
β_1	7,47	12,67
β_0	-1937,11	-6733,67
P.E(6P.E)	0.20(1.22)	0.18(1.10)

Table 5. Correlation and regression analysis between Earnings and Research & Development Expenditure:

The analysis between R&D cost and stock price reveals a different situation. The outcome of the data analysis for the data presented indicates a coefficient of correlation 0.20 and 0.53 for the lag stock and the yearly data. This indicates there is a weak correlation between stock price and R&D yearly figures. In lag period, there is no correlation between R&D and stock price since the coefficient of correlation (r) is less than the P.E (0.20<0.22). Moreover, the coefficient of determinations are 4.2% and 28% for the lag stock and yearly stock indicating that the variation in dependent variable (stock) has been explained by the independent variable (R&D) by 4.2% and 28% respectively. A further analysis using the coefficient of regression reveals that a percentage increase in R&D results to a 9.7% and 26% increase in stock price for the lag and the yearly data respectively.

	Model	10 years data
Coefficient of Correlation (r)	0,20	0,53
R Square	4,2%	28%
β_1	0,097	0,26
β_0	-14,54	-156,08
P.E (6P.E)	0.22(1.47)	0.15(0.92)

Table 6. Correlation and regression analysis between Stock price and R & D Expenditure.

The above analysis can be supported by the pictorial representation as seen in figure 1, 2a and 2b below and figure 1, appendix A. R&D expense has increased slightly over the years with a relative increase in earnings as a result the correlation between the two variables is weak for both cases. In similar situation, the trend of R&D with that of stock price is opposite. For example from 1996 to 2000, the values of R&D decreased as that of stock price increased justifying no correlation ($r=0.20$) between the two variables in the consideration of lag stock. However, the figures justifies the correlation of ($r=0.53$) in yearly data because of increase of both R&D and stock price in the same direction from 2002 to 2005 which was just opposite before 2002.

Figure 1

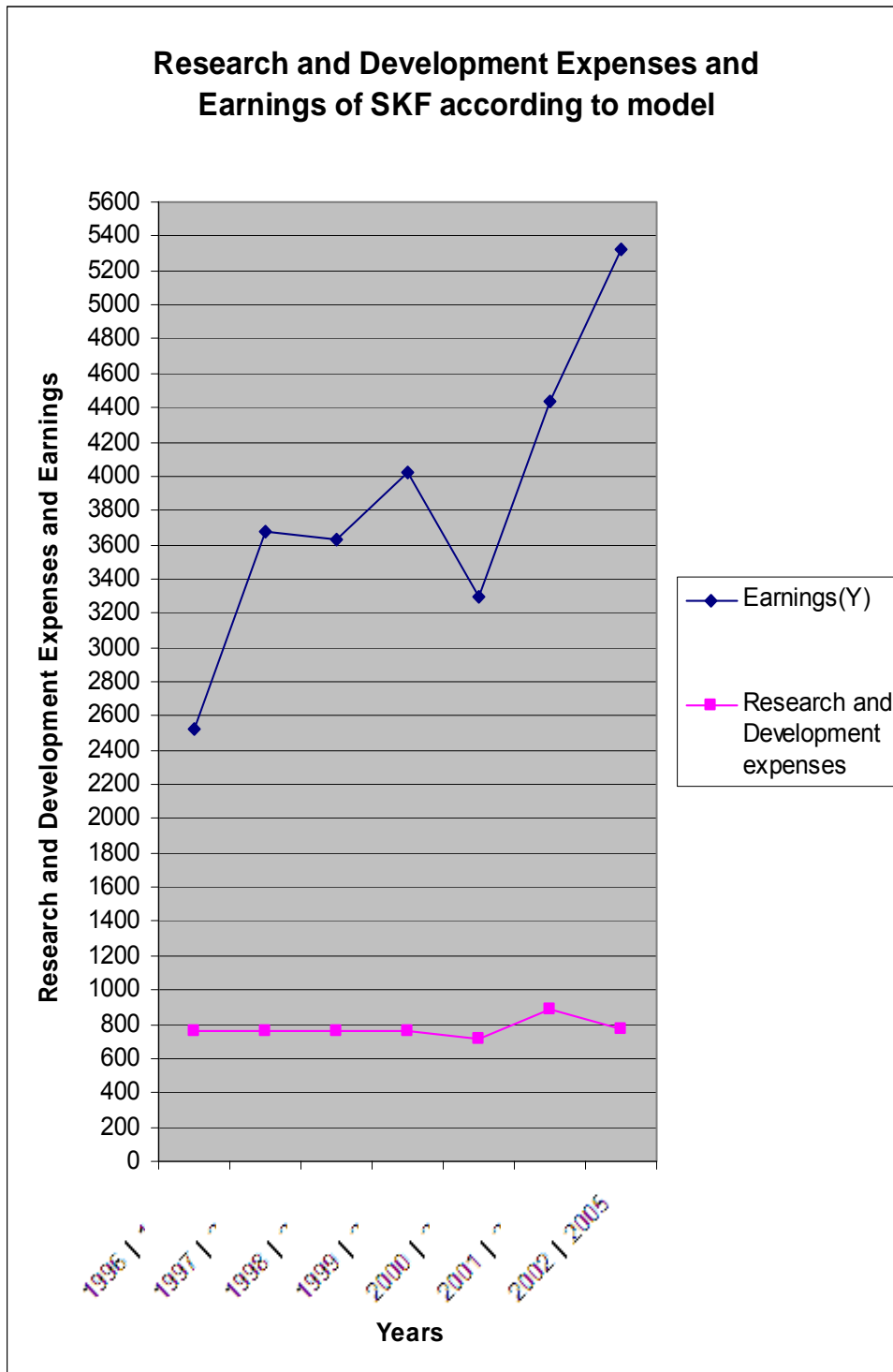


Figure 2a

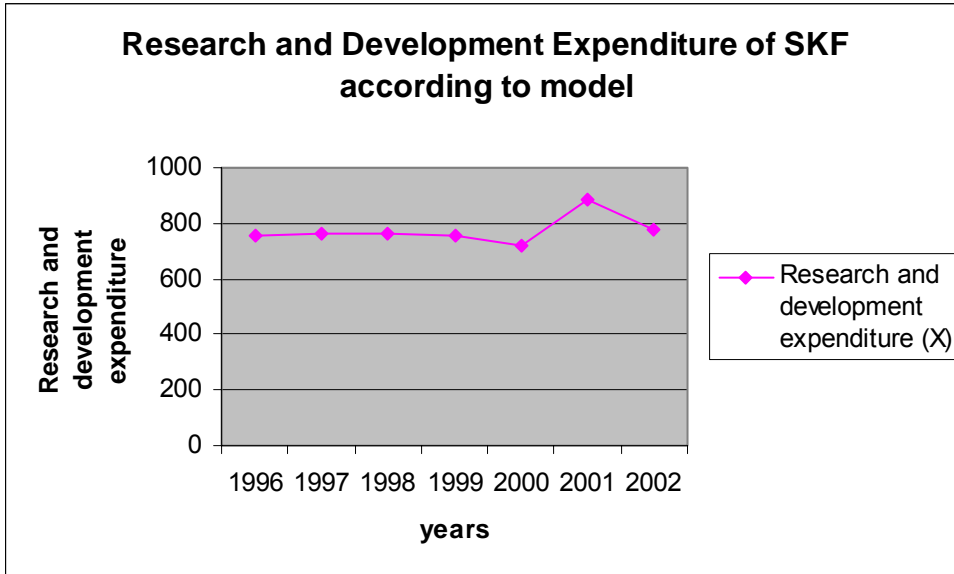
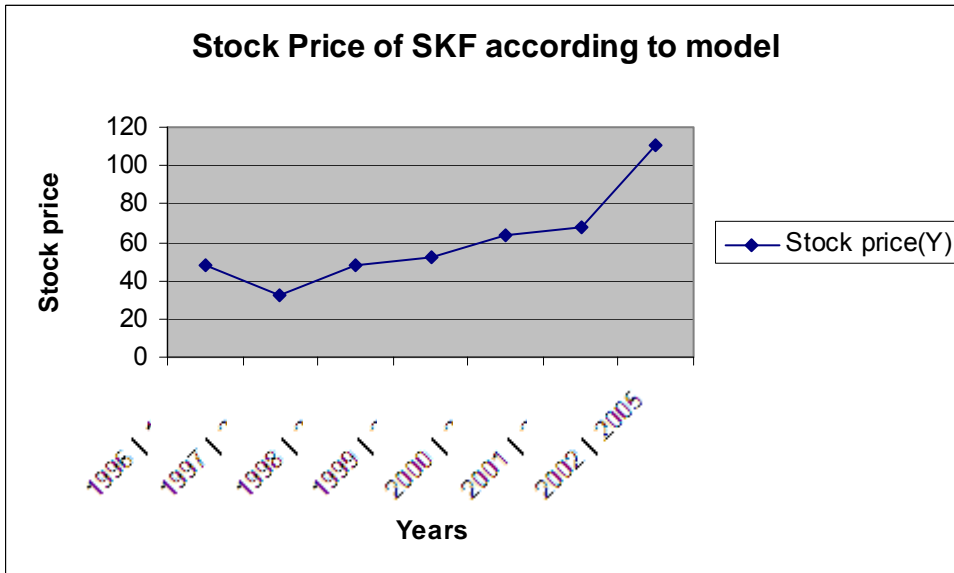


Figure 2b



4.5.2 Volvo Group

The results of the analysis show negative correlations between both the lag and yearly earnings and Research and Development. Correlation coefficients r of the yearly data for ten years range turns out to be negative (-0.14) as well as that revealed by our model (-0.56) obeying the lag period. This shows that a very weak negative relationship exists between R&D and Earnings in the yearly data range while a more reasonable negative relationship exists between R&D and Earnings in the data range according to our model. Since the probable error for the yearly data range is higher than coefficient of correlation ($0.21 > 0.14$) shows no existence of correlation. The coefficient of determination (R^2) of 30.8% for the model and 1.9% for the yearly data shows the respective proportion of contribution by R&D in both cases. It means that out of total variation of earnings, only 69.2% and 99.1% is due to other factors. Finally, the coefficient of regression of -2.84 and -0.70 for lag and the yearly data earnings indicates that a unit change in R&D results to a negative change of 2.84 and 0.70 in earnings of former and later respectively.

