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The Impact of Research and Development (R&D) Intensity on Financial Performance and Firm Value: An Empirical Study on Pharmaceutical Companies Listed on Egyptian Stock Exchange

Dr. Dalida Mohamed Adel Eldawayaty[1]

Accounting Lecturer
Faculty of Management Sciences
October University for Modern Sciences and Arts (MSA)

Abstract

This paper examines the relation between Research and Development (R&D) intensity and both of the financial performance and firm value for pharmaceutical companies listed on Egyptian Stock Exchange. Because of the future benefits related to R&D, the researcher examines the relationship between R&D intensity and both of the current and future performance. R&D intensity is measured as the ratio of R&D expenditures to total revenues. The financial performance as a first dependent variable is measured using three accounting-based operating performance measures; Return on asset (ROA), Return on Equity (ROE), and return on sales (ROS). ROA is computed as the ratio of Earnings Before Interest and Tax (EBIT) to total assets; ROE is the ratio of Net income after tax to stockholder equity, and ROS is the ratio of Net income after tax to net sales. With regard to the second dependent variable, firm value, Tobin's Q is used, which is measured by (market value of equity+ book value of liabilities) divided by book value of total assets. Using data of listed pharmaceutical companies on Egyptian stock market for the period between 2000 to 2019, empirical results showed a significant negative relationship between R&D intensity and current performance measured by ROE and ROS, in addition to Tobin's Q. However, the results showed an insignificant negative relation with ROA. On the contrary, Findings indicated a significant positive relationship between R&D intensity and future firm performance measured by ROA only and Tobin's Q, and an insignificant positive relation with ROE and ROS.

Keywords: R&D intensity, Financial performance, firm value, and pharmaceutical industry.

[1] E.mail: dmadel@msa.eun.eg

ملخص البحث

يهدف هذا البحث إلى اختبار العلاقة بين كثافة الاستثمار في البحوث والتطوير وكل من الأداء المالي وقيمة الشركة لشركات الأدوية المقيدة في بورصة الأوراق المالية المصرية. ونظراً لوجود منافع مستقبلية تتعلق بنشاط البحوث والتطوير، فقد قامت الباحثة باختبار العلاقة بين كثافة البحوث والتطوير وكل من الأداء الحالي والمستقبلي. وقد تم قياس كثافة البحوث والتطوير بمعدل نفقات البحوث والتطوير إلى إجمالي الإيرادات. تم قياس الأداء المالي باعتباره المتغير التابع الأول من خلال ثلاثة مقاييس محاسبية هي العائد على الأصول، والعائد على حقوق الملكية، والعائد على المبيعات. وقد تم قياس العائد على الأصول من خلال الدخل قبل الفائدة والضريبة مقسوماً على إجمالي الأصول. كذلك تم قياس العائد على حقوق الملكية من خلال صافي الربح بعد الضرائب مقسوماً على إجمالي حقوق الملكية. وبالنسبة للعائد على المبيعات فقد تم استخدام النسبة بين صافي الربح بعد الضريبة إلى صافي المبيعات. وفيما يتعلق بالمتغير التابع الثاني وهو قيمة الشركة تم قياسه من خلال Tobin's Q (القيمة السوقية لحقوق الملكية + القيمة الدفترية للالتزامات) مقسوماً على القيمة الدفترية لإجمالي الأصول. وباستخدام بيانات شركات الأدوية المقيدة في بورصة الأوراق المالية المصرية في الفترة من ٢٠٠٠ إلى ٢٠١٩، أوضحت النتائج وجود علاقة عكسية ومعنوية بين كثافة البحوث والتطوير والأداء المالي الحالي مقاساً بالعائد على حقوق الملكية والعائد على المبيعات، بالإضافة إلى وجود علاقة عكسية ومعنوية بين كثافة البحوث والتطوير وقيمة الشركة. وبالنسبة للعائد على الأصول كانت العلاقة عكسية ولكنها غير معنوية. وعلى صعيد الأداء المستقبلي، فقد أشارت النتائج إلى وجود علاقة طردية ومعنوية بين كثافة البحوث والتطوير وكل من الأداء المالي مقاساً بالعائد على الأصول وقيمة الشركة، بينما كانت العلاقة بين كثافة البحوث والتطوير وكل من العائد على حقوق الملكية والعائد على المبيعات طردية وغير معنوية.

الكلمات المفتاحية: كثافة الاستثمار في البحوث والتطوير، الأداء المالي، قيمة الشركة، شركات الأدوية.

1. Introduction

Most organizations in modern business environment concentrate on Research and Development (hereafter R&D) activity, as they currently face several critical changes because of the following reasons: the increase of competitiveness; globalization; technological progress; international networks spread; risk increase; the increase of the need to offer new products and services into market; and the fluctuation of demand rates on existing products and services. All of these aspects lead organizations to focus on research and innovation of competitive advantages that distinguish them from others in the market and make them able to continue competing in their business. This can be accomplished by R&D activity.

The company's decision to invest in R&D activity is affected by several factors such as: internal finance and sales; competition in product markets; government policy (such as R&D tax credits and direct subsidies); membership of a research joint venture and cooperation with research centers; human capital embodied in knowledge of workers; and spillovers from foreign R&D (Becker, 2013). Moreover, the company's sources of knowledge affect the investment decision in R&D, that is, the companies that lack internal knowledge sources, such as qualified human resources and cash flow, avoid investment in R&D. While the companies that have internal and external knowledge resources reflected in relations with clients and suppliers, or those that have only internal ones, prefer to invest in R&D (Cuervo-Cazurra and Un, 2010).

Companies who direct their investments to R&D can eventually produce a distinctive product or service, and unusual returns can be reaped from producing this product or service and extensively marketing it. There are a lot of factors related to financial performance improvement under such investments such as: the accounting policy used by the company to treat R&D expenditures; the

company's strategy and its focus on profitability and the increasing market share; success rate in converting R&D efforts into new products or services; and the rapid introduction of those products and services commercially to the markets (Das et al., 2009).

The interest with measurement and disclosure of R&D expenditures has increased, especially expenditures that can be found in financial statements and are subject to auditing by external auditors. This helps in insuring how to treat them and test their impact on firms' value and performance. On the other side, R&D acts as a vital activity especially for life sciences industry, such as chemical and pharmaceutical manufacturing companies, as those companies invest huge amounts of money in R&D activity to discover new medicine and medical tools that achieve future returns (Walther & Strickland, 2002).

To assure the importance of this activity, the professional institutions such as International Accounting Standards Board (IASB) had issued the international accounting standard No. 38 (IAS No.38) for intangible assets[1], where R&D activity is listed among those assets, and its Egyptian amended equivalent number 23 "intangible assets" –Egyptian Accounting Standard (EAS 23) issued by the Financial Regulatory Authority in 2015, as well as Australian accounting standard number 138 (AASB 138) issued by Australian Accounting Standards Board 2015.

[1] The differences in classification of intangible assets generally lead to inconsistencies in treating each category. There are three categories for classifying intangible assets. First category relates to intangible assets owned by the company and makes the presence of a trade market through the value paid for the acquisition of those assets, such as inventions, copyrights, trade name, license, enforceable contracts, and data bases. The second category relates to intangible assets owned by the company and does not have a trade market like R&D expenditures and reputation. The third category relates to intangible assets that are not controlled by the company like intellectual capital which includes three elements: the first element relates to human assets such as knowledge and experience owned by employees and their various competences and skills; the second element relates to organizational assets, like procedures, polices, and computer operating systems; and the third element relates to company association with others like its relation with customers, suppliers, and stakeholders.

Pharmaceutical industries are characterized by high innovation rate, and this sector has assisted in health improvement and diseases elimination over eras. Those organizations face several challenges such as: increase of R&D expenditures on new medicines; increase of competition from new companies; increase of customers' expectations for new effective and low price medicines; increase of specialization rates in these industries; high rate of turnover of qualified resources; high rate of technological complications and change of these techniques; and continuous change of production cycle (Raja & Sambandan, 2015).

Several researchers have focused on the relationship between R&D intensity and performance. For example, Su & Su (2017); Eberhat et al., (2008), and Ali et al., (2012) assured the necessity of the disclosure of R&D activity and the amounts invested in it by business organizations, which positively affects the quality and disclosed information sufficiency to investors, and thus positively affects firm's performance and value as well.

Similarly, as for the relation between R&D intensity and accounting performance, many researches (e.g., Bae et al., 2008; Pandit et al., 2011; Schimke and Brenner, 2014) revealed the existence of a positive relation between R&D intensity and financial performance. While, Wang, (2011) found that this relation is non-linear of three stages, where it is positive at first stage, then it becomes negative because of uncertainty, and then returns to a positive one at the last stage. Also, Aguiar and Gagnepain, (2017) found that there is no relation between R&D intensity and financial performance. On the other side, Vithessonthia and Racela, (2016) found that this relation is negative.

Based on market performance, Conolly and Hirschey, (2005); Ehie and Olibe, (2010); Parcharidis and Varsakelis, (2010); and Gupta et al., (2017) pointed out that there is a positive relationship between R&D intensity and firm

value. On the other side, Kim et al., (2018), and Naik et al., (2012) indicated that relation between R&D and firm value takes U shape. This means that there is a positive relationship between R&D and firm value in specific stage, and then the relation turns to negative one in another stage. On the contrary, Feng and Rong, (2007) investigated this relationship and they found a negative relationship on short term, and a positive one in long run.

Regarding future benefits of R&D, Freihat and Kanakriyah, (2017); Usman et al., (2017), and Alam et al., (2020) conducted studies to test the relation between R&D and firm performance in current period and its future performance. Results suggested a negative relation with current performance and a positive one with future performance.

This paper contributes in narrowing the research gap in Egyptian business market by focusing on theoretical and practical studies that investigated the effect of R&D intensity on financial performance and firm value on listed pharmaceutical companies in Egyptian Stock Exchange. This is due to, the importance of medicine industry sector in Egyptian economy and society on one side. On the other side, R&D activity represents an important and valuable activity for pharmaceutical companies in improving medicines and finding cures to the most challenging diseases.

To achieve the research's aim, a sample of listed pharmaceutical companies in Egyptian stock market between 2000 to 2019 was used. Necessary data needed for the study was obtained from financial statements, complementary clarifications included, and disclosed board of directors' reports about these companies. Regression model results of this study showed a significant negative relationship between R&D intensity and current performance measured by ROE and ROS only, and Tobin's Q, and an insignificant negative relation with ROA. On the contrary, Findings indicated a significant positive relationship

between R&D intensity and future firm performance measured by ROA only and Tobin's Q, and insignificant positive relation with ROE and ROS.

2. Research problem

Nowadays, business organizations are more concerned about R&D investments and their related accounting treatment. Moreover, studying the consequences of those investments on the firm's performance and value in the long run is very important. Taking into consideration the nature of the pharmaceutical sector, the R&D activity is a vital issue for this sector. In addition, the Egyptian pharma market grew at a compound annual growth rate (CAGR) [(2)] of 17 percent between 2011 to 2017 in the Egyptian market (Pharma boardroom, 2019).

As mentioned above, previous studies indicated different directions and effects of R&D intensity on firm value and performance. Consequently, this supports the importance of this study. The study problem can be addressed through the following questions:

- Are pharmaceutical companies listed on Egyptian Stock Market Exchange disclosing R&D expenditures in its financial statements or its board of directors' reports?
- To what extent pharmaceutical companies listed on Egyptian Stock Market Exchange invest in R&D activity?
- Is there an impact for R&D intensity on current financial performance of those companies?
- Does R&D intensity have an effect on current firm value for those companies?

[(2)] The compound annual growth rate (CAGR), is a statistic used to express trends in revenues, or other data over period of time by providing the annualized rate of change between the specific base year amount and the final year amount (Goertz, 2014).

- Is there a positive relationship between R&D intensity and future financial performance of those companies?
- What is the impact of R&D intensity on future firm value of pharmaceutical firms listed on Egyptian Stock Market?

3. Research objective

This research aims to study and investigate the effect of R&D intensity on both financial performance and firm value of the listed pharmaceutical companies in Egyptian stock market. In addition, taking into account the underlying nature of future benefits, the analysis will be expanded to test this effect on future performance and value.

4. Research importance

The importance of this research, academically and practically, arises from its focusing on scientific research, creativity, and testing the reflect of those issues in Egyptian business environment. The competition and technological progress have intensely stressed on firms in general to discover new competitive advantages that distinguish them from other competitors. More specially, pharmaceutical companies face more competition pressure in their industry, whereas R&D activity is an important and vital activity for this sector.

Additionally, the pharmaceutical sector is one of the sectors that currently affects the Egyptian society. At the same context, the Egyptian studies that practically tested the relation between R&D and financial performance and firm value are rare, to the knowledge of the researcher. Thus, the importance of this paper arises from investigating the impact of R&D intensity on short and long run performance for pharmaceutical companies listed in Egyptian stock market.

5. Research plan

In the light of research problem and its aim, the rest of the paper is organized as follows:

6. The theoretical background.
7. Literature review and developing research hypotheses.
8. Research Methodology.
9. The Empirical results.
10. The Conclusions.

6. The theoretical background

This part addresses the definition of R&D and their activity sources as well as challenges affecting investment in R&D, theories related to R&D in pharmaceutical industry, and the accounting treatment of R&D expenditures in this sector.

6.1 Defining R&D.

Financial Accounting Standard Board (FASB) issued in 1974, an accounting standard No. 2 that deals with R&D expenditures. In 2009, the board delegated the Accounting Standards Codification (ASC) to follow up the standard which, in turn, issued standard number 730 (ASC 730), and a definition of R&D that was not differ in both standards (FASB, 2009).

Statement of Financial Accounting Standards (SFAS) No. 2 defines Research as planned search or accurate investigations for discovering new knowledge to acquire future advantages in order to improve product or new service or reach a substantial progress for an existing product or process. As for development, it was defined as translation or alternation of search results or knowledge to a plan, or new product design, or new process or substantial progress of an existing product or service to sell or use. In addition, it includes any basic modifications in design or testing product substitutes or making models or preliminary processes. While,

it excludes routine or periodic improvements to existing products or production lines, or industrial processes or market researches and testing activities [3](FASB, 2010).

Both International Accounting Standard No. 38 (IAS No. 38) and Australian Accounting Standard number 138 (AASB 138) agreed on defining research as an achievement of a plan or critical study that discovers new scientific knowledge. The following are examples of research activities aiming to acquire new knowledge; studies and assessments of final researches or other knowledge results; findings of substitutes for elements, tools, processes, systems, products, or services; and assessment of chosen substitutes for products, processes, new systems, or improving existing ones (AASB 138; p. A1077; IAS 38).

Moreover, both standards agreed on development definition to be an application of search results, plan, or new design for production to discover new products or improve the existing products before making mass. The following are examples of development activities: the design and test of pre-production models and processes; the initial design of tools and new technological processes; the design of a feasibility study for initial producer before commercial production; the testing of final substitutes chosen for products, processes, new systems, or improving existing ones (AASB 138; p. A1077; IAS 38).

[3] The following activities are included among R&D; laboratory tests that aim to discover new knowledge, finding applications to new researches and knowledge results, creating designs for possible products or changing processes, testing substitutes to improve a product or a service, base modification or product or process design, designing, creating, and testing pre-production processes. Also, tools and models design essential for new technology, setting and design preliminary processes for the producer which is un-demanded economically or commercially for the company, engineering activities for product design to reach the desired level for jobs and essential economic requirements for production (FASB, 2010; p.5).

In 2015, Financial Regulatory Authority (FRA) issued Egyptian Accounting Standard No. 23 (ESA 23). This standard is not different from the previous two standards as it defines research as an inspection and a planned study for achieving new scientific or professional knowledge. In addition, it defines development as the application of study results to introduce new or improved production of elements, tools, products, processes, activities, or services before economic production (FRA, 2015).

According to the Organization for Economic, Co-operation and Development- (OECD) report issued in 2015 that deals with integration rules and reporting of research and experimental development data, the report states that research and experimental development include systematic and creative business that increases human knowledge and culture beside the invention of new applications for existing knowledge (OECD, 2015).

Furthermore, the report classified R&D activities into three main elements. The first element is basic research, which includes inspections and studies that are not directed to accomplish determined goal or certain application, but to achieve a new knowledge. The second element is applied research, which is any theoretical or practical business that achieves new knowledge according to results and facts without any usage or practical applications. The third element is experimental development, which includes any systematic business according to searches, practical knowledge, additional knowledge and leads to new products, processes production, or the development of products or existing processes (OECD,2015).

The Federal Acquisition Regulations (FAR), defined basic research as directed efforts that increase knowledge of a certain science. The primary target of basic research is represented in complete knowledge or searches based perception. Applied research represents the efforts following basic research and is attached to

it. Those efforts determine basic scientific discovery or any development in used technology, elements, processes, or tools that contribute to recent science stage development. Development is defined as the systematic usage of scientific knowledge in the designs, tests, products or new services evaluation (existing product or service progress), and it includes engineering design jobs, primary models, and engineering tests, and it excludes subsidiary efforts for sale and finding additional sources for existing product (FAR, 2015).

Likewise, National Science Foundation (NSF) defined research as direct systematic study focused to achieve more integrated new knowledge or understand subject perception. The research is divided into basic research and applied research according to the study sponsor organization. Basic research is a direct systematic study, directed to achieve integrated knowledge or perception of basic characteristics of a certain phenomenon, or noticed facts without any application on products or processes. The applied research is a systematic study aiming at acquiring knowledge and substantial perception in order to assess necessary ways that complete necessary needs. Development is the application of systematic knowledge and pre-perception directed to produce elements or new certain ways of production, and it includes design and development processes for primary models or new processes needed to accomplish needed requirements for development (NSF, 2004).

In the light of previous definitions, there is an agreement on defining research as planned and systematic investigation in order to discover new knowledge in general, while development related to transfer this new knowledge into tangible products or service. However, this new knowledge can be related to new product or service completely or to improve existing products, services or processes.

6-2 Challenges affecting investment in R&D

Investments in R&D are linked with information asymmetry problem compared with other assets, as the R&D projects have unique characteristics for each company. This unique nature affects investors' ability to evaluate expected returns of these investments in comparison with other companies in the market. Moreover, the lack of systematic market for R&D investment negatively affects investors' ability to evaluate expected returns from those investments comparing with other companies on the market. In addition, the nature of accounting treatment of R&D expenditures requires immediate recognition for these expenditures as periodic expenses regardless of financial reporting of the productivity or the value of those investments (Palmon and Yezegel, 2012).

R&D activity is flawed by two important factors that have a negative effect on encouraging companies to invest in this activity. The first factor is the knowledge generated from R&D efforts cannot be kept secret. This cannot prevent other companies from using it. The second factor is spillovers where the companies that invest in R&D usually stimulate other companies internally to take advantage of those investments results which lead companies to minimize investments to defend itself from this effect. Different countries' governments interfere in order to minimize these factors in production by directly supporting R&D activity in companies, giving tax advantages, or encouraging companies to participate in R&D and supporting them to participate in what is known as research joint ventures (RJVs) (Aguiar and Gagnepain, 2017).

It should be noted that recent accounting treatments of intangible assets didn't pay attention to company's value and large differences between book value and market value of owner's equity. Also, financial statements have become less informative of future positions of the company as this information is objective but irrelevant to evaluate company's value. To minimize this gap, intangible

assets must be disclosed. These treatments also lack reflection of this value in balance sheets, but only immediate disclosure of R&D expenditures in income statement, and thus financial statements failed to correctly and fairly disclose the nonfinancial position of the company (Canibano et al., 2000).

6.3Theories related to R&D in pharmaceutical industry

Behavioral theory clarifies the relation between performance level and R&D intensity in general in all industry sectors according to three stages. The first stage compares actual performance with targeted performance; whereas if performance deviation is unfavorable, decision makers increase investment in R&D and accept high level of risk to improve performance. While, the second stage deals with achieving targeted performance, and management prefers to avoid risk, and therfore, it does not invest in R&D. Finally, the third stage concerns with achieving higher levels of performance than targeted ones. Therefore, those companies increase investment in R&D because of having several slack physical and nonphysical resources that can be employed in R&D; the ability to bear high cost for long time until R&D success; and having a high level of experience in risk assessment of R&D because of the previous pioneers' successes in this field (Su and Su, 2017).

Odagiri, (2003) pointed out that both transaction-cost theory and capability theory explain pharmaceutical companies' limits and attitude concerning internal dependence on R&D activity or acquiring external resources for some tasks. As for transaction-cost theory, high level of uncertainty leads to high level of processes complexity and asymmetric information in market which lead to opportunistic attitude of scientific information holders and inability of others to acquire this information. This leads to achieve high returns in the short-run. But in the long run, the information will widely spread among competitors. Pharmaceutical companies generally make a balance between any task and the

decision of buying or producing according to targeted results, which affect their performance.

As for capability theory, each pharmaceutical company's capability differs from the other, and this capability is assessed by its financial and human resources or what is known as Resource-based view. Companies' growth rate is evaluated by its financial and non-financial resources growth, and this growth needs a long period of time to earn this experience. Therefore, those companies can achieve competitive advantages by doing some tasks faster, more efficiently, and with less cost than other companies. While, other companies can get some R&D specialized tasks from outsourcing. Thus, the capability theory explains why some companies purchase R&D tasks externally or acquiring assets and ready technological programs necessary for R&D.

The main motive for pharmaceutical companies to invest in R&D depends on three basic determinants: scope of opportunity cost (the extent of deviation of expected returns for new products compared with the existing alternatives), previous experience of the company in this field, and the competition conditions (McGrath & Nerkar, 2004). Big pharmaceutical companies tend to merge with other companies in order to increase their ability for innovation and production, while small pharmaceutical companies follow these strategies to cover some of their financial problems (Danzon et al., 2007).

Open innovation concept is a new culture in pharmaceutical field, whereas one of the biggest Swedish pharmaceutical company, Eli Lilly, prefers to specialize in some pharmaceutical components, which is the basis for its competitiveness by depending on internal R&D projects. Also, the company temporarily merges with other pharmaceutical companies or other interested parties in order to discover how to deal with environmental updates (Raja & Sambandan, 2015).

Banerjee & Siebert, (2017) noted that early participation in R&D leads companies to accomplish R&D projects and increase medicine presented in market, while companies that are late in participation have a lower number of medicine products than early participants do. Pharmaceutical companies must adjust their special strategies of R&D to increase their values. They showed that the development of pharmaceutical production stages can be presented in seven stages as in table (1):

Table (1) :Drug development phases

Stage	Description
Discovery	Determining targets and used biochemistry technique.
Formulation	Assessing medicine stability level
Lead molecule	Defining lead molecule for improvement.
Preclinical	Experimenting on animals to discover different symptoms.
Phase 1	Practicing on narrow range, studying frequent dosages, assessing ability to bear level, preliminary dosage, increasing dosages, experimenting on volunteers.
Phase 2	Practicing on narrow range, preliminary experiments on patients.
Phase3	Practicing on wide range, assessing medical effects, studying efficiency and safety factors, application on more patients, acquiring legal license from specialized entities.

Source: (Banerjee & Siebert, 2017; p. 1257)

Overall, four relevant strategic R&D decisions can identify the relation between R&D and performance; absorptive capacity, type of R&D, internal organization of R&D activities, and degree of openness in the R&D strategy. Absorptive capacity deals with employees' ability and proficiency to acquire new knowledge and transfer it to the company's experience in R&D field. The second decision related to hierarchical structure of R&D department in the

company where the companies prefer teams' and employee's participation as a whole, but regarding the relation between R&D and performance, it is preferred to be a separate department of R&D, which makes it easier to evaluate its financial outcomes.

The third decision deals with R&D type where the research is accompanied by high level of uncertainty of outcomes. This risk is a market risk related to the extent of market acceptance of the new or developed product. The fourth decision deals with open creativity, as the rising level of complexity of processes, knowledge, and competitiveness lead companies to deal with external environment to enhance the expected returns of R&D (Teirlink, 2017).

6.4 Accounting treatments of R&D expenditures

There are four alternative accounting treatments that deal with R&D expenditures according to SFAS No.2: charge all expenditures to expenses when incurred; capitalize all expenditures when incurred; capitalize expenditures when incurred if specified conditions are fulfilled and charge all other expenditures to expenses; or accumulate all expenditures in a special category until the existence of future benefits can be determined (FASB, 1974).

According to ASC-730, and ASC-350, the accounting treatment of R&D depends upon the nature of the cost. R&D costs incurred in the ordinary course of operations consist of materials, equipment, facilities, personnel, and indirect costs that can be attributed to research or development activities. These costs are expensed in the period in which they are incurred unless they have alternative future uses (FASB, 2017).

According to IAS 38, it differentiates between research phase and development phase. It states that no capitalization arising from research, and all research's expenditures shall be recognized as expenses when they are incurred. The conditions of capitalization of development expenditures can be demonstrated as

the following: the availability of technical feasibility; the presence of intention to complete the intangible asset for purposes of using or selling; the ability of intangible asset to generate economic future benefits can be measurable in the market; and the availability of relevant financial and technical sources to measure those expenditures (IASB, 2016).

Actually, no significant differences exist between American and International accounting standards in this regard. Under both accounting standards, the expenditure of research phase must be recognized as an expenses for the period incurred. While development expenditures may be capitalized if they met some conditions as mentioned before. Table (2) compares between the two accounting issues (Ernest & Young, 2019).

Table (2): Comparison between US GAAP & IFRS

	US GAAP (ASC 730–ASC–350)	**IFRS (IAS 38)**
Research and development expenditures	Research and development expenditures recognized as expenses when incurred, unless the expenditures of items that have future use.	Research expenditures recognized as expenses when incurred. While development expenditures can be capitalized when technical and economic feasibility can be determined on the light of specific conditions, such as: the availability of technical feasibility; the presence of intention to complete the intangible asset for purposes of using or selling; the ability of intangible asset to generate economic future benefits.

Source: (Ernest & Young, 2019, p. 94)

To address the effect of accounting treatment for R&D expenditures, Eberhat et al. (2008) mentioned that capitalization of R&D expenditures gives advantages to owners by increasing operational income, stock returns, and company's value. In addition, Ahmed and Falk (2006) found that companies that capitalize R&D expenditures have higher market share price compared to

companies that expense R&D expenditure. Moreover, Mazzi et al. (2019) found that in countries with high corruption level, managers choose to capitalize R&D expenditures compared to expensed it, and this treatment is reflected on future performance.

At the same context, Ali et al. (2012) analyzed the effect of the accounting treatment for R&D expenditures as period expenses. They found that this treatment affects investors and stock analysts' evaluation for future returns, which leads to lower estimation and lower stock price. Also, Ciftis & Darough (2015) added that the treatment negatively affects financial performance and does not meet the matching principle whereas R&D expenditures are disclosed in current period while their expected returns are in future periods.

Wang et al. (2017) compared between accounting treatments for R&D expenditures as an asset or expenses. Results supported that companies which chose capitalization of R&D expenditures had higher market value, and companies that chose to expense R&D expenditures had higher accounting performance. At the same direction, Wang and Fan (2014), found that firms which select to expense R&D expenditures had lower stock price, and R&D expenditures were negatively related to market value measured by stock price.

7. Literature review and developing research hypotheses

7.1 The relation between R&D intensity and Financial performance

This section presents previous studies that concerned with the relation between R&D intensity and financial performance. Banker et al. (2008); Wang (2011); and Rafiq et al. (2016) focused on testing the relation between the R&D intensity and financial performance in special sectors in many industries. For example, Banker et al. (2008); and Wang (2011) concerned with testing this relation in information technology sector, while Rafiq et al. (2016) aimed at

testing this relation in mining sector. Also, Bhagwat & DeBruine (2011) studied the relation in pharmaceutical, and car sectors, while others, Tyagi & Nauriyal (2016); and Jaisinghani (2016) studied it specially in pharmaceutical sector.

Czarnitzki and Kraft (2006); Lee and Min (2015); and Aguiar & Gagnepain (2017) concentrated on the relation between investment in R&D according to certain characteristics, such as environment based or government supported R&D activities, and financial performance of companies. Lee & Min (2015) studied the relation between investment in green R&D and the financial and environmental performance of companies for a sample of Japanese industrial companies. While, Aguiar & Gagnepain (2017) studied the relation between investment in R&D in companies shared in the European Union program and financial performance of those companies. While, Czarnitzki and Kraft (2006) tested the relation between government supported investments in R&D and financial performance of different German companies between 1994 and 2000.

Lome et al. (2016); and Teirlink (2017) focused on testing the relationship during financial crisis. Lome et al. (2016) studied the effect of intensity in R&D on financial performance during financial crisis using a sample of 247 Norwegian industrial companies between 2004 and 2009. Results showed that companies with more investment in R&D were better in financial performance during the financial crisis. Also, R&D investment was more during the crisis than in other periods. On the same side, Terlinck (2017) studied the effect of R&D on financial performance after the financial crisis in 2009 for a sample of small and medium sized Belgian companies between 2010 and 2014.

As for the results, the previous studies had shown different results. Bae et al. (2008); Pandit et al. (2011); Tubbs (2007); and Lucias et al. (2008) showed the existence of a positive relation between R&D intensity and frms' financial performance, while others Czarnitzki and Kraft (2006); Aguiar & Gagnepain

(2017); and Ahmed et al. (2011) showed that there was no relation between the two variables.

On the contrary, Vithessonthia & Racela (2016) showed a negative relation between the two variables. In the same direction, Wang (2011) showed that the relation between these variables is a non-linear relation passing by three stages, starting by a positive relation, then negative, and finally positive again.

Regarding the measurement of the independent variable R&D intensity, most of studies such as Bae et al. (2008); Lome et al. (2016); and Wang (2011) measured it in a same way by using the rate of R&D expenditures to total sales. While, Vithessonthia and Racela (2016) used the rate of R&D expenditures to total assets. Furthermore, Aguiar and Gagnepain (2017) used the rate of intangible assets to Logarithm of employees' number. The studies of Teirlinck (2017); and Pandit et al. (2011) depended on non-financial measurements such as rate of R&D employees' number to total employees' number, total number of patents for five years, and average adopted innovations for last five years.

In the same context, for financial performance variable measurement as the dependent variable, Wang (2011) used return on equity measured by net income divided by equity. While, Jaisinghani (2016) used return on assets and return on sales, which measured by profit before interest, tax, depreciation and amortization (PBITA) scaled by total assets, and PBITA divided by total sales respectively.

Consequently, there are several methodologies used for studying the relation between R&D and financial performance. Banker et al. (2008); Lome et al. (2016); Falk (2012), and Vithessonthia and Racela (2016) followed an empirical study methodology by using actual data of financial statements and available databases to test the relation. Raja and Sambandan (2015) used a case study methodology on one of the greatest Swedish pharmaceutical company.

From previous analysis, the researcher concludes that some studies (e.g., Bae et al., 2008; Pandit et al., 2011; Tubbs, 2007) focused on empirical testing of the relation between these variables. Many studies (e.g., Pandit et al., 2011; Schimke and Brenner, 2014) found a positive relation between the two variables, while Wang (2011) reached this relation passing through three stages: firstly, positive; then, negative because of uncertainty and finally positive again. On the same side, Aguiar and Gagnepain (2017) did not find a relation between R&D intensity and financial performance. Also, Czarnitzki and Kraft (2006) concluded that there is no relation in industrial companies. On the other side, Vithessonthia and Racela (2016) found a negative relation between the two variables for a sample of non- financial companies listed on US stock exchanges.

Finally, the analysis showed a rare in Egyptian studies- to the knowledge of the researcher- that dealt with R&D intensity and financial performance in particular and the practical testing of this relation depending on actual data of listed pharmaceutical companies in Egyptian stock Exchange in general. This indicates the importance of this paper. Due to the socially and economically importance of pharmaceutical sector in Egyptian environment, and as it is one of the most important sectors that is concerned with R&D activity because of its nature, the researcher sees that it is important to study the relation between R&D intensity and financial performance on that sector, and expects to be a negative relationship between the two variables in pharmaceutical companies; because of accounting treatment for R&D expenditures, which is consided as expenses for the accounting period, which results in a reduction in net income. Therefore, the first three research hypotheses can be derived as follows:

H_1: *R&D intensity is negatively associated with the current firm performance measured by return on assets in pharmaceutical companies listed on the Egyptian Stock Exchange.*

H_2: *R&D intensity is negatively associated with the current firm performance measured by return on equity in pharmaceutical companies listed on the Egyptian Stock Exchange.*

H_3: *R&D intensity is negatively associated with the current firm performance measured by return on sales in pharmaceutical companies listed on the Egyptian Stock Exchange.*

7.2 The relation between R&D intensity and firm value

This section focuses on relation between R&D intensity and firm value measured by Tobin's Q as an indicator for market performance. Connolly and Hirschey (2005); and Ehie and Olibe (2010) focused on testing the impact of R&D investments on firm value. According to Connolly and Hirschey (2005), they examined the relation between R&D and Tobin's Q for a sample of American companies for five years. The results showed that R&D has a positive effect on Tobin's Q in large firms more than in small firms. Furthermore, Ehie and Olibe (2010) tested the same relation in US companies for 18 years specially before and after 11, September, 2001. They found R&D positively affects firm performance for US firms, and R&D in manufacturing firms was more positively related to firm market value than service firms pre 11, September.

At the same direction, Hughes (2008) examined the relation using 8,559 observations for UK firms from 1994 to 2005. He found a positive relationship between R&D and firm value, and that companies may use dividends to announce about companies' future profitability. Moreover, Asthaan and Zhang (2006) pointed out that R&D intensity are positively correlated with firm performance measured by abnormal earnings.

Parcharidis and Varsakelis (2010) found positive relationship between R&D and Tobin's Q which was higher in small firms in Athens stock market. In addition, Gupta et al. (2017) investigated that relation using sample of companies from 75 countries covering the period from 2004–2013. Their findings suggested that firms in developing countries in low competitive conditions had higher positive impact for R&D on firm value. While firms in the developed countries had a positive relationship between the two variables for all level of competition.

On the other direction, Kim et al. (2018) evaluated relation between R&D and firm value using sample of 563 Chinese companies for the period from 2005 to 2013. The findings indicated that the relation takes a U-shape. It means that there is a positive relationship between R&D and firm value in a specific stage, and then the relation turns to negative in other stage. Also, Naik et al. (2012) previously conducted a study on Indian manufacturing companies for the period 2001- 2010 to evaluate the relation between R&D and market performance measured by Tobin's Q. their findings presented a U-shape relationship between the two variables.

In addition, Sofronas et al. (2019) conducted study to examine the relation between R&D and market value measured by Tobin's Q, using a sample of 133 European firms covering period from 2002 to 2012. Their results didn't support strongly the positive relation between the two variables and they varied according to countries and samples. Another study was conducted by Bracker and Krishnan (2011) that examined the effect of R&D intensity on Tobin's Q. They found that the relation is curvilinear, and there are specific variables such as firm size, growth rate, and manufacturing sector that have a significant impact on this relation.

On the contrary, Feng and Rong (2007) investigated the relation between R&D intensity and firm performance in Japanese electricity firms for the period

from 2000 to 2005. Results suggested the existence of negative relationship between R&D and firm performance measured by Tobin's Q on the short run, and positive in long run.

At the same manner, the researcher expects a negative relationship between R&D intensity and firm value in pharmaceutical companies listed on Egyptian stock market. This is due to accounting treatment of R&D expenditures, which is considered as expenses for the accounting period, and that results lead to reduction in net income, and in turn reduces firm value. Thus, the fourth hypotheses can be derived as follows:

H_4: *R&D intensity is negatively associated with current firm value measured by Tobin's Q in pharmaceutical companies listed on The Egyptian Stock Exchange.*

7.3The relation between R&D intensity and future performance

Taking into consideration the future benefits of R&D intensity, Pandit et al. (2009) pointed out that R&D benefits are gained in the future. They hypothesized that positively relationship between R&D and performance depends on stability of future performance, productivity, and quality of firm's patents. They used average net income or cash flow for future five years. Results presented a positive relation between R&D and the variability of future earnings. This means that companies that have a productive R&D showed greater and stable future performance.

Consequently, Tong and Zhang (2014) believed that R&D activities generate their benefits in the future. Therefore, they tested the relation between R&D and firm performance using sample of 1,027 firms listed on Compustat database for the period from 1998 to 2006. They used sum of adjusted earnings per share (EPS) for next five years of analysts' forecasts as a proxy for expected

future cash flow. The study found that firms with more R&D expenditures had higher future cash flows.

At the same direction, Freihat and Kanakriyah (2017) conducted a study that investigate the relation between R&D and performance of Jordanian pharmaceutical companies listed on the Amman Stock Exchange during period 2006 - 2015. According to the future benefits of R&D, the researchers collected data for R&D in previous year from 2006-2010, and from 2011-2015 for performance data. Results indicated a significant positive relationship between R&D and performance measured by return on assets, return on equity, and earnings per share. In addition, Parcharidis and Varsakelis (2007) conducted a study on a sample of computer and manufacturing firms listed on Athens stock market during 1995 to 2000. They pointed out that the relation between R&D and firm performance is negative, and it showed strong positive relation after two years of incurring R&D expenditures.

Moreover, Usman et al. (2017) evaluated the relationship between R&D and firm value in seven developed countries; France, Canada, UK, USA, Germany, Japan and Italy. They used accounting and market measures to evaluate firm performance. Return on assets and cash flow on operating revenue had been used as accounting measures, and Tobin's Q and market capitalization measured by outstanding shares× market price per share as a market measure. They used three level of R&D, current expenditure, one year lagged, and two years lagged. Results suggested that the same period R&D had a negative impact on accounting performance and positive one on market performance. On the other side, for one year lagged, R&D had a positive relationship with both of accounting and market performance. Finally, two years lagged R&D didn't have any impact on both performance measures.

Alam et al. (2020) hypothesized that there is negative relationship between R&D and current performance, and positive relationship between R&D and future performance. Firm performance is measured by return on assets and return on invested capital and they used three years lag for future performance. By using a sample consists of 423 firms from 12 emerging countries, their findings supported their hypotheses. In addition, the level of investor protection is more important than governance mechanisms in enhancing the relation between R&D and performance. At the same context, Mazzi et al. (2019) used the time lag of five years for future earnings and they found a positive relationship between R&D and firm performance.

With regard to the future benefits of R&D intensity, the researcher will test the relation between R&D intensity and Future performance, whereas it is expected to be positive. Following previous literature (e.g., Alam et al., 2020; Tong and Zhang, 2014), these relationships can be expressed in the following hypotheses:

H_5: *R&D intensity is positively associated with future financial performance measured by return on assets in pharmaceutical companies listed on The Egyptian Stock Exchange.*

H_6: *R&D intensity is positively associated with future financial performance measured by return on equity in pharmaceutical companies listed on The Egyptian Stock Exchange.*

H_7: *R&D intensity is positively associated with future financial performance measured by return on sales in pharmaceutical companies listed on The Egyptian Stock Exchