Business & Entrepreneurship Journal, vol. 6, no. 2, 2017, 1-20
ISSN: 2241-3022 (print version), 2241-312X (online)
Scienpress Ltd, 2017

The Effects of Research and Development Expenditure on Firm Performance: an Examination of Pharmaceuticals Industry in Bangladesh

Dr. Jannatul Ferdaous[1] and Mohammad Mizanur Rahman[2]

Abstract

The purpose of this study is to provide a comprehensive evaluation of firm performance against R&D expenditure. The issue of firm performance is measured within the purview of financial performance, market position performance, and market based performance. The data have been collected for the period of 2001-2015 from listed pharmaceuticals firms in stock exchanges of Bangladesh. This inductive research uses both pooled OLS regression analysis and panel data (fixed effect) estimation technique for unbalanced panel data to measure, describe, and analyze the firm performance. After controlling some specific variables the present study finds significant positive non-linear relation between R&D expenditure and firm's financial performance, and R&D expenditure and firm's market position performance. However, a significant negative relation has found for the firm's market based performance against R&D expenditure. In other words, investors of Bangladesh do not consider R&D expenditure to be a creator of innovation rather they seem to be affected negatively in their assessment of the firm's financial condition by R&D expenditure. The study findings may provide useful guidance for entrepreneur, management for pharmaceuticals firms, and the general investors. The assessment of firm's performance against R&D expenditure can also be a useful source of information for the Bangladesh government's policy makers.

JEL classification numbers: O32, L25, L65, C23
Keywords: Research and Development Expenditure, Firm Performance, Pharmaceuticals Industry, Panel Data, Bangladesh Stock Exchanges

[1] Assistant Professor & Chairman, Department of Business Administration in Finance and Banking, Faculty of Business Studies, Bangladesh University of Professionals (BUP).
[2] MPhil Researcher, Department of Business Administration in Finance and Banking, Faculty of Business Studies, Bangladesh University of Professionals (BUP).

1 Introduction

Bangladesh is a country of emerging economy because of its recent high growth rate of industrialization and investment in different sectors. One of them is pharmaceuticals industry; it is considered one of the most research intensive industries around the world and so is for Bangladesh. This industry is accelerating at a very swift rate and contributing almost 1% to total GDP with great potential for expansion. Pharmaceuticals industry is advanced technological based where rigorous R&D practice is expected because R&D expenditure secures rigid competitive position, financial position, and patent rights which can be commercialized later. A crucial key success factor for firms is constant upgradation of their technology to maintain their competitiveness making effective R&D activity. A country's economic growth is adjudged to improvement in technology rather than the accumulation of capital. Economic growth is often backed by the prime driving force - technical innovation that comes from R&D activity. The idea behind R&D expenditure is to add value to the firm, deliver near-term growth with significant future opportunities, and improve firm's productivity and growth which in turn helps the firm to survive fierce domestic and international competition. In addition, R&D strategy accelerates reliable discovery of product, improves product quality, reduces fixed cost, and surges return on investment for the firm. That's why Jones and Williams [1] says R&D as key determinant of long-run productivity and welfare. A firm can enjoy a massive return when the innovation - new product or service - is marketed on a larger scale.

There is no doubt that R&D activity brings future benefit for the firm. Although this is often very costly and involves high risk, Lev and Sougiannis [2] have not demonstrated a direct relationship between R&D expenditure and specific future revenue. Moreover, Damodaran [3] observes noticeably less conformity on the magnitude of R&D contribution in the empirical literature. According to Siliverstovs and Kancs [4], this happens firstly, the presumed absence of a significant correlation between R&D expenditure and increased future benefits and also failure to address the issues of reliability, objectivity, or value relevance of R&D capitalization might be the reasons behind the fact. Secondly, the accounting treatment of R&D activity, U.S. GAAP requires R&D expenditure as operating expense against income that lowers net income, might be another reason. In effect, the investors often encounter difficulties to value the firm properly; as a result, strong mispricing of stock in the market happens when a firm has large amount of intangible assets like R&D.

In modern economy, many pharmaceuticals firms consist of large amounts of intangible assets such as R&D, patents, brand names, advertising, and employees' expertise that are not included as separate segment in financial statement as sources of value under U.S. generally accepted principles. As a result, public information about R&D activities is inadequate for the purpose of investment analysis. Moreover, there is no way to reliably measure the future economic benefits from associated R&D expenditure since there are uncertainties surrounding the results of R&D. Nevertheless, we cannot ignore the R&D and its subsequent future benefits because empirical research findings of Deng et al. [5] have established that corporate R&D is strongly associated with subsequent productivity, earnings, and stock price. Investors usually underestimate the information content of R&D activity and slowly respond or react to the information of R&D investment in stock market amid the absence of appropriate valuation tools for R&D intensive firms. Firms do R&D activity by spending considerable amount of resources; so it is rational desire to

know whether financial markets value R&D firms differently from non-R&D ones because resources are not abundant; they are scare. Although the innovations brought by R&D activity may be small in the larger scheme of things in Bangladesh, they appear to have valued insofar as they contribute to increasing firm productivity and profitability. Some innovations may be directed towards imitation and diffusion in some cases, which may be just as important in generating profits and hence market value, even though such activity may not generate any patents.

There is well established and persuasive empirical evidence that stock markets in developed economies do value R&D activity by firms. A major reason for the fact is the predominant share of R&D capital appears to be generated in a handful of developed economies, whether measured in terms of the inputs into innovation such as R&D expenditure, or in terms of the outputs of innovation such as patents. The present study explores to get same empirical evidence in the context of less developed economies like Bangladesh.

In view of these arguments, therefore, questions about the stock market's responsiveness. Is responsiveness become as relevant in the context of Bangladesh? Since historically, the country has been following developed economies. Thus, are more R&D firms valued more highly than less R&D ones, ceteris paribus? Is the firm's financial performance and revenue growth improved to the success or quality of R&D expenditure? These are the questions that might be of interesting to be explored in the context of Bangladesh. The present study explores these questions in the context of pharmaceuticals industry by using historical data from 2001-2015 in the emerging economy like Bangladesh.

The scope of the study includes only 4 pharmaceuticals firms that are listed in Dhaka Stock Exchange Ltd. (DSE) and Chittagong Stock Exchange Ltd. (CSE), Bangladesh have been covered. This is because the concept of R&D expenditure is new for Bangladesh and not all the firms are involved in doing R&D expenditure.

What distinguishes the present study from those in the developed country literature is precisely the fact that we do not follow the literature that uses patent counts - raw or citation weighted - in studying the relationship between firm's financial and market performance, precisely because none of the pharmaceuticals firm operating in Bangladesh takes out patents, especially product patents. Despite the fact, these firms are indeed innovative, although those innovations may not be enough of an advance over the international state of the art to merit formal protection in the form of patents.

It is also worth noting that in the context of developing country like Bangladesh the phenomenon of R&D is new. No study has been done so far; and there is little evidence available for relationships between R&D expenditure and firm performance in Bangladesh. So, the study takes an attempt to provide more empirical evidence to the existing literature related to the effects of R&D expenditure on firm performance providing the data from Bangladesh.

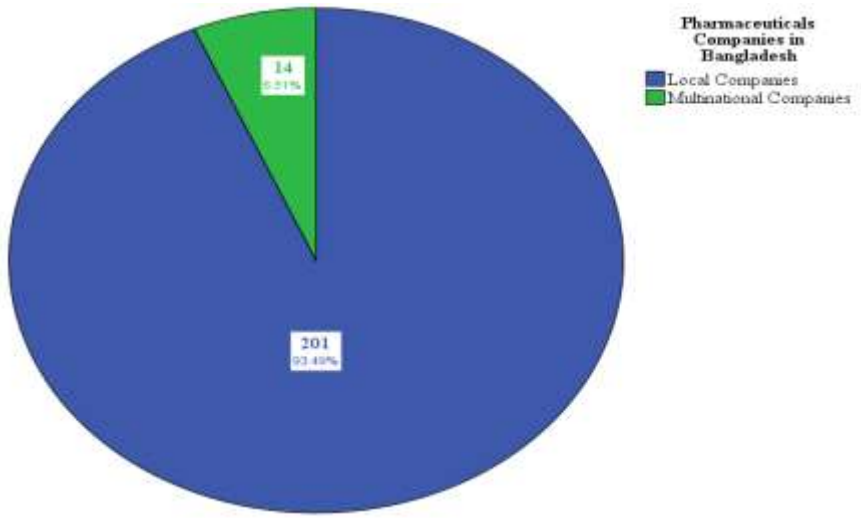
2 Background of the Study

2.1 Pharmaceuticals Industry in Bangladesh

This sector started to improve from 1980s and has grown tremendously in the last two decades. More than 97% of local demand of medicines is fulfilled by the industry and about 30 local pharmaceuticals companies export a significant quantity of medicines to

106 countries, including Germany, USA, France, Italy, UK, Canada, Netherlands, and Denmark. The World Trade Organization's (WTO) Trade-Related Aspects of Intellectual Property Rights (TRIPs) agreement permits Bangladesh to reverse-engineer patented generic pharmaceutical products to sell locally and export to markets around the world. The TRIPs agreement is turning Bangladesh into a hub for affordable and high-quality generic medicines, and contract manufacturing with exports to potentially more than 106 countries across the world.

According to the Directorate General of Drug Administration (DGDA) in 2016, there are 266 licensed allopathic drug manufacturing units in the country, out of which only 215 are in active production; others are either closed down on their own or suspended by the licensing authority for drugs due to non-compliance to good manufacturing practices or drug laws. Bangladesh manufactures more than 450 generic drugs for 5,300 registered brands, which have 8,300 different forms of dosages and strengths.



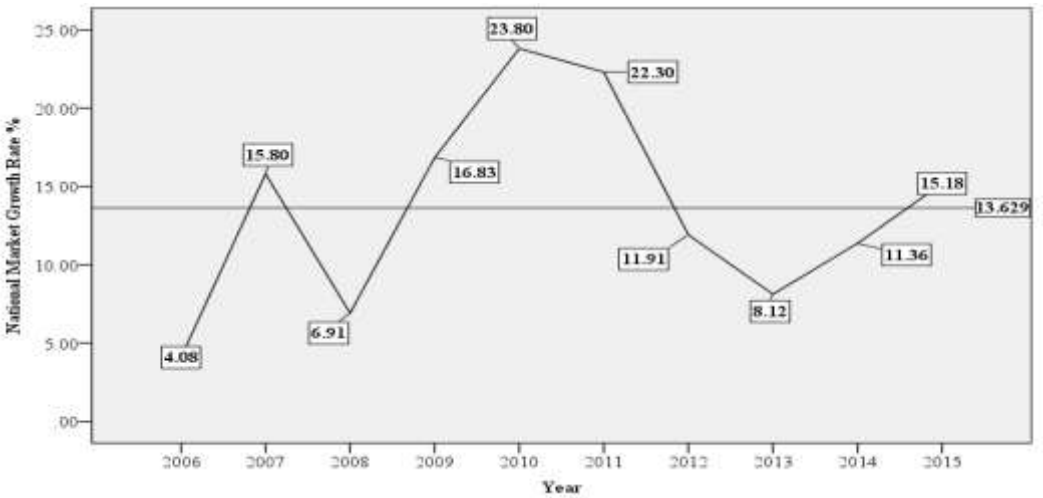
Source: Directorate General of Drug Administration (DGDA), Ministry of Health & Family Welfare, Government of the People's Republic of Bangladesh

Figure-1: Total No. of Registered and Functional Pharmaceuticals Companies in Bangladesh

2.1.1 Market Share and Annual Growth Rate

Bangladesh pharmaceuticals industry is mainly dominated by domestic manufacturers. Before 1982, there were about 10 multinational companies availing about 80% of the domestic market. The situation is reversed now; local manufacturers dominate the industry, enjoying about 87% of market share while multinationals hold a 13% of market share. According to IMS report, the Bangladesh pharmaceuticals market was valued at more than Tk 130 billion or around $1.6 billion in 2015. The IMS report also says the global pharmaceuticals market reached $1.06 trillion in 2015, growing by 5% percent over the previous year. The top 10 manufacturers by market share over the revenue are Square (19%), Incepta (9.5%), Beximco (9%), Opsonin (5%), Renata (4.9%), Eskayef (4.7%), ACI (4.3%), ACME (4.1%), Aritstopharma (4%), and Drug International (3.7%).

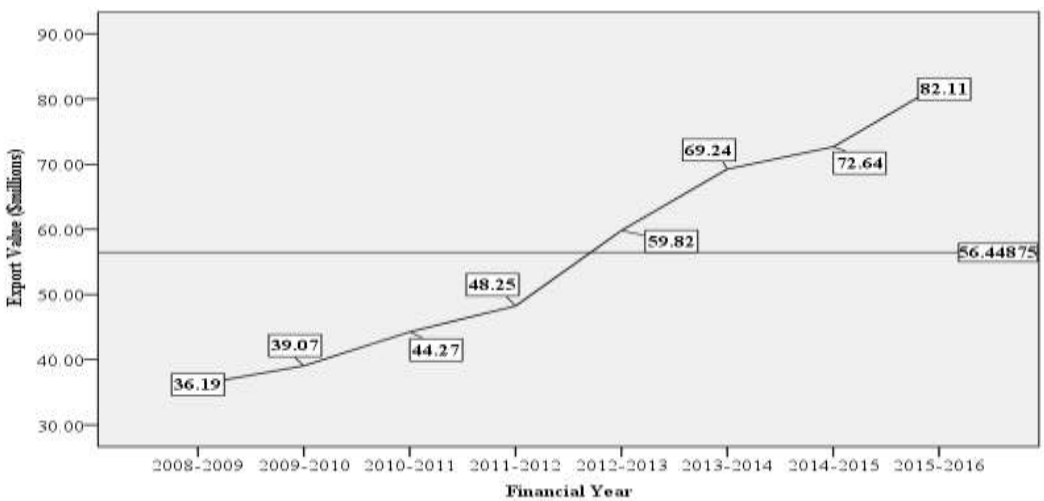
The top 10 players control around two-third of the market share. Annual growth rate of pharmacy market in Bangladesh is as follows:



Source: Annual Reports of Square Pharmaceuticals Ltd.
Figure-2: Annual Pharmacy Market Growth Rate in Percentage

2.1.2 Export Trend

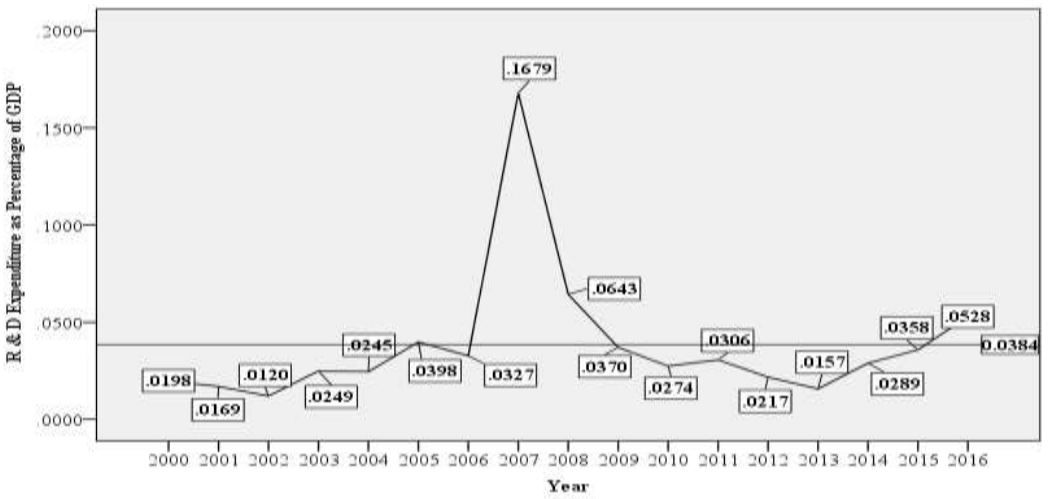
Pharmaceuticals companies in Bangladesh have the potential to earn $1 billion a year through exports in the next five years, if the sector gets proper fiscal benefits and policy support. Export earnings from the sector still remain below $100 million a year, but drug makers are optimistic about reaching the $1-billion mark as the industry is growing at little over 10 percent a year. A couple of local companies in Bangladesh have also gained access to the highly regulated markets of the U.S. and the UK. The industry is achieved superiority by exporting its product to foreign market with bigger success.



Source: Export Promotion Bureau, Ministry of Commerce, Government of the People's Republic of Bangladesh
Figure-3: Export Trend of Pharmaceuticals Industry in Bangladesh (Value in Millions)

2.2 Research and Development Expenditure as Percentage of GDP in Bangladesh

There is a direct relationship prevails between R&D expenditure and country's economic growth. However, Bangladesh invests few capitals during the last decade for R&D; apparently, the amount spends in R&D seems minimal, but encouraging thing is country's initiative to launch for high tech product. R&D expenditure is required for manufacturing high technology products such as aerospace, information and technology, technical textiles, pharmaceuticals, scientific instruments, and electrical machinery. The mean expenditure of R&D over the GDP during the period of 2000 to 2016 is about 0.0384 percentages. The low mean expenditure against GDP suggests country's poor performance in R&D expenditure. This happens because Bangladesh is neither well equipped nor has advanced technology for manufacturing such robust and sophisticated items that requires rigorous expenditure in R&D. Although this percentage is very low, the initiative that Bangladesh takes as a developing nation is truly appreciable.



Source: R&D Expenditure Data from World Data Atlas and GDP Data from World Bank
Figure-4: Research and Development Expenditure Trend

2.3 R&D Activity and Firm Performance

The activities of R&D are classified in two ways and differ from firm to firm. In first case, the primary function of an R&D group is to develop new products. To discover and create new knowledge about scientific and technological topics for the purpose of uncovering and enabling development of valuable new products, processes, and services are the primary function of second phase of R&D group.

Firm performance is a broad term and could be measured within the purview of financial performance, market position performance, and market-based performance. Sharma and Lacey [6] says innovativeness obtained from R&D expenditure positively contributes to firm performance by attenuating the natural forces of competition or changes in consumption patterns that tend to dissipate superior returns over time. Pauwels et al. [7] and Srinivasan et al. [8] and Sorescu and Spanjol [9] support this fact that indicates innovativeness has positive consequences for various performance outcomes, including a firm's market position, financial position, and firm's value in the stock market. Market

position refers to the revenue based performance of firms in the marketplace (e.g., sales, market share, and sales growth). Financial position represents the cost-based performance in the marketplace, which accounts for the cost component of firm's activities (e.g., overall profitability, return on assets (ROA), return on investment (ROI), and return on equity (ROE). According to Rust et al. [10] firm value refers to the firm performance in the stock market, which accounts for both current and future gains (e.g., stock market performance, Tobin's q, market capitalization, and market-to book ratio).

Penrose [11] suggests that innovative product enables the firm to sense new opportunities in the marketplace. Similarly, Morgan, Slotegraaf, and Vorhies [12] and McGrath et al. [13] advocate that firms with new product have superior market-sensing capabilities; they also suggest that new product improves financial position reducing the average costs through more productive resource utilization.

It is expected that innovativeness will directly influence firm's financial position and market position, which in turn will improve firm's value. Srinivasan and Hanssens [14] suggest that, in addition to the innovativeness ⟶ market position ⟶ financial position ⟶ firm value path, innovativeness should have a direct positive effect on firm value.

3 Literature Review

In the realm of research of R&D expenditure and firm performance, a large number of studies have been made in finance and accounting field which dealt with the valuation of intangibles expenditure like R&D and its investments on creation of innovation. A significant number of these studies reach the conclusion that firms view cost of R&D as investments that are expected to return future benefits. However, it is very difficult to cover and present all the prior works related to R&D. In reviewing literature, the present study has been grouped into three general topics identified among the overall volume of research.

3.1 R&D Expenditure and Subsequent Operating Performance

Existing research of R&D Expenditure and subsequent operating performance mainly focuses on to testify significant association between operating income and current and lagged R&D values, controlling other factors.

As a reference we may include the study findings of Sougiannis's [15] evidence that the reported earnings, after being adjusted for the expensing of R&D, reflect benefits. Sougiannis finds that on average, a one dollar increase in R&D expenditures leads to a two dollar increase in profit over a seven year period. In the same direction, Lev and Sougiannis [2] testify a positive association between operating income and current and lagged R&D values. They also find that the time window for which past R&D values are able to influence current operating results (average duration of R&D benefits) depends on the industry. However, this evidence is not so much supported by Megna and Mueller [16] who find that differences in profitability across firms in a particular industry are not explained just by adjusting accounting profits to take into account intangibles (R&D and advertising). The study findings of Dave et al. [17] suggest a considerable relationship between R&D intensity and gross margin; their findings also confirm a powerful connection between the gross margins and the financial sustainability, calibrated by the

ROA.

On the other hand, Eberhart et al. [18] have conducted research focusing on R&D increases, instead of the current and past level of R&D to investigate the relationship between R&D investment and future profitability. Interestingly, they find evidence of significantly positive abnormal operating performance over the five years following the increases in R&D spending and conclude that R&D is a beneficial investment. Finally, Ho et al. [19] have conducted research focusing on to find out the relationship between firm performance and R&D intensity and advertising intensity. Their findings suggest that R&D investment is positively related to holding period return for manufacturing firm and non-manufacturing firm. Similarly, the study findings of Beld [20] reveal a nonlinear relationship between R&D investment and the firm's financial performance; and VanderPal [21] confirms that R&D expense indicator is positively correlated with the financial performance of the firm (revenues, net income, equity, and ROE).

3.2 R&D Expenditure and Subsequent Market Performance

This topic has been deeply researched. Till now, the results are very encouraging and Anagnostopoulou [22] reveals that there exists a positive relationship between R&D and future market performance. VanderPal [21] also finds an intense positive connection between R&D, profitability and the organization's market value. The methodologies used for this research vary from Tobin's Q to market value or market-to-book models and return model. Hall [23], Hirschey and Weygandt [24] , Cockburn and Griliches [25], Munari and Oriani [26], Chung et al. [27], Connolly and Hirschey [28], Feng and Rong [29], and Bracker and Krishnan [30] use Tobin's Q model and find positive effects of R&D on market value. Hirschey [31], Chauvin and Hirschey [32], and Beld [20] use market valuation approaches (market-to-book) and come out with similar results.

On the other hand, Lev and Sougiannis [2] use stock prices and stock returns as measures of market performance and demonstrate that across time R&D capital is significantly associated with subsequent stock returns, after controlling for other risk and fundamental factors. Similarly, Duqui et al. [33] show that financial arena values R&D undertakings better in investor-friendly environments. However, Chan et al. [34] do not find evidence that generally supports a direct link between R&D spending and future stock returns. They observe that the average return on stocks of firms that invest in R&D is comparable to the return of stocks with no R&D investment. The strongest signs of an association between R&D and stock returns exist for those stocks with high ratios of R&D to market value of equity, and the latter tend to be past losers. But, Pandit et al. [35] study findings show that the connection between R&D efforts and future earnings can be understood better including the information about firm's R&D outlays.

Anagnostopoulou and Levis [36] addresses the issue of R&D investments with operating growth and market performance and confirm the relationship between R&D intensity and growth in sales and gross income. Their findings also show the evidence that R&D intensity improves persistence in stock return. While assessing the influence of R&D investment on the market value in manufacturing and service firms, Ehie and Olibe [37] show a positive contribution of R&D to firm performance; but this performance is not the similar for manufacturing and service firms. Given that, Garcia-Garcia and Magdaleno [38] study results confirm that the market acknowledges the role of R&D expenditures. Finally, Eberhart et al. [18] testify that significant R&D increases are associated with significant positive abnormal risk-adjusted returns for the five-year period following the R&D increase.

3.3 R&D Expenditure and Market Responsiveness

Chan et al. [39] using the event study methodology approach examine the change in stock prices when an announcement of augmented R&D expenditure occurs. The conclusions of this study depict that these announcements seem to trigger the rise of stock prices, even though the enterprise might have recorded losses.

In 1996, two different studies of Lev and Sougiannis [2] and Green et al. [40], reach similar conclusions with the above mentioned findings. Franzen and Radhakrishnan [41] using a residual income valuation framework examine the informative value that investors attribute to R&D expenditures, for firms that present profits and losses and conclude that R&D expenditures affect stock prices for both firms that disclose profits and losses.

Finally, R&D expenditure holds value for the firm but there are some contradictory findings. Tahinakis and Samarinas [42] take an attempt to examine whether investors are affected in their decision for buying or selling a stock. Their findings depict that a strong negative relation between R&D expenditures and stock price. In other words, investors seem to be affected negatively in their assessment of the firm's financial condition by R&D spending. As a result, the subject of R&D expenditure demands further investigation.

Many of the above mentioned methodologies have been applied utilizing UK, USA, and European countries data samples. These are the countries with developed economies, which emphasize on creation of knowledge, innovation and its reproduction. So, do similar results apply to developing countries like Bangladesh for pharmaceuticals industry? Keeping this reasoning as our background the study attempts to address this issue for Bangladesh. According to prior studies mentioned above the following hypotheses have been considered:

Hypothesis 1: Expenditure in R&D will affect the firm's financial performance positively.
Hypothesis 2: Expenditure in R&D and revenue growth is not independent.
Hypothesis 3: Expenditure in R&D will affect the stock price negatively.

4 Research Method

The present study is a descriptive and relational. An inductive research approach has been used for this study. This empirical study is primarily based on quantitative secondary data obtained from published audited financial statement of respective pharmaceuticals company's website from 2001 - 2015. So, the present study has used panel data analysis technique in order to capture the dynamics of selected indicators to highlight the relationship between R&D expenditure and firm performance. There are some advantages remain to use panel data because of its clear results based on multiple degrees of freedom and a low degree of multicollinearity. Hence, this type of data helps to improve the efficiency of econometric estimates. Moreover, Baltagi and Kao [43] study findings advocate the superiority of panel data analysis because it allows for possible development of correlations in time and units of study.

The unit of analysis of this study is pharmaceuticals firm. All the registered pharmaceuticals firms currently operating in Bangladesh are the target firms of this study. However, accessible firms are only listed firms in both Dhaka Stock Exchange Ltd. (DSE)

and Chittagong Stock Exchange Ltd. (CSE). The total number of 11 pharmaceuticals firms have found listed in DSE and CSE. The criteria that have been used to select firm mainly based on the existence of the variables in the audited financial statement (some firms might not have the R&D expenditure component) for the selected period; in addition, to be a sample firm that firm must have the available accounting and financial data such as ROA, EPS, leverage ratio, revenue, advertising expenditure, market price per share, and other necessary information to measure the firm performance. Firms that do not fulfill these basic criteria have been removed, in order to be statistically valid for the regression. After considering all the criteria, 4 pharmaceuticals firm out of 11 have qualified and have been taken as a study sample.

The present study has ensured research quality by focusing on the validity and reliability of the data. Validity issue has been solved by improving good statistical power - significance level. Reliability issue is concerned with the consistency of the findings of research. In order for research to be reliable, other researchers should be able to replicate it and get the same result. The study has used the data from the public sources, company's website. This means that if others could review the data and follow the same method, they would be able to get the same results.

4.1 Description of the Variables

The present study will investigate and see how R&D expenditure affects the firm performance. The selected independent variable of the study is R&D expenditure; and firm performance is depended variable. Some control variables are selected to see if the firm performance is caused by these variables. The following discussion represents the summary of variables construction for the study.

4.1.1 Independent Variables

4.1.1.1 R&D Expenditure per Share

The variable R&D Expenditure per Share (RDPS) represents the R&D expenditure for year $_t$ and firm $_j$, expressed in a per share form. Firm's total numbers of outstanding shares have been used from the firm's financial statement while determining RDPS. This variable has been used following the methodology of Tahinakis and Samarinas [42].

4.1.1.2 Square of R&D Expenditure per Share

The variable square of R&D Expenditure per Share ($RDPS^2$) represents the R&D expenditure for year $_t$ and firm $_j$, expressed in a square of per share form. Like RDPS, Firm's total numbers of outstanding shares have been used from the firm's financial statement while determining $RDPS^2$. The square of RDPS term is deployed in order to check for a possible non-linear effect with firm performance. Beld [20] uses square of RDI term while addressing for a possible non-linear effect of R&D expenditure with firm performance.

4.1.1.3 Earning per Share before R&D Expenditure

Firm's net income on income statement excludes R&D expenditure. So, R&D expenditure has been added to earning per share (EPS) in order to investigate the effect of R&D expenditure as a separate variable to the stock price following the methodology of Tahinakis and Samarinas [42]. This variable is symbolized in the equation as EPSBRD.

4.1.2 Dependent Variables

4.1.2.1 Return on Assets

Return on Assets (ROA) give an indication of how profitable a firm is according to its total assets. A higher ROA ratio means the firms are using its assets better to generate profit. In this study, the variable ROA has been used to measure firm's financial performance, and is calculated as net income available to common stock holders divided by total assets. This ratio has been used by Rahman [44] to measure the financial performance of scheduled banks in Bangladesh.

4.1.2.2 Revenue

Revenue (REV) is the measure of the firm performance, and the variable is taken to measure the firm's market position performance following the methodology of VanderPal [21]. Revenue is the income that a firm receives from its normal business activities, usually from the sale of goods and services to the customers.

4.1.2.3 Market Price per Share

Market price per share (P) has been taken to test the firm's market responsiveness meaning that in what way investors react towards the R&D intensive firms. Do the investors value R&D intensive firms or not? The market price per share has been taken at the end of the firm's financial year. According to prior studies related to R&D expenditure and firm's market based performance, this variable was previously used in the study conducted by Tahinakis and Samarinas [42].

4.1.3 Control Variables

4.1.3.1 Firm Size

Firm size (SIZE) measures a firm's level of concentration or market power in the industry in which the firm operates. Large firms are likely to lead better performance since they come out more efficiently in the market by exploiting economies of scale. That's why the variable firm size is most commonly used in a broad range of R&D expenditure and firm performance literature (e.g. Chauvin and Hirschey [32]; Ho et al. [19]; Munari and Oriani [26]; Feng and Rong [29]; Chadha and Oriani [45]; Bhat and Narayanan [46]. Firm size is measured as the total assets of the company.

4.1.3.2 Export Intensity

Export intensity (EI) is one of the avenues to measure firm's growth and financial strength. Exporting firms can take advantage of a growing market abroad and become more successful in the market in long run. According to Lee and Habte-Giorgis [47], in certain industries, firms can gain access to technology and sophisticated consumers by selling abroad. Export intensity is measured as the value of total exports of goods as a percentage of net sales. The same measure was previously used in the study conducted by Naik et al. [48].

4.1.3.3 Book Value per Share

Book value per share (BVPS) is the ratio of shareholder's common equity to numbers of shares outstanding in the market. Shareholder's equity represents the amount by which a firm is financed through common and preferred shares. After taking the data of

shareholder's equity from firm's balance sheet, the amount of preferred shares have been deducted carefully. This variable has been added following the methodology of Tahinakis and Samarinas [42] and acts as a control variable in the model for the firm's market based performance.

4.1.3.4 Dummy R&D Expenditure Variable

A dummy R&D expenditure variable (DRD) has been introduced in the equation of present research that makes an avenue to check and verify the robustness of statistical significant findings that may potentially arise from multivariate regression analysis. The dummy variable is used as a benchmark for comparison, the average R&D expenditure. The value of DRD is 1, if R&D expenditure for firm $_j$ on year $_t \geq$ average R&D expenditure for year $_t$, otherwise is 0. The utilization of such variable creates two distinct groups. The firms that record R&D expenditure equal or larger than the average R&D expenditure constitutes the group of firms that are considered more R&D intensive firms belong high amount of intangible assets. On the other hand, the opposite applies for firms that record less R&D expenditure than the average.

4.2 Estimated Model

The present research has split the firm performance into three - financial performance, market position performance, and market based performance - to examine the effects of R&D expenditure on it. The equations for estimated model are given below:

Equation (1): $ROA_{t,j} = a_0 + a_1\, RDPS_{t,j} + a_2\, RDPS^2_{t,j} + a_3\, EI_{t,j} + a_4\, DRD_{t,j} + e_{t,j}$
Equation (2): $REV_{t,j} = a_0 + a_1\, RDPS_{t,j} + a_2\, RDPS^2_{t,j} + a_3\, SIZE_{t,j} + a_4\, DRD_{t,j} + e_{t,j}$
Equation (3): $P_{t,j} = a_0 + a_1\, EPSBRD_{t,j} + a_2\, RDPS_{t,j} + e_{t,j}$
Equation (4): $P_{t,j} = a_0 + a_1\, EPSBRD_{t,j} + a_2\, BVPS_{t,j} + a_3\, DRD_{t,j} + e_{t,j}$

The equation (1) and equation (2) are the estimated measure of firm performance within the purview of firm's financial performance and market position performance respectively. While the equation (3) and equation (4) are the estimated appraising models for firm's market based performance.

4.3 Descriptive Statistics of Variables

The following table represents descriptive statistics of the sample firms. Total 40 observations have been collected from four pharmaceuticals firm for the analysis of firm's return on assets, revenue, and market price per share.

The ROA varies between -0.7987% and 18.9152% with a mean of 6.90%. While the mean revenue for the sample firms is BDT 7502882961.88, the minimum and maximum market prices per share are BDT 9 and BDT 411 respectively. The mean value of R&D expenditure per share by the sample firms is very low only BDT 0.0935. It is important to note that if the firms capitalized the R&D expenditure rather than expense their EPS would improve since the mean of EPS before R&D expenditure is slightly higher than the mean of EPS after R&D expenditure. Sample firms mean leverage ratio is only 0.35 which means firms are not financially weak.

Table -1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
R&D Expenditure per Share (RDPS)	40	0.0019	0.4605	0.0935	0.1187
Square of R & D Expenditure ($RDPS^2$)	40	0.000003435	0.2121	0.0225	0.0486
Earning before R&D (EPSBRD)	40	-0.24	23.51	5.9990	5.2514
Earning per Share (EPS)	40	-0.29	23.47	5.9055	5.24514
Return on Assets (ROA %)	40	-0.7987	18.9152	6.8954	5.3671
Revenue (REV)	40	227819297	33133054692	7502882961.88	8198265372.30
Market Price per Share (P)	40	9	411	128.82	108.23
Leverage Ratio	40	0.11	0.75	0.3455	0.13683
Book Valu per Share (BVPS)	40	9.15	138.88	54.3073	34.25940
Size of the Company (SIZE)	40	604093394	38365592493	12784424274.18	10467879324.05
Export Intensity (EI)	35	0.0070	0.0650	0.0330	0.0159
Valid N (listwise)	40				

5 Data Analysis and Findings

In order to estimate the empirical evidence for the effects of R&D expenditure on firm performance for the case observed, a Pooled Ordinary Least Squares (OLS) regression has been implemented for the set of equations- equation (1), equation (2), and equation (3 & 4) to estimate firm's financial performance, market position performance, and market based performance of firm's respectively on R&D expenditure.

5.1 R&D Expenditure and Firm Performance

5.1.1 R&D Expenditure on Return on Assets (ROA)

The output of regression analysis that has been employed for the ROA analysis as a measure of firm's financial performance is presented in following table - 2.

Table -2, Pooled OLS Estimates for Equation (1)

	Constant	**RDPS**	**RDPS^2**	**EI**	**DRD**
Equation -1	6.232***	47.185*	-129.699**	-39.620	3.545*
	(0.007)	(0.061)	(0.033)	(0.515)	(0.058)

Equation -1 $ROA_{t,j} = 6.232 + 47.185\, RDPS_{t,j} - 129.699\, RDPS^2_{t,j} - 39.620\, EI_{t,j} + 3.545\, DRD_{t,j} + e_{t,j}$

***** The level of significance at 10%, ****** The level of significance at 5%, ******* The level of significance at 1%. The values in the parentheses depict the significance value (p).

	R Square	**Adjusted R Square**	**ANOVA**		**Durbin-Watson**
			F	Sig.	
Equation -1	0.224	0.121	2.165	0.097	0.632

The significant results are marked with asterisk. It is obvious from the OLS estimation results of equation (1) that the coefficients of variables RDPS, RDPS^2, and DRD along with intercept are statistically significant at the level of significance 10%, 5%, 10%, and 1% respectively. The coefficient, for example, of 47.185 means that an increase of 1% RDPS leads to the increase of ROA with 47.185%. At first, the independent variables RDPS and RDPS^2 are inserted and ROA is inserted as dependent variable. Later, the two control variables, EI and dummy variable DRD, are included in the model. Without control variables the model is significant meaning that RDPS and RDPS^2 both are significant parameters of ROA. RDPS has shown a positive significant parameter with ROA. However, RDPS^2 has a negative significant influence on ROA; this is because R&D expenditure is not linearly related to ROA, the measure of firm's financial performance.

After controlling for EI and DRD, the coefficients of RDPS and RDPS^2 are still positively and negatively significant respectively. An increase of control variable EI with 1% will decrease the ROA with 39.620%. But this interpretation is not valid amid insignificant coefficient value of EI. The dummy control variable, DRD, is created to use as a benchmark for comparison, the average R&D expenditure. It has a positive coefficient value of 3.545 that means if the company expenditures from below R&D average to above R&D average, the ROA will likely to increase by the value of 3.545%. The adjusted R Square of the equation (1) estimation is 0.121, presenting a reasonable degree of explanatory power. This value tells us financial performance (ROA) of the firm can be explained 12.1% by the variables RDPS, RDPS^2, EI, and DRD. The value of Durbin-Watson statistic test is 0.632 which is far less than 2; it suggests that there is a positive autocorrelation present in the sample. The whole estimated model is significant at 10% level of significance.

At this point, first hypothesis, Hypothesis -1, is confirmed by the significant coefficients of RDPS and RDPS^2. R&D expenditure will affect the firm performance positively but in a non-linear way, with ROA, the measure of firm's financial performance. The present study findings are encouraging because Beld [20] who has also observed similar findings, positive and non-linear relationship between R&D expenditure and ROA.

5.1.2 R&D Expenditure on Revenue (REV)

The pooled OLS estimation for equation (2) is presented in table - 3. Second equation has been employed for the REV analysis as a measure of firm's market position performance.

Table -3, Pooled OLS Estimates for Equation (2)

	Constant	**RDPS**	**RDPS^2**	**SIZE**	**DRD**
Equation -2	-2807121643****	32504161560***	-124928458133*****	0.681*****	3440027689****
	(0.017)	(0.099)	(0.004)	(0.000)	(0.010)
Equation -2	$REV_{t,j} = -2807121643 + 32504161560\ RDPS_{t,j} - 124928458133\ RDPS^2_{t,j} + 0.681\ SIZE_{t,j} + 3440027689\ DRD_{t,j} + e_{t,j}$				

***** The level of significance at 10%, ****** The level of significance at 5%, ******* The level of significance at 1%. The values in the parentheses depict the significance value (p).

	R Square	**Adjusted R Square**	**ANOVA**		**Durbin-Watson**
			F	Sig.	
Equation -2	0.814	0.792	38.202	0.000	0.483

As depicted in table -3, the significant results are marked with asterisk. Just like immediate previous model, here also some significant results have found. As presented in table - 3, the coefficient of variables, namely, RDPS, RDPS^2, SIZE, and DRD along with the intercept appear to be statistically significant. It is noticeable that the RDPS and RDPS^2 have maintained the value of coefficient statistically significant before adding control variables. After adding control variables, the statistical significance of coefficient values of RDPS and RDPS^2 has not changed. The negative coefficient value of RDPS^2 confirms non-linear relationship of R&D expenditure with REV, the measure of firm's market position performance. The control variable SIZE which is measured as firm's total asset size has secured statistical significance by its coefficient value at 1% level of significance and so has for the other control variable, DRD, at 5% level of significance.

The adjusted R Square of the equation (2) estimation is 0.792, presenting a very strong degree of explanatory power. This value signifies that REV of the firm can be explained 79.2% by the variables RDPS, RDPS^2, SIZE, and DRD. The value of Durbin-Watson statistic test is 0.483 which is far under the value of 2; like equation (1), it also suggests that there is a positive autocorrelation present in the sample. The whole estimated model for firm's market position performance is significant at 1% level of significance.

At this point, second hypothesis, Hypothesis -2, is confirmed by the significant coefficients of RDPS and RDPS^2 respectively. There exists overriding positive influence of R&D expenditure on firm performance but in a non-linear way, with REV, the measure of firm's market position performance. So, we may conclude that R&D expenditure and firm's revenue growth is not independent. The study findings are consistent with that of VanderPal [21] who has revealed positive linkage between R&D expenditure and firm's revenue growth.

5.1.3 R&D Expenditure on Stock Price (P)

The present study also takes an attempt to examine whether investors value the potential of Bangladeshi pharmaceuticals firm for innovation. The below mentioned equation (3) and equation (4) are the estimated equations for stock price considering the R&D expenditure. These equations also explain firm's performance in the stock market as well. The regression output is summarized in table - 4.

Table -4, Pooled OLS Estimates for Equation (3 & 4)

	Constant	EPSBRD	RDPS	BVPS	DRD
Equation -3	39.645**	17.383***	-161.433*	----------	----------
	(0.016)	(0.000)	(0.048)		
Equation -4	64.857**	21.953***	----------	- 1.127**	-16.376
	(0.006)	(0.000)		(0.008)	(0.427)

Equation -3 $P_{t,j} = 39.645 + 17.383\ EPSBRD_{t,j} - 161.433\ RDPS_{t,j} + e_{t,j}$

Equation -4 $P_{t,j} = 64.857 + 21.953\ EPSBRD_{t,j} - 1.127\ BVPS_{t,j} - 16.376\ DRD_{t,j} + e_{t,j}$

***** The level of significance at 10%, ****** The level of significance at 5%, ******* The level of significance at 1%. The values in the parentheses depict the significance value (p).

	R Square	**Adjusted R Square**	**ANOVA**		**Durbin-Watson**
			F	Sig.	
Equation -3	0.724	0.709	48.462	0.000	0.933
Equation -4	0.749	0.728	35.799	0.000	0.998

It is obvious from the OLS estimation results of equation (3), that the coefficients of variables EPSBRD and RDPS along with the intercept are statistically significant. The level of significance is estimated at 1% and 10% for the coefficients of EPSBRD and RDPS respectively, while 5% statistical significance has found for the coefficient of intercept. The negative sign of RDPS coefficient demonstrates a negative or inverse relation between the innovation input, namely, R&D expenditure and stock price. The Adjusted R^2 of the equation (3) estimation is 0.709, presenting strong degree of explanatory power, while the whole model is significant at 1% level of significance.

The findings of pooled OLS estimation for equation (4) are also presented in table - 4. As depicted in table - 4, the coefficients of variables, namely, EPSBRD, BVPS, as well as the intercept appear to be statistically significant. In this equation an important control variable BVPS is incorporated; this variable is statistically significant at 5% level of significance, however, it adds decrement value to the stock price. The coefficient value of the EPSBRD has not changed despite the introduction of a new variable, BVPS to the equation (4).

The estimate of the DRD dummy variable seems to verify the results of equation (4) estimation. The coefficient amounts -16.376, depicting once more a negative relation between R&D expenditure and stock price. This negative coefficient implies that the higher (above average) the R&D expenditure may be for a firm, the bigger the negative effect may be on its stock price and vice versa, thus depicting a paradox that is not consistent with the previous literature, and also the growth potential that supports R&D as an innovative creator. As a matter of fact, estimation of equation (4) incorporates a new perspective, suggesting that if a firm spends below the average of R&D spending, this will result in an increase of the stock price, implying that investors' perception towards R&D is negatively affected by firm's spending heavily on R&D. The above statement might be invalid because of no statistical significance of DRD coefficient in the equation (4). The adjusted R^2 of the equation (4) is 0.728 slightly improves from the previous equation (3). Like the previous equation, the whole model is significant at 1% level of

significance. The value of Durbin-Watson statistic test for equation (3) and equation (4) is far under the value of 2 suggests that there is a positive autocorrelation present in the sample.

At this point, third hypothesis, Hypothesis -3, is confirmed by the negative significant coefficient of RDPS of equation (3). There exists overriding negative influence of R&D expenditure on the stock price. It can be said that investment of public firms in Bangladesh does not seem to value R&D expenditure as a value creator for both the firm and the economy and seems to believe that future benefits cannot flow towards the firm that invests in innovation.

6 Conclusion

The effects of R&D expenditure on firm performance are often studied in prior studies in the context of USA, European countries, and some time for Indian manufacturing firm as well. But, there is little evidence available for measuring the relationships between R&D expenditure and firm performance in the context of Bangladesh. Moreover, prior studies could not make clear cut demonstration about the relationship between R&D expenditure and firm performance. The aim of present study was very clear, providing an empirical evidence to fill up the gap in the existing literature with the data from Bangladesh. The present study takes an attempt to examine the effects of R&D expenditure on firm performance which has been seen within the purview of firm's financial performance, market position performance, and market based performance. Return on assets (ROA), revenue (REV), and stock price (P) are used to measure the firm performance. The empirical evidence has been done by using both the pooled OLS regression technique and also with a panel data estimation technique. The study analyzed the relative impact of R&D expenditure on firm performance by providing a few paradigms with the presence of some other firm characteristics such as firm size, export intensity, book value per share, EPS before R&D, and also with the inclusion of dummy R&D variable. After controlling the above mentioned firm characteristic variables, the present study finds that R&D expenditure affects the firm performance positively but in a non-linear way, with ROA and REV, those are the measure of firm's financial performance and market position performance respectively. The result is statistically significant and consistent with Beld [20] for Netherland, Belgium, and Luxembourg. On the other hand, the relationship is reversed for firm's market based performance indicating diminishing stock price for the firm against R&D expenditure. This time, the result is also consistent with the study findings of Tahinakis and Samarinas [42] for Greece perspective.

The present study recommends that pharmaceuticals firms should keep proper recording of their R&D expenditure data. This will help the firms to measure future economic benefits associated R&D expenditure and trigger them for rationale allocation of money in R&D segment in future. On the other hand, government of Bangladesh may take a policy and impose it to the firms for the proper recording and discloser of the amount of R&D expenditure to the public.

The present study takes an attempt to give empirical evidence providing the data for a few firms from the pharmaceuticals industry. So a logical extension of this study would collect data for large sample and compare between them. In addition, although this study has controlled a number of firm's specific variables in the equations to explain the firm

performance, it does not claim all the potential variables of firm performance have been controlled. Considering the facts, future research could be done in new aspect taking the data from large sample and incorporating some other potential variables as well as a systematic comparison of high R&D intensive firms and low R&D intensive firms for the pharmaceuticals industry in Bangladesh.

References

[1] Jones, C. I. and Williams, J. C., Too Much of a Good Thing? The Economics of Investment in R&D, *Journal of Economic Growth*, 5 (1), (2000), 65-85.

[2] Lev, B. and Sougiannis, T., The Capitalization, Amortization, and Value-Relevance of R&D, *Journal of Accounting and Economics*, 21, (1996), 107-138.

[3] Damodaran, A., Research and Development Expenses: Implications for Profitability Measurement and Valuation, *NYU Working Paper No. FIN-99-024*, (1999).

[4] Siliverstovs, B. and Kancs, D. A., R&D and Non-linear Productivity Growth of Heterogeneous Firms, *KOF Working Paper No. 315*, (2012).

[5] Deng et al., Science and Technology as Predictors of Stock Performance, *Financial Analysts Journal*, 55 (3), (1999), 20-32.

[6] Sharma, Anurag and Lacey, Nelson, Linking Product Development Outcomes to Market Valuation of the Firm: The Case of the U.S. Pharmaceutical Industry, *Journal of the Academy of Marketing Science*, 21 (5), (2004), 297-308.

[7] Pauwels et al., New Products, Sales Promotions, and Firm Value: The Case of the Automobile Industry, *Journal of Marketing*, 68 (4), (2004), 142-156.

[8] Srinivasan et al., Staying Ahead in the Innovation Race: New-Product Introductions and Relative Firm Value, *Anderson School of Management, University of California, Los Angeles, Working paper*, (2004).

[9] Sorescu, A. B. and Spanjol, J., Innovation's Effect on Firm Value and Risk: Insights from Consumer Packaged Goods, *Journal of Marketing*, 72 (2), (2008), 114-132.

[10] Rust et al., Measuring Marketing Productivity: Current Knowledge and Future Directions, *Journal of Marketing*, 68 (4), (2004), 76-89.

[11] Penrose, Edith T., *The Theory of the Growth of the Firm*, Oxford University Press, New York, USA, 1959.

[12] Morgan, N.A., Slotegraaf R. J., and Vorhies, D.W., Linking Marketing Capabilities with Profit Growth, *International Journal of Research in Marketing*, 26 (4), (2009), 284-293.

[13] McGrath et al., Innovation, Competitive Advantage, and Rent: A Model and Test, *Management Science*, 42 (3), (1996), 389-403.

[14] Srinivasan, S. and Hanssens, D.M., Marketing and Firm Value: Metrics, Methods, Findings, and Future Directions, *Journal of Marketing Research*, 46 (3), (2009), 293-312.

[15] Sougiannis, T., The Accounting Based Valuation of Corporate R&D, *The Accounting Review*, 69 (1), (1994), 44-68.

[16] Megna, P. and Mueller, D., Profit Rates and Intangible Capital, *Review of Economics and Statistics*, 73, (1991), 632-642.

[17] Dave et al., The Impact of Research and Development on the Financial Sustainability of Information Technology (IT) Companies Listed on the S&P 500 Index, *Journal of Sustainable Development*, 6 (11), (2013), 122-138.

[18] Eberhart et al., An Examination of Long-Term Abnormal Stock Returns and Operating Performance Following R&D Increases, *Journal of Finance*, 59 (2), (2004), 623-650.

[19] Ho et al., R&D Investment and Systematic Risk, *Journal of Accounting and Finance*, 44, (2005), 393-418.

[20] Beld, B., The Effects of R&D Investment on Firm Performance, *University of Twente*, (2014).

[21] VanderPal, G. A., Impact of R&D Expenses and Corporate Financial Performance, *Journal of Accounting and Finance*, 15 (7), (2015), 135-149.

[22] Anagnostopoulou, S. C., R&D Expenses and Firm Valuation: A Literature Review. *International Journal of Accounting & Information Management*, 16 (1), (2008), 5-24.

[23] Hall, J., The Stock Market's Valuation of R&D Investments during the 1980s, *American Economic Review*, 83 (2), (1993), 259-264.

[24] Hirschey, M. and Weygandt, J., Amortization Policy for Advertising and Research and Development Expenditures, *Journal of Accounting Research*, 23 (1), (1985), 326-335.

[25] Cockburn, I. and Griliches, Z., Industry Effects and Appropriability Measures in the Stock Market's Valuation of R&D and Patents, *American Economic Review*, 78, (1988), 419-423.

[26] Munari, F. and Oriani, R., Privatization and R&D Performance: An Empirical Analysis Based on Tobin's q, *FEEM Working Paper No. 63,* (2002).

[27] Chung et al., Corporate Governance and Market Valuation of Capital and R&D Investments, *Review of Financial Economics*, 12, (2003), 161-172.

[28] Connolly, R. A. and Hirschey, M., R&D, Market Structures and Profits: A Value Based Approaches, *Review of Economics and Statistics*, 66, (2005), 682-686.

[29] Feng, He. and Rong, C., Innovation, Firm Efficiency and Firm Value: Firm Level Evidence in Japanese Electricity Machinery Industry, *Wireless Communications, Networking And Mobile Computing, International Conference on Sept. 21-25: 4217 - 4220,* (2007).

[30] Bracker, K. and Krishnan, R., Examining the Impact of Research and Development Expenditures on Tobin's Q, *Academy of Strategic Management Journal*, 10 (1), (2011), 63-79.

[31] Hirschey, M., Intangible Capital Aspects of Advertising and R&D Expenditures, *Journal of Industrial Economics*, 30 (4), (1982), 375-390.

[32] Chauvin, K. W. and Hirschey, M., Advertising, R&D Expenditures and the Market Value of the Firm, *Financial Management*, 22 (4), (1993), 128-140.

[33] Duqui et al., An Analysis of the R&D Effect on Stock Returns for European Listed Firms, *European Journal of Scientific Research*, 58 (4), (2011), 482-496.

[34] Chan et al., The Stock Market Valuation of Research and Development Expenditures, Journal of Finance, 56 (6), (2001), 2431-2456.

[35] Pandit et al., The Effect of R&D Inputs and Outputs on the Relation between the Uncertainty of Future Operating Performance and R&D Expenditures, *Journal of Accounting, Auditing & Finance,* 26 (1), (2011), 121-144.

[36] Anagnostopoulou, S. C. and Levis, M., R&D and Performance Persistence: Evidence from the United Kingdom, *The International Journal of Accounting*, 43 (3), (2008), 293-320.

[37] Ehie, I. C. and Olibe, K., The Effect of R&D Investment on Firm Value: An Examination of US Manufacturing and Service Industries, *International Journal of Production Economics*, 128 (1), (2010), 127-135.

[38] García-García, J. and de Magdaleno, M. A., Fair Value on Open Source Business, *XIV Encuentro AECA, Coimbra (Portugal),* (2010).

[39] Chan et al., Corporate Research and Development Expenditures and Share Value, *Journal of Accounting and Economics*, 26, (1990), 255- 276.

[40] Green et al., UK Evidence on the Market Valuation of Research and Development Expenditures, *Journal of Business Finance & Accounting*, 23 (2), (1996), 191-216.

[41] Franzen, L. and Radhakrishnan, S., The Value Relevance of R&D Across Profit and Loss Firms, *Journal of Accounting and Public Policy*, 28 (1), (2009), 16-32.

[42] Tahinakis, P. and Samarinas, M., R&D Expenditures And Investors' Perception For An Input On Innovation Creation And Firm Growth: Empirical Evidence From Athens Stock Exchange, *Journal of Applied Business Research*, 29 (1), (2013), 125-138.

[43] Baltagi, B. H. and Kao, C., Non Stationary Panels, Co integration in Panels and Dynamic Panels: A Survey, *Centre for Policy Research, Maxwell School of Citizenship and Public Affairs, Syracuse University, Working Papers 16,* (2000).

[44] Rahman, M.M., Financial Performance Analysis of Scheduled Commercial Banks in Bangladesh, *Universal Journal of Accounting and Finance,* 4 (5), (2016), 166-184.

[45] Chadha, A. and Oriani, R., R&D Market Value Under Weak Intellectual Property Rights Protection: the Case of India, *Scientometrics*, 82 (1), (2009), 59 - 74.

[46] Bhat, S. and Narayanan, K., Technological Efforts, Firm Size and Exports in the Basic Chemical Industry in India, *Oxford Development Studies*, 37 (2), (2009), 145-169.

[47] Lee, J. and Habte-Giorgis, B., Empirical Approach to the Sequential Relationships between Firm Strategy, Export Activity, and Performance in US Manufacturing Firms, *International Business Review*, 13 (1), (2004), 101-129.

[48] Naik et al., R&D Intensity and Market Valuation of Firm: A Study of R&D Incurring Manufacturing Firms in India, *Journal of Studies in Dynamics and Change (JSDC)*, 1 (7), (2012), 295-308.