	Model	10 years data
Coefficient of Correlation (r)	-0.56	-0.14
R Square	30.8%	1.9%
β_1	-2.84	-0.70
β_0	28379.89	14492.96
P.E(6P.E)	0.18(1.06)	0.21(1.26)

Table 7. Correlation and regression analysis between Earnings and Research & Development Expenditure:

A similar analysis of R&D and stock price reveals a positive association between R&D and stock price in the yearly data ($r=0.46$). On the other hand, in lag stock there is negative association being correlation coefficient ($r= -0.29$). A further analysis using the coefficient of determination of 21% and 8.4% for ten years and lag data reveals factors other than R&D (external factors) contributes up to 79% and 91.6% to the changes in

yearly and lag stock. Moreover, the coefficient of regression of 0.012 and -0.007 for yearly and the lag data stock prices indicates that a percentage change in R&D results to 1.2% positive change in stock price for the ten years data and a 0.7 % negative change in stock price for the lag stock prices.

	Model	10 years data
Coefficient of Correlation (r)	-0.29	0.46
R Square	8.4%	21%
β_1	-0.007	0.012
β_0	256.66	124.29
P.E(6P.E)	0.23(1.40)	0.17(1.01)

Table 8. Correlation and regression analysis between Stock price and Research and Development Expenditure:

Based on our findings from the figures below, there is ample evidence to support the negative correlation that exists between R&D cost and Earnings. As seen in figure 3 in appendix A, increases in earnings from 1997 to 1999 correspond to decreases in R&D cost for the same period. Likewise, decreases in earnings from 2000 up to 2002 correspond to steady increases for the same period. This opposite trends in the values of the variables confirms the coefficient of correlation($r = -0.14$) and regressions ($\beta_1 = -0.70$) obtained for the yearly data. The same situation prevails for the lag data with more relative change($r = -0.56$) in these two variables as can be seen from figure 3 below.

A closed look at the figures shows the relationship between R&D expense and stock price for the yearly (figure 4a and 4b in appendix A) and lag data (figure 4a and 4b below) confirms the results obtained in the correlation analysis. Increases in R&D investments from 1996 to 1999 onwards corresponded to increases in stock price like wise increases in R&D cost from 1999 also corresponds to increases in stock price from 1999, confirming the results earlier obtained for the yearly data. For the lag data, the increases in R&D investments from 1996 to 1998 were accompanied by decreases in stock from 1999 to 2001 hence supporting the results obtained as depicted in table 8 above.

Figure 3.

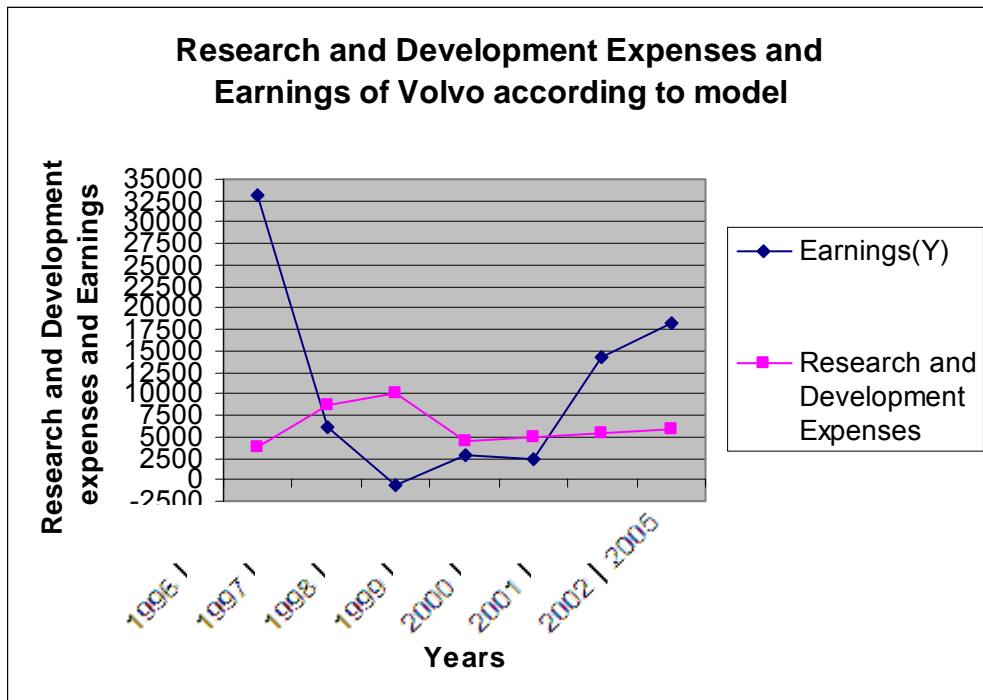


Figure 4a

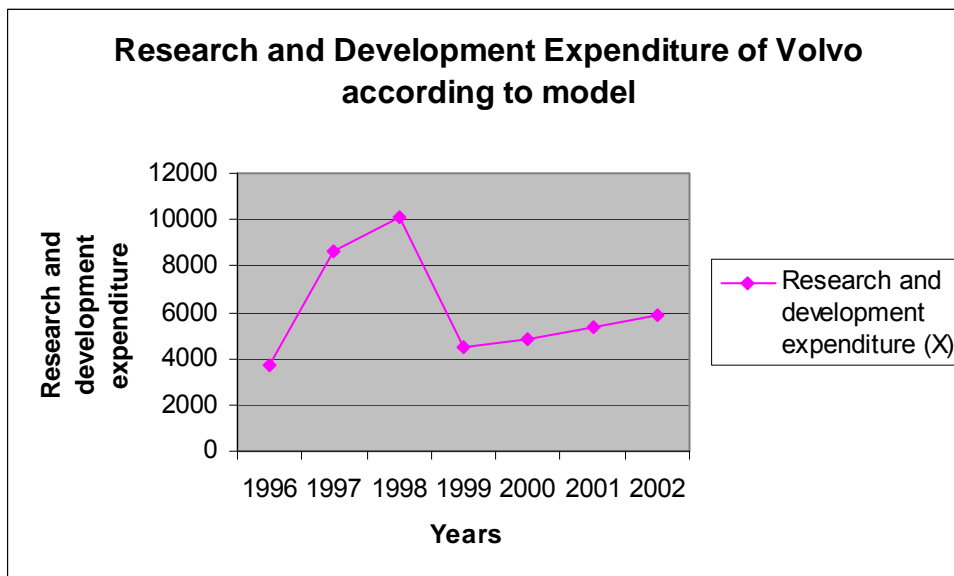
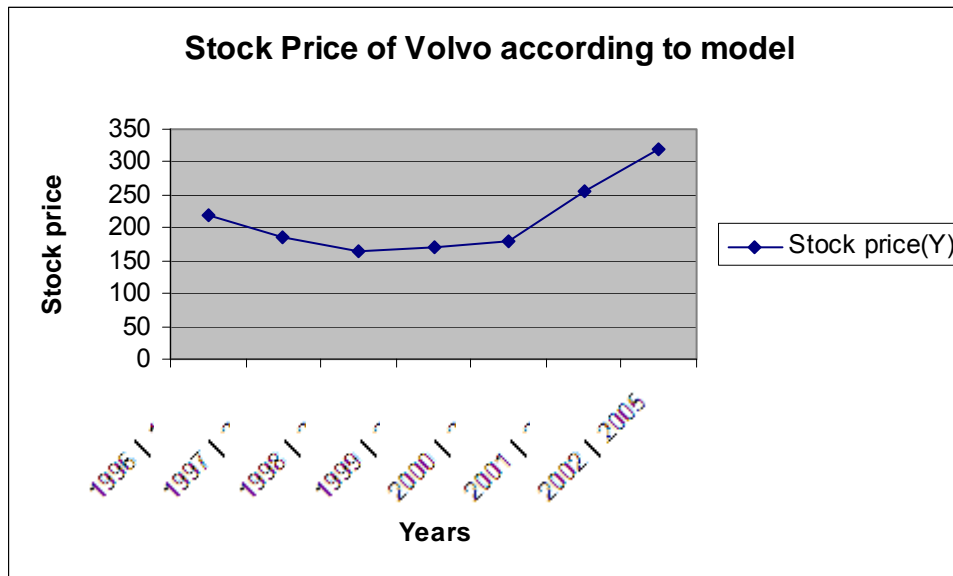


Figure 4b



4.5.3 AstraZeneca

A presentation of the computed data depicted in the tables below shows a positive correlation between R&D cost, lag and yearly earnings data. In lag earnings, we noticed positive association of correlation ($r= 0.62$), and yearly earnings also scored strong positive correlation ($r= 0.76$). Since the value of 'r' is six times greater than probable error ($6P.E=0.55$), the coefficient of correlation is highly significant in yearly data range. R^2 for the lag and yearly data is 39% and 57% showing R&D cost has much more influence in earnings in the case of yearly data as compared to lag earnings. In addition, the coefficient of regression is 0.77 and 1.28 respectively. This means a unit increase in R&D investments leads to increase of 0.77 in lag earnings, while the same unit increase in R&D investment leads to increase of 1.28 unit change in yearly earnings.

	Model	10 years data
Coefficient of Correlation(r)	0.62	0.76
R Square	39%	57%
β_1	0.77	1.28
β_0	19067.81	1585.26
P.E(6P.E)	0.16(0.93)	0.09(0.55)

Table 9: Correlation and regression analysis between Earnings and Research and Development Expenditure:

Analysing the stock price situation, we observed a negative correlation between the stock price and R&D expense for the lag stock price($r = -0.44$). On the other hand, the yearly stock price data revealed a positive association ($r = 0.46$) between stock price and R&D. R^2 for the lag and yearly data is 19% and 21% respectively, indicating the corresponding contribution of R&D to changes in stock price. Moreover, a unit change in R&D resulted to a negative change (fall in stock price) of 0.004 and 0.013 in stock price for the lag and yearly data respectively as tabulated in table 10 below. These statistical findings are supported by the graphical representations of our results as shown in the figures below. The shape of the graphs in figures below shows R&D cost and earnings for the yearly and the lag data rising and falling at the same rate, both experiencing the lowest and highest values in the same years. This confirms R&D cost correlates with earnings in both situations.

	Model	7 years data
Coefficient of Correlation(r)	-0.44	0.46
R Square	19%	21%
β_1	-0.004	0.013
β_0	463.65	6.80
P.E(6P.E)	0.21(1.24)	0.20(1.21)

Table 10: Correlation and regression analysis between Stock price and Research & Development Expenditure:

The trend of the graphs between R&D cost and stock prices for both the yearly and the lag data also confirms the results of the correlation and regression analysis conducted with the former being positively correlated and the later negative. The shapes of the graphs (figure 5, 6a, 6b below and figures 5,6a, 6b in appendix A) clearly show and support the findings of the analysis. For the yearly data, the graphs could be seen heading the same direction, attaining the maximum and minimum values almost the same period. The Lag situation is more glaring as the graph for R&D cost is seen moving in the opposite direction.

Figure 5

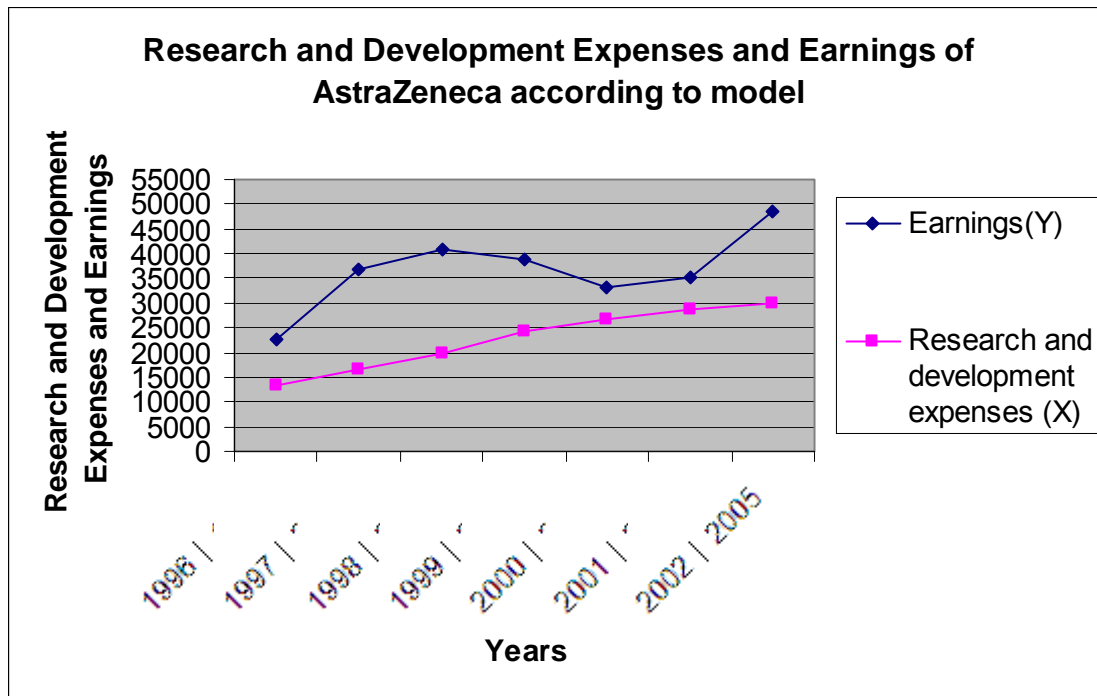


Figure 6a

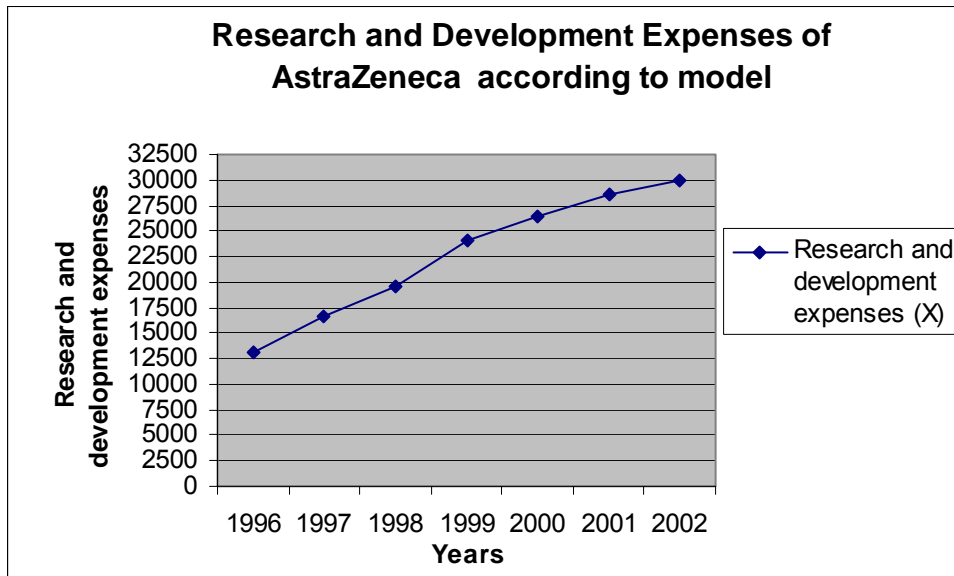
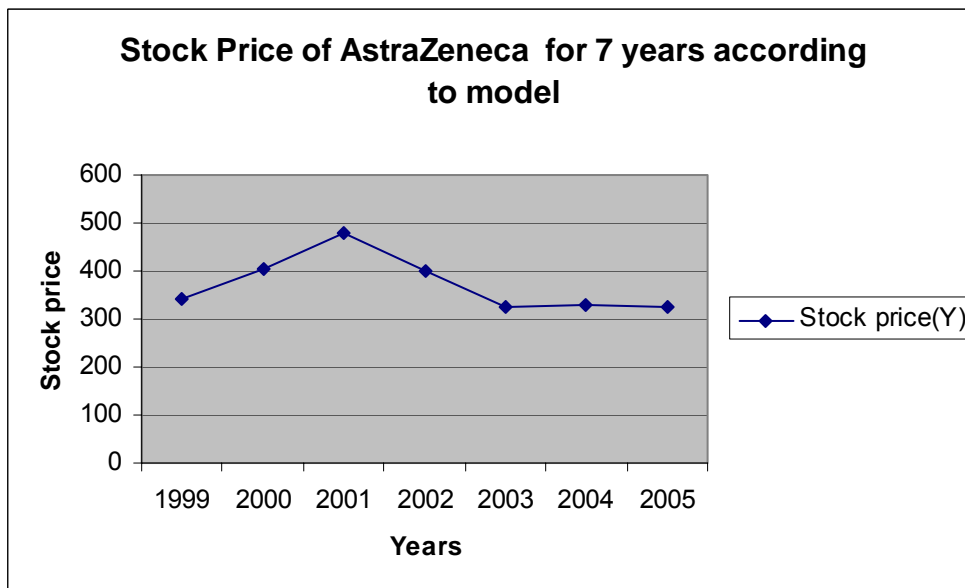


Figure 6b



4.5.4 Nobel Biocare

At a glance, the result from the analysis of Nobel Biocare data provides the most accurate information supporting the propositions based on theory and the model we designed. The result based on the coefficient of correlation reveals a high degree of positive correlation on both the lag and the yearly data. The figures ($r=0.91$) and ($r=0.88$) indicates increases in lag and yearly earnings with the growth of R&D expenses. For the lag earnings, the probable error is 0.05 and where $r > 6P.E$ indicates the coefficient of correlation is highly significant because the value of (r) is greater than six times of PE.

Similarly, the value of coefficient of correlation is also greater than six times of the probable error ($0.88 > 0.31$) in the yearly earnings again indicating these two variables are highly correlated. Since the coefficient of determination in lag is higher than that of the yearly data i.e. 83% and 77%, it indicates that lag earnings is less affected by other factors other than R&D expenses. The coefficient of regression (β_1) of 16.5 in lag means a percentage increase in R&D expenses results to 16.5% increases in earnings. Although coefficient of regression (β_1) is less in the yearly data, it also results to a positive change of 14.1% in earnings, with a percentage change in R&D expenses.

	Model	9 Years data
Coefficient of Correlation (r)	0.91	0.88
R Square	83%	77%
β_1	16.5	14.10
β_0	-804052.83	-985068.24
P.E(6P.E)	0.05(0.28)	0.05(0.31)

Table 11 Correlation and regression analysis between Earnings and Research & Development Expenditure:

In like manner, the table below shows a high correlation between the stock price and R&D expenses. We found that there was strong positive association of lag stock values ($r= 0.81$) and the yearly stock values ($r=0.86$) with R&D cost although the former is

smaller than the later. The coefficient of determination between two variables of 66% and 74% in lag stock and yearly data indicates that the relationship between the dependent and independent variable for the lag and the yearly data situation are affected by 34% and 26% respectively by factors other than R&D expenses. The values of the coefficient of regression signify that lag stock and yearly stock changes by 1.5% and 1.4% positively with the change in R&D expenses.

	Model	9 Years data
Coefficient of Correlation (r)	0.81	0.86
R Square	66%	74%
β_1	0.015	0.014
β_0	-786.39	-997.17
P.E(6P.E)	0.09(0.56)	0.06(0.35)

Table 12 Correlation and regression analysis between Stock price and Research & Development Expenditure:

The results obtained can be explained and supported by taking a close look at figures 7, 8a, 8b below and figures 7, 8a, and 8b in appendix A. Both graphs reflect the strong correlation established from the calculation above revealing that R&D cost has a lot to do with earnings and stock prices of Nobel Biocare.

Figure 7

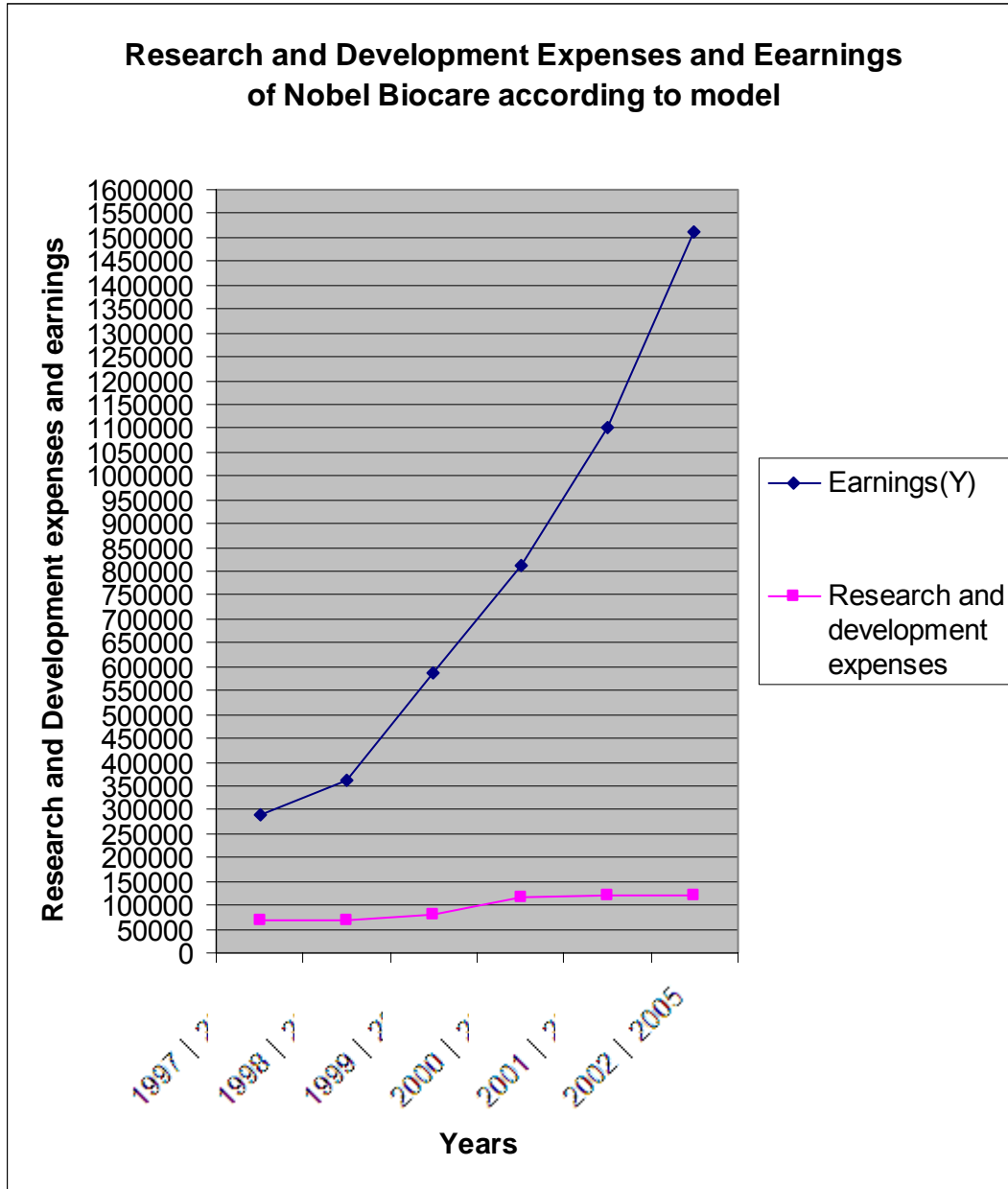


Figure 8a

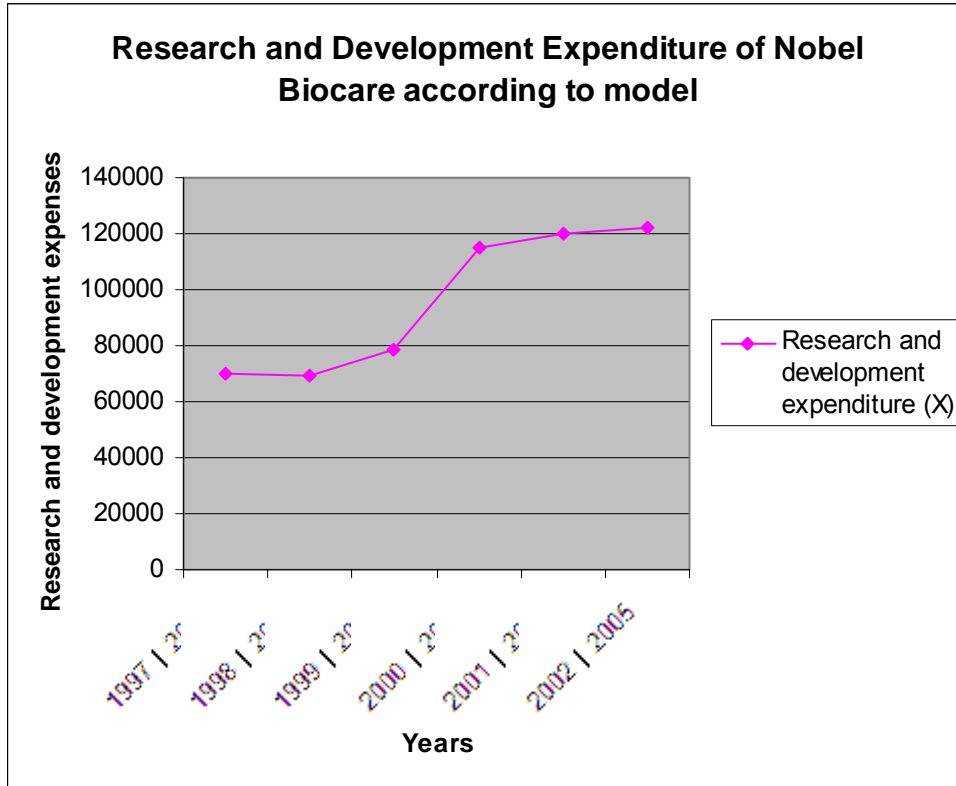
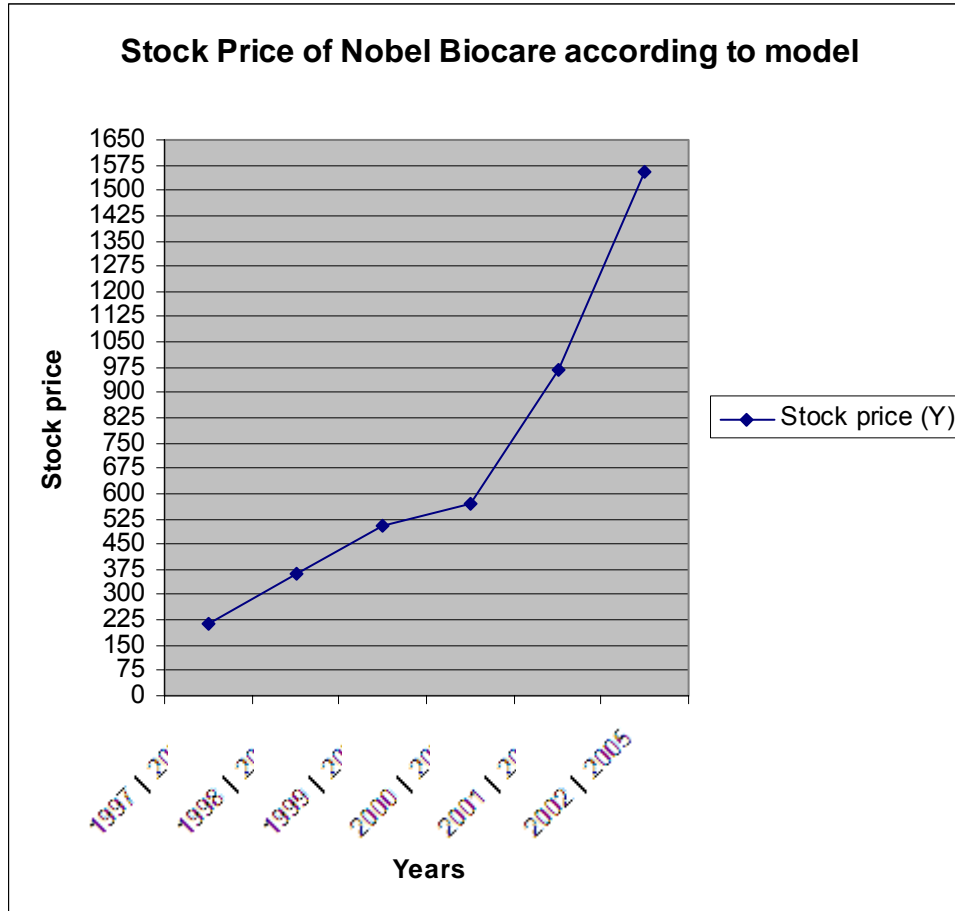


Figure 8b



4.5.5 Policy Treatment

In the review of our thesis, we came across certain issues that can be coined under the industry policy with regard to how the decision affects the business in its entirety and particularly in the long run. We have succeeded in reviewing how manufacturing and pharmaceutical companies extend their accounting treatment over the R&D cost intangible. We realized that it is the policy of manufacturing companies to treat their R&D cost according to the prescription of the standard setting body IASB. This is why they go as far as capitalizing part of this intangible asset by recognizing it in the balance

sheet. Also, SKF maintains the all round smoothening of its R&D spending trend as seen from the graph above, by writing off most of its fixed cost incurred. For the pharmaceutical, it has been their policy statement not to recognize this cost as an asset. This is for the reason of cooperative agreement between similar companies to avoid the detrimental situation in which the capitalization of this expense leaves the pharmaceuticals. This has left us with the following thrilling questions:

-which specific aspect if recognize in pharmaceutical companies will identify and solve the problem being posed in the long run?

-Is the Accounting treatment of this asset considered in the strictest possible sense for all those that are recognized as cost?

-If manufacturing companies could reap enormous benefits from their investment in this cost and its recognition as an asset, why can not there be inter-company review to locate and solve the crisis arising from this treatment?

-Is there a problem that has not been exposed in the general treatment of this intangible because R&D spending volume in manufacturing companies does not equate that incurred by pharmaceuticals?

4.5.6 Disclosures

This is the aspect related to the manner in which our targeted companies reviewed their financial information in their annual reports from which we got our secondary data. While companies like Volvo and SKF provided us with a high disclosure of their financial information, we were faced with limited information in other companies and in this case, the pharmaceutical companies. Nobel Biocare's information was quite satisfactory but the currency swap from SEK to Euro was really a difficult situation to handle. Also, AstraZeneca's disclosure required much patience and time to interpret. Also, the R&D activity of Nobel Biocare is more focused while that of AstraZeneca is diversified. This difference emanates from their difference in strategy and especially for AstraZeneca, a company that had once experience a merger.

These analyses together with some of the responses gotten from the interview will be used to conclude this thesis by providing answers for the research questions raised.

Chapter Five

5 Conclusions and Recommendation

This chapter shall present conclusion based on the analysis that has been revealed above. We shall also disclose areas that may have lead to possible errors after which, we shall end with suggestions for future research.

5.1 Summary of Findings

The results of our analysis are divergent in nature depending on the company, its lag time and the accounting policy used. Our finding shows that SKF has the least correlation between the dependent and the independents variable(s), closely followed by the Volvo. AstraZeneca provides the second best result while Nobel Biocare is the most efficient company as its R&D projects usually is realized. Below is a table presenting a summary of these findings.

Summary of result

Companies	Correlation between Earnings and R&D expense		R ²		Correlation between Stock price and R&D expense		R ²	
	Lag Period	Without lag period	Lag period	Without lag period	Lag period	Without lag period	Lag Period	Without lag period
SKF	Weak positive	Weak positive	20%	14%	None	Weak positive	4.2%	28%
Volvo	Weak negative	None	30.8%	1.9%	Weak negative	Weak positive	8.4%	21%
AstraZeneca	Positive	Significant positive	39%	57%	Weak positive	Weak positive	19%	21%
Nobel Biocare	Significant positive	Significant positive	83%	77%	Significant positive	Significant positive	66%	74%

This thesis had as purpose, to explore the relationship between R&D cost and operating earnings, and to determine the influence of R&D investments on the share price of companies. In other to achieve this, the authors have attempted to provide answers to the following research questions.

- Does R&D expense contribute in anyway to the earnings of companies and to what extent is the contribution?
- What is the responsiveness of share price to changes in R&D cost?

Generally, as seen from the table above, we found that a relationship exist between R&D cost, earnings and stock price for both manufacturing and pharmaceutical industries. The authors will thus agree with Shortridge (2004) that companies engage in successful R&D schemes to attract economic benefits. The most significant relationship was found between R&D cost and earnings, for the lag data range (the case of Nobel Biocare), indicating 83% influence in earnings is as a result of R&D expense. This exceeds the correlation obtained between R&D expense and stock price and thus confirms one of the propositions of our model stated in the third chapter that purports a direct and indirect relationship between R&D expense, earnings and stock price respectively. The extent of R&D cost on earnings depends on the time horizon as the effect is more felt in the long run than in the short term. This is confirmed by the values of R^2 .

The R^2 value of pharmaceuticals reveals that a greater proportion of earnings are influenced by R&D investments with that of Nobel Biocare, a smaller firm compared to a bigger firm like AstraZeneca being influenced much by R&D cost factor. An explanation of this situation can be done by supporting the work of Ballester et al. (2003). He argues in the literature review that the value of the intangible decreases with size and longevity of the business because earlier in the life cycle of smaller firms, they concentrate on building the R&D intangible while already larger and more mature firms have already benefited from this R&D spending aspect.

The effect on the company depends much on the lag period between R&D spending and earnings realized. The result of Nobel Biocare shows a strong positive correlation between the variables compared to that obtained for AstraZeneca in both situations. Our findings confirm that R&D expense has a long term effect on the variables since the relationship is more significant between R&D expense, lag earnings and lag stock price.

With regard to the stock price, R&D expense has both immediate and long term effect. This is because the degree of association between R&D expense and stock price in both the pharmaceutical and manufacturing industries was higher in the yearly data situations. So, companies can influence their stock price with the announcement of R&D expenses which is true especially in the case of pharmaceutical companies as revealed by our analysis. In practice, this increase is as a result of the interest that stock analysts place on R&D spending on pipeline projects. It is thus worthwhile to confirm the assertion of Ballester et al (2003) that investors always consider the economic value of R&D when they lobby to set their stock prices because they believe it will lead to future profitability. Practice has also closely been related to theory as pharmaceuticals record increases in stock prices which come with an announcement of an increase in R&D cost (Nystrom and Mank, 2001). In the long term, our result shows that the impact of R&D expense on earnings and stock price is in the same direction. This implies that if R&D expense increases earnings, the stock price will also go up and vice versa. Thus, the finding supports our model that R&D expense has an indirect effect on stock price in the long term and can serve as an indicator of business performance (Lev and Sougiannis, 1996). The coefficient of determination (R^2) that measures the variation of the dependent variable (Stock price) explained by independent variable (R&D) is quite low in both manufacturing and pharmaceutical companies. Thus, other factors that affect stock price other than R&D cost are quite influential which include business risk, firm size (capitalization), financial leverage and patents of the company.

Furthermore, based on our analyses as seen in the table above, we observed that the effect of R&D expense on earnings and stock price depends on the type of company in question. The overall results show that R&D expense has more effect in the pharmaceutical industry

compared to manufacturing industries. Nobel Biocare and AstraZeneca provided the best results, thus confirming the proposition of Mike Tubes, one of the authors of the UK Department of Trade and Industry (DTI) scoreboard that the influence of R&D expense depends on the industry employed (Financial Times, November 2006).

Mindful of the shortcomings of inappropriate lag time applied, the result of the correlation between R&D cost and earnings for the manufacturing and pharmaceuticals companies revealed a better result for the later. The fascinating point discovered was that the manufacturing companies adhered to the IASB mandatory reporting standard of capitalizing R&D expenditures, while the pharmaceutical companies we reviewed still recognize their R&D expense as cost (thus, following FASB pronouncement) in the income statement. The later had the best result. Consequently, the standard regarding the treatment of research and development cost (SFAS 2, 1974, Accounting for Research and Development Costs) issued by the rule based FASB, clamoring for full expensing of R&D cost should be unanimously applied after the convergence project.

5.2 Suggestion for Further Research

In our opinion, we believe this thesis is in a good position to help companies to seek solution to locate their position when they seek to invest in R&D activities. Though we did not have access to in-depth figures, which implies we were left only with the figures from the financial publications, the analysis has helped to review the relationship that exists between the various variables.

Due to the differences emanating from especially the lag period, the authors will first of all suggest that similar research should be carried out after a longer time frame maybe several decades later. This is to enable a concise data to be obtain that will provide a relative and reasonable lag period for both pharmaceutical and manufacturing companies that has the long time period influencing R&D spending.

Also, a similar research could be carried out only on pharmaceutical companies whereby one set of the companies should be capitalizing some of its costs while the other set

should be made up of companies that write-off completely their R&D cost to the income statement. In this way, the veracity of the problem resulting from the assertion purported by the two main accounting standard boards shall be determined.

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APPENDIX A

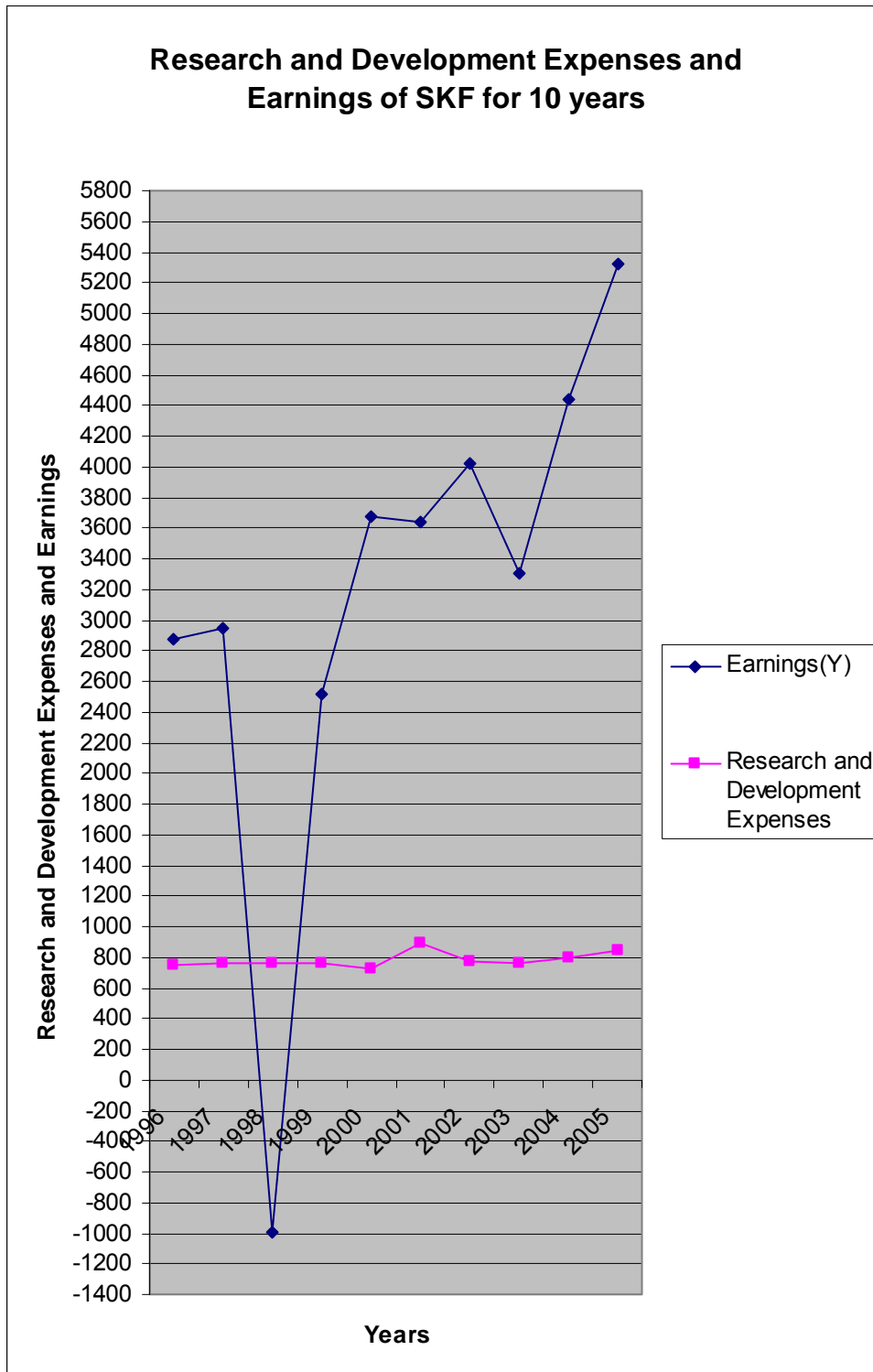


Figure 1

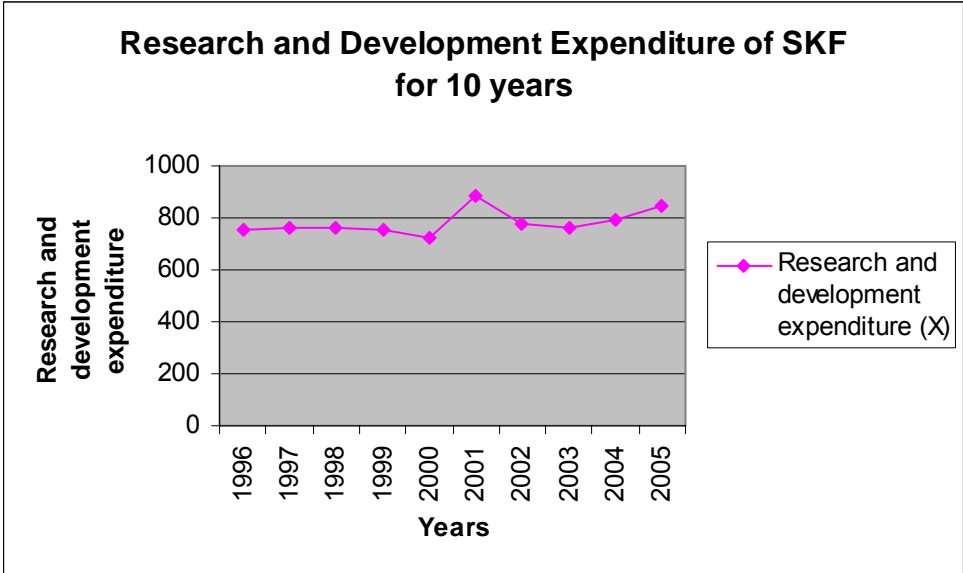


Figure 2.a

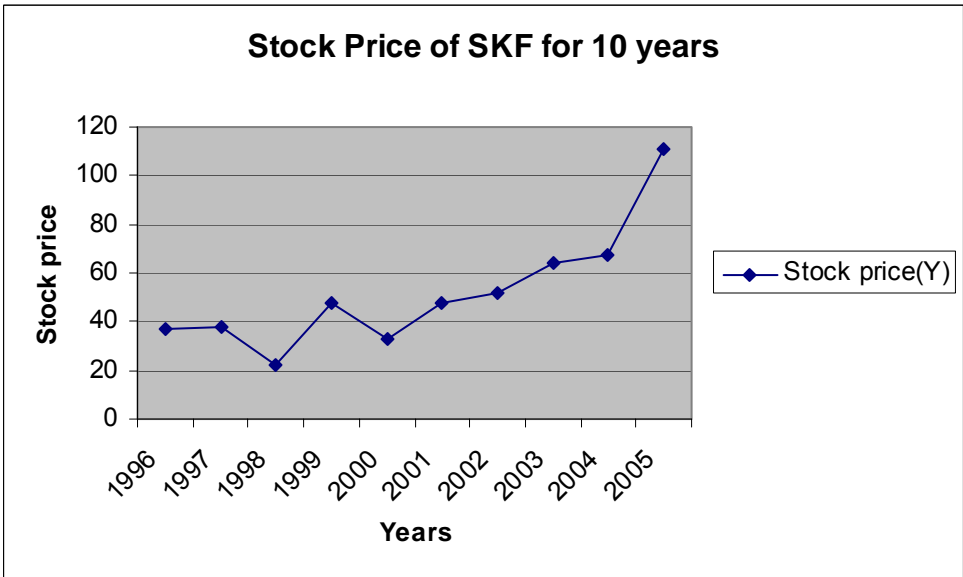


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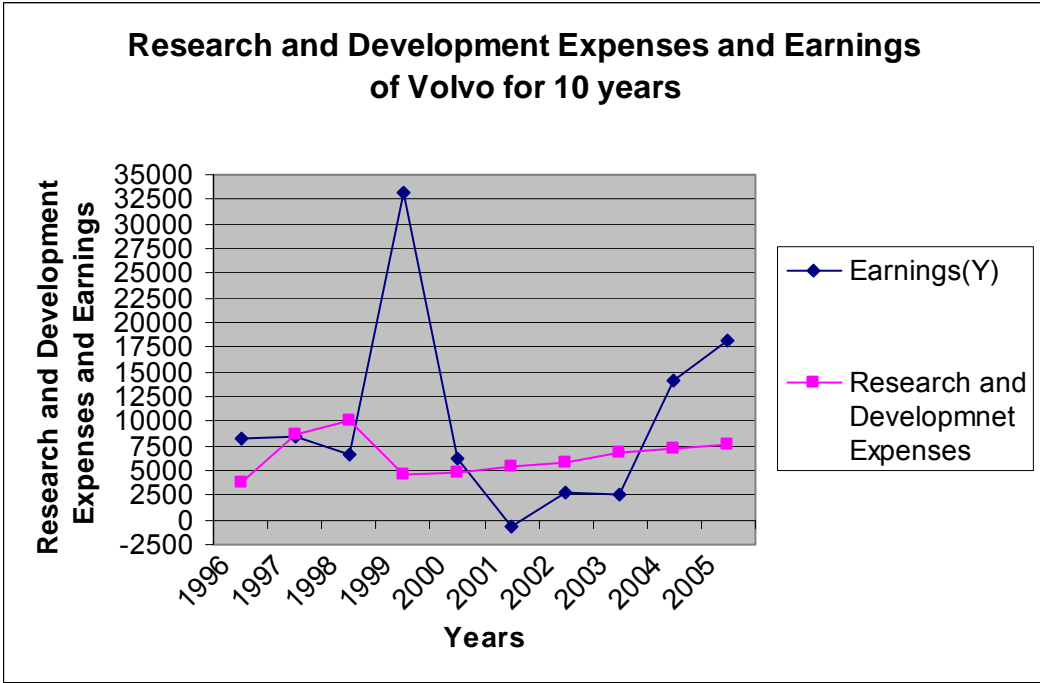


Figure 3

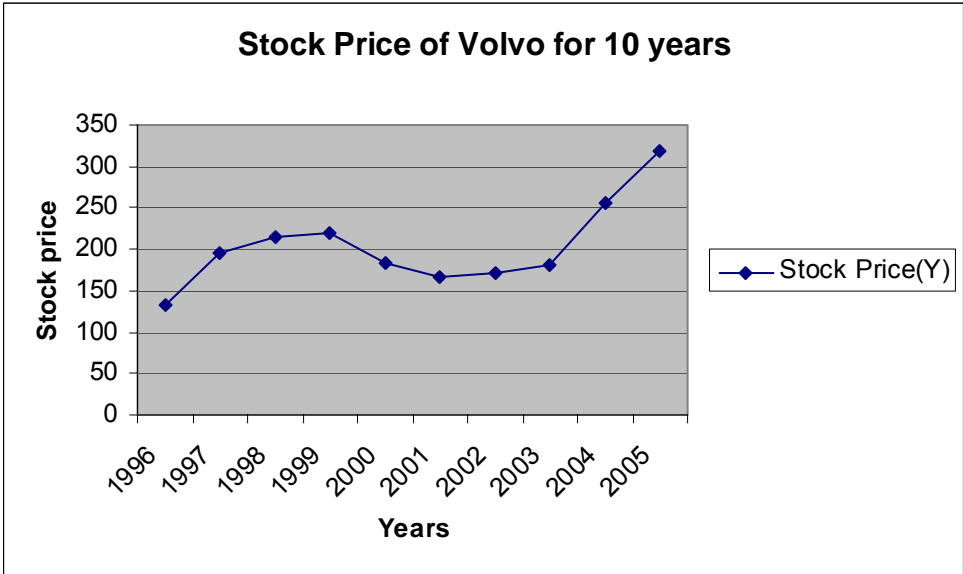


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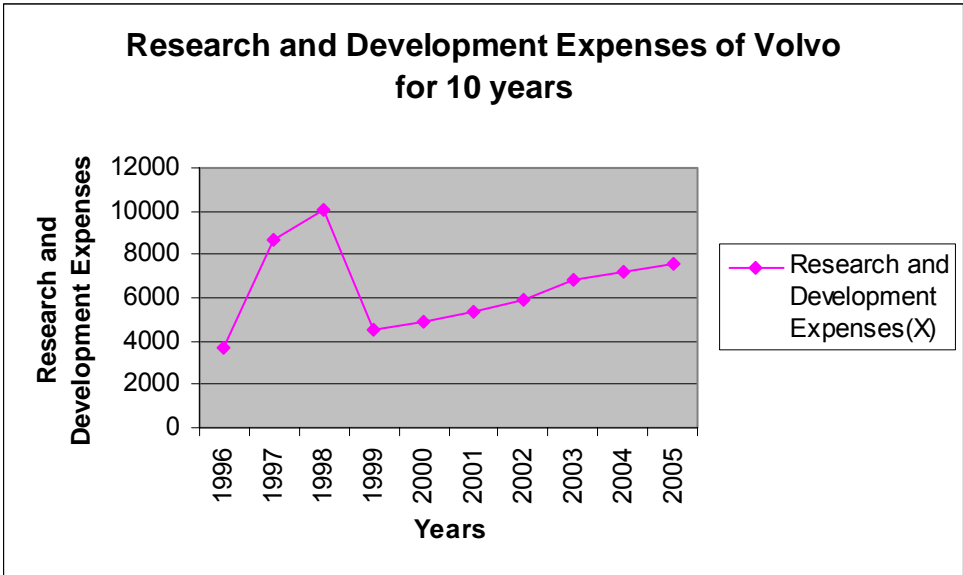


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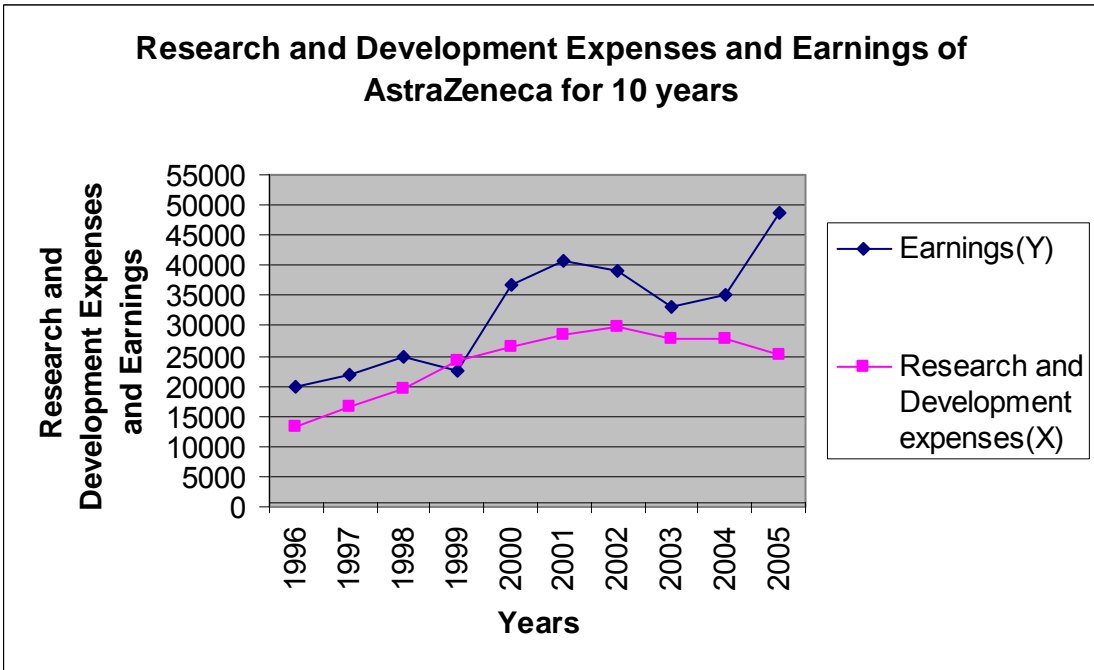


Figure 5

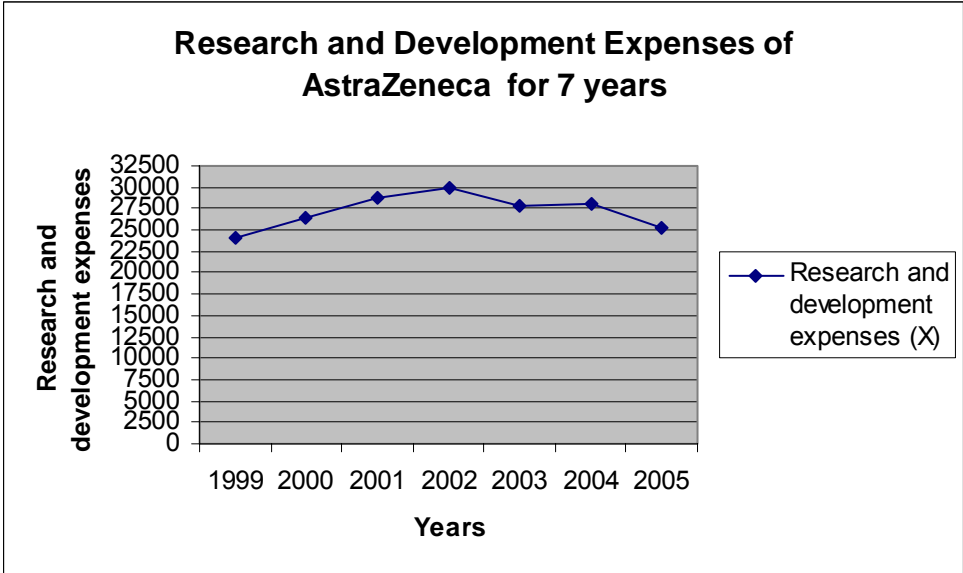


Figure 6.a

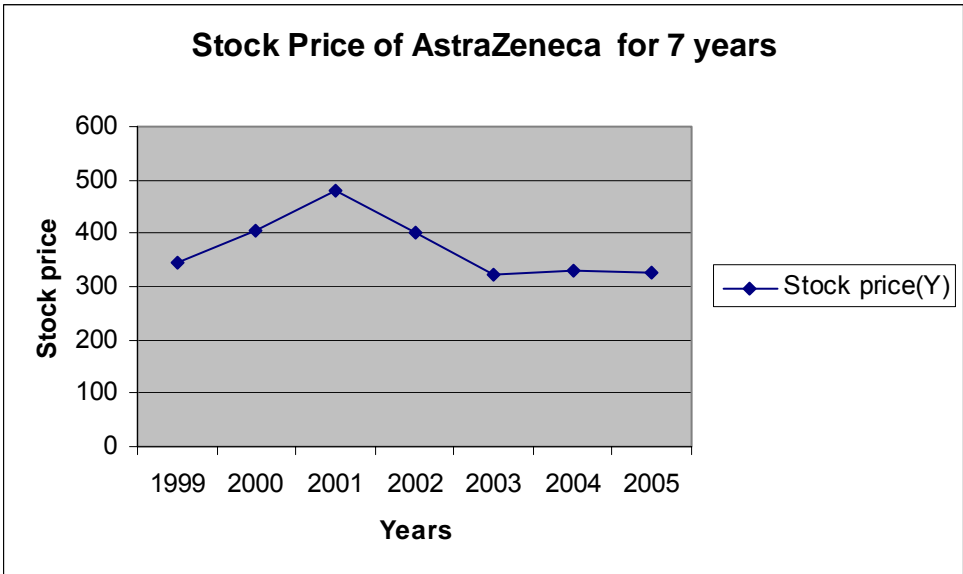


Figure 6.b

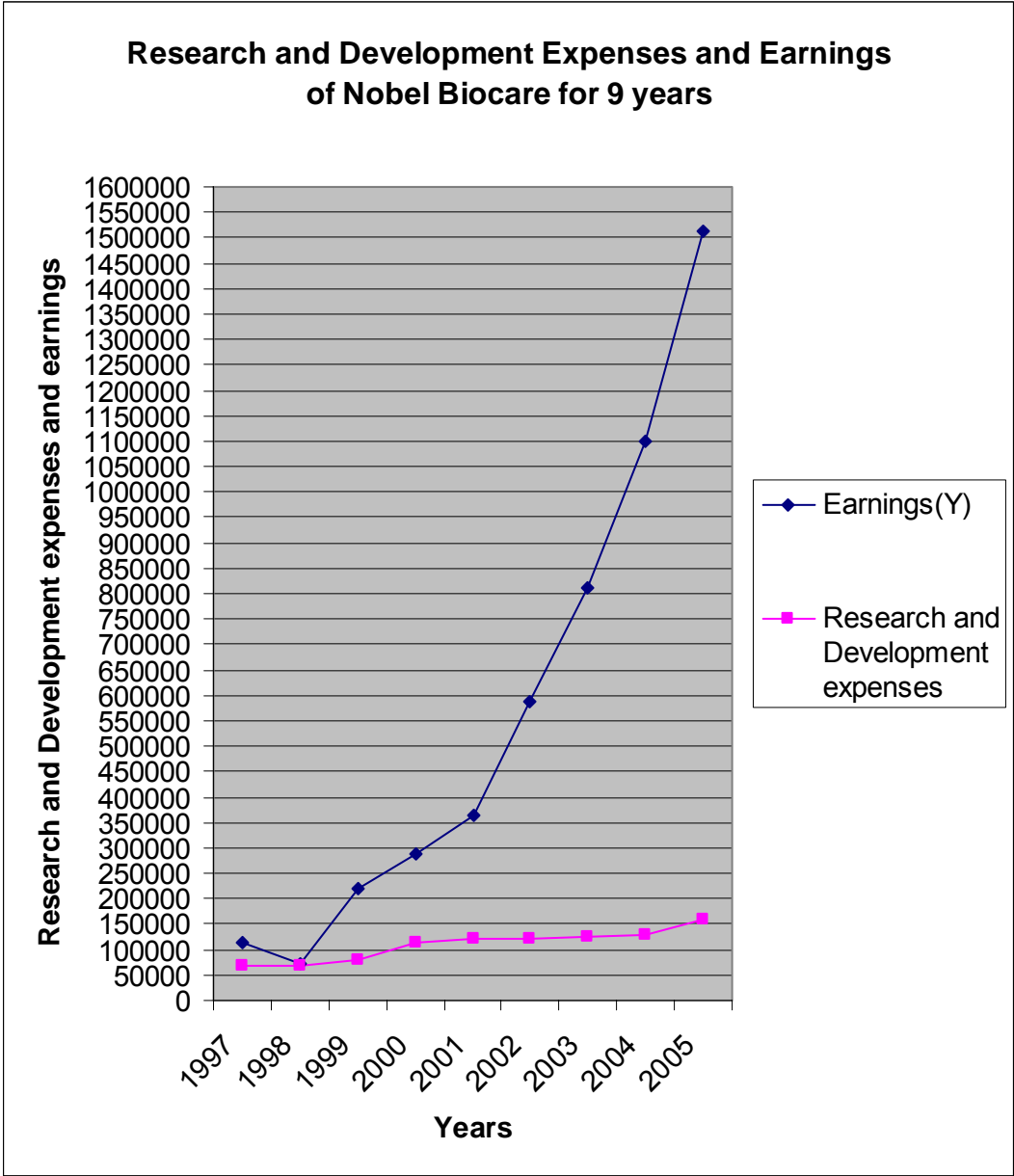


Figure 7

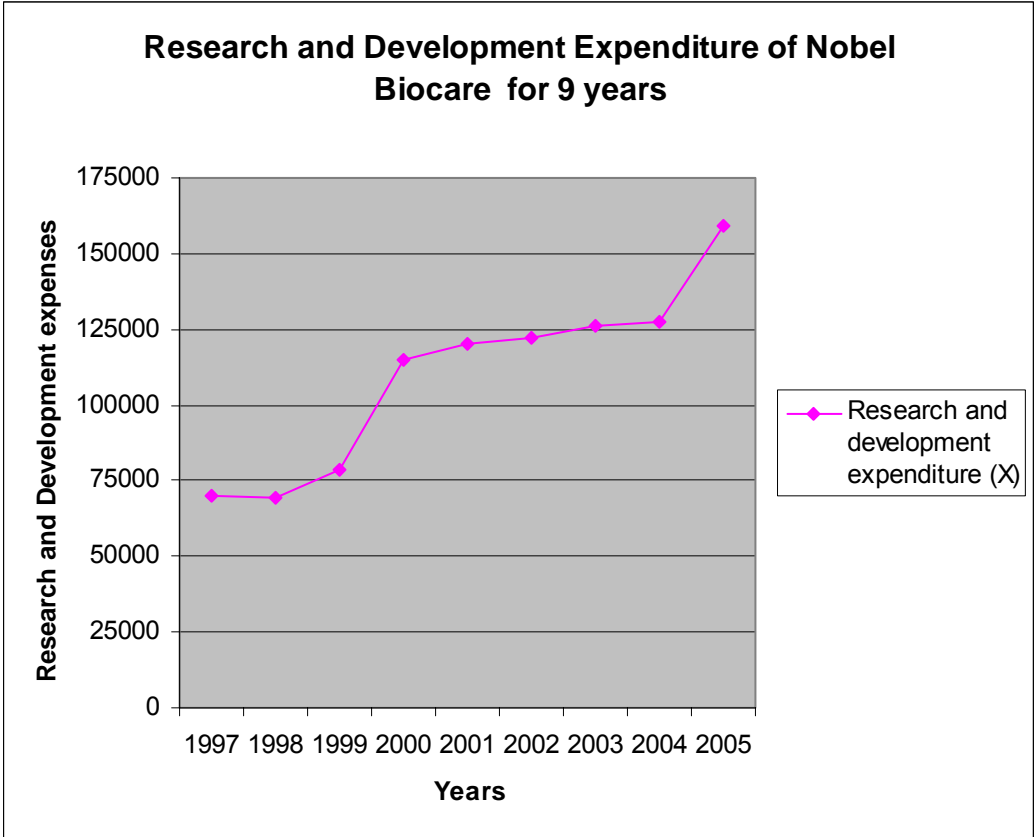


Figure 8.a

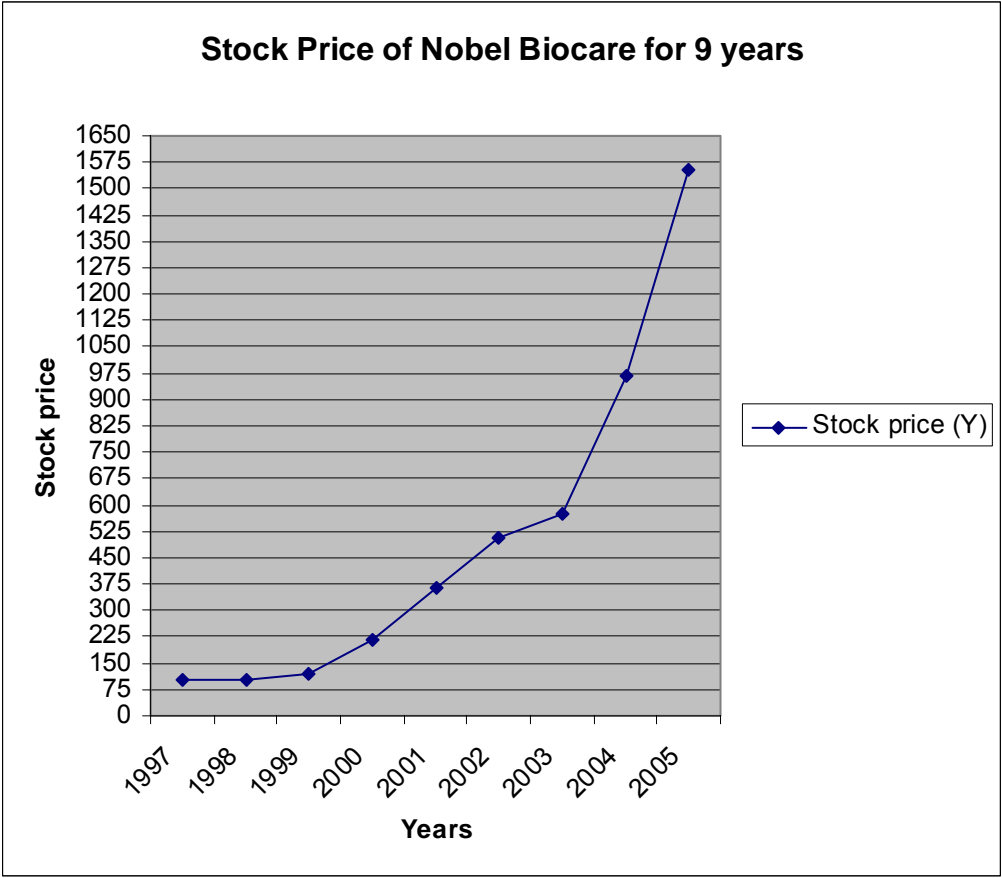


Figure 8.b

APPENDIX B

The calculations below show the sample procedure how the different statistical tools were used to get the results of different four companies. The calculation is for AstraZeneca and the same procedure has been applied for rest three companies.

$$\text{Coefficient of Correlation (r)} = \frac{N \sum XY - \sum X \cdot \sum Y}{\sqrt{N \sum X^2 - (\sum X)^2} \sqrt{N \sum Y^2 - (\sum Y)^2}}$$

Coefficient of regression is given by solving the following equation:

$$Y = \beta_0 + \beta_1 x + e \dots\dots\dots \text{equation 4.1 (as derived in page 35)}$$

$$\beta_1 = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2}$$

$$\beta_0 = \frac{\sum Y}{N} - \frac{\beta_1 \sum X}{N}$$

$$\text{Probable Error (P.E)} = 0.6745 \times \frac{1-r^2}{\sqrt{N}}$$

Year	Earnings(Y)	R&D expense (X)	y ²	x ²	X.Y
1996	19963,76	13150,46	398551713,3	172934598,2	262532627,3
1997	21812,91	16567,73	475803042,7	274489677,4	361390403,4
1998	24978,59	19660,12	623929958,4	386520318,4	491082076,8
1999	22688,55	24151	514770301,1	583270801	547951171,1
2000	36722,1	26506,25	1348512628	702581289,1	973365163,1
2001	40841,26	28642,6	1668008518	820398534,8	1169799874
2002	39006,82	29883,16	1521532007	893003251,6	1165647043
2003	33242,78	27905,82	1105082422	778734789,9	927667035
2004	35054,25	27947,87	1228800443	781083437,5	979691621,9
2005	48590,1	25251,61	2360997818	637643807,6	1226978255
	ΣY=	Σ=X	Σ=y ²	Σ=x ²	Σ=X.Y
	322901,12	239666,62	1124598852	6030660505	8106105271

AstraZeneca

1. Determination of Coefficient of Correlation and regression between Earnings and Research and Development expenses for 10 years

$$r = \frac{10 \times 8106105271 - 322901,12 \times 239666,62}{\sqrt{10 \times 6030660505 - (239666,62)^2} \sqrt{10 \times 1124598852 - (322901,12)^2}}$$

$$r = 0.76$$

$$\beta_1 = \frac{10 \times 8106105271 - 239666,62 \times 322901,12}{10 \times 6030660505 - (239666,62)^2}$$

$$\beta_1 = 1.28$$

$$\beta_0 = \frac{322901,12}{10} - \frac{1,28 \times 239666,62}{10}$$

10 10

$$\beta_0 = 1585,26$$

$$P.E = 0.6745 \times \frac{1 - (0.76)^2}{\sqrt{10}}$$

$$P.E = 0.09 \text{ or } 6 P.E = 0.55$$

2. Determination of Coefficient of Correlation and regression between Earnings and Research and Development expenses for model

Year	Earnings(Y)	R&D expenses(X)	y ²	x ²	X.Y
1996					
1999	22688,55	13150,46	514770301,1	172934598,2	298364869,2
1997					
2000	36722,1	16567,73	1348512628	274489677,4	608401837,8
1998					
2001	40841,26	19660,12	1668008518	386520318,4	802944072,6
1999					
2002	39006,82	24151	1521532007	583270801	942053709,8
2000					
2003	33242,78	26506,25	1105082422	702581289,1	881141437,4
2001					
2004	35054,25	28642,6	1228800443	820398534,8	1004044861
2002					
2005	48590,1	29883,16	2360997818	893003251,6	1452025733
	ΣY=	ΣX	Σy ²	Σx ²	ΣX.Y
	256145,86	158561,32	9747704138	3833198470	5988976521

$$r = \frac{7 \times 5988976521 - 158561,32 \times 256145,86}{\sqrt{7 \times 3833198470 - (158561,32)^2} \sqrt{7 \times 9747704138 - (256145,86)^2}}$$

$$r = 0.62$$

$$\beta_1 = \frac{7 \times 5988976521 - 158561,32 \times 256145,86}{\sqrt{7 \times 3833198470 - (158561,32)^2} \sqrt{7 \times 9747704138 - (256145,86)^2}}$$

$$\beta_1 = 0.77$$

$$\beta_0 = \frac{256145,86}{7} - \frac{0.77 \times 158561,32}{7}$$

$$\beta_0 = 19067,81$$

$$P.E = 0.6745 \times \frac{1 - (0.62)^2}{\sqrt{7}}$$

$$P.E = 0.16 \text{ or } 6 \text{ P.E} = 0.93$$

3. Determination of Coefficient of Correlation and regression between Stock price and Development expenses for 7 years

Year	Stock price(Y)	R&D expenes(X)	y ²	x ²	X.Y
1999	343,5	24151	117992,25	583270801	8295868,5
2000	403,16	26506,25	162537,9856	702581289,1	10686259,75
2001	480,78	28642,6	231149,4084	820398534,8	13770789,23
2002	399,83	29883,16	159864,0289	893003251,6	11948183,86
2003	323,47	27905,82	104632,8409	778734789,9	9026695,595
2004	330,42	27947,87	109177,3764	781083437,5	9234535,205
2005	325,8	25251,61	106145,64	637643807,6	8226974,538
	$\Sigma Y =$	$\Sigma X =$	$\Sigma y^2 =$	$\Sigma x^2 =$	$\Sigma X.Y =$
	2606,96	190288,31	991499,5302	5196715911	71189306,68

$$r = \frac{7 \times 71189306,68 - 190288,31 \times 2606,96}{\sqrt{7 \times 5196715911 - (190288,31)^2} \sqrt{7 \times 991499,53 - (2606,96)^2}}$$

$$r = 0.46$$

$$\beta_1 = \frac{7 \times 71189306,68 - 190288,31 \times 2606,96}{7 \times 5196715911 - (190288,31)^2}$$

$$\beta_1 = 0.013$$

$$\beta_0 = \frac{2606,96}{7} - \frac{0.013 \times 190288,31}{7}$$

$$\beta_0 = 6.80$$

$$P.E = \frac{0.6745 \times 1 - (0.46)^2}{\sqrt{7}}$$

$$P.E = 0.20 \text{ or } 6 P.E = 1.21$$

4. Determination of Coefficient of Correlation and regression between Stock price and Development expenses for model

Year	Stock price(Y)	R&D expenes(X)	y2	x2	X.Y
1996					
1999	343,5	13150,46	117992,25	172934598,2	4517183,01
1997					
2000	403,16	16567,73	162537,9856	274489677,4	6679446,027
1998					
2001	480,78	19660,12	231149,4084	386520318,4	9452192,494
1999					
2002	399,83	24151	159864,0289	583270801	9656294,33
2000					
2003	323,47	26506,25	104632,8409	702581289,1	8573976,688
2001					
2004	330,42	28642,6	109177,3764	820398534,8	9464087,892
2002					
2005	325,8	29883,16	106145,64	893003251,6	9735933,528
	$\Sigma Y =$	$\Sigma X =$	$\Sigma y^2 =$	$\Sigma x^2 =$	$\Sigma X.Y =$
	2606,96	158561,32	991499,5302	3833198470	58079113,97

$$r = \frac{7 \times 58079113,97 - 158561,32 \times 2606,96}{\sqrt{7 \times 3833198470 - (158561,32)^2} \sqrt{7 \times 991499,53 - (2606,96)^2}}$$

$$r = -0.44$$

$$\beta_1 = \frac{7 \times 58079113,97 - 158561,32 \times 2606,96}{7 \times 991499,53 - (2606,96)^2}$$

$$7 \times 3833198470 - (158561,32)^2$$

$$\beta_1 = -0.004$$

$$\beta_0 = \frac{2606,96}{7} - \frac{-0.004 \times 158561,32}{7}$$

$$\beta_0 = 463,65$$

$$\text{P.E} = 0.6745 \times \frac{1 - (-0.44)^2}{\sqrt{7}}$$

$$\text{P.E} = 0.21 \text{ or } 6 \text{ P.E} = 1.24$$

SAMPLE QUESTIONS ADDRESSED TO COMPANIES

1. Do you believe that investment in R&D affects the revenue and stock price of your company?
2. How much fund is allocated to research and development in the company's budget and what is the basis for allocation?
3. How does your company justify that the criteria for capitalisations of R&D costs are met?
4. What is the lag time for reaping benefits from R&D investments and for how long can your company continue to reap this benefit?
5. Besides affecting revenue and stock prices, what other major role does R&D play in the development of your company's image and how is the company motivated to increase its R&D investments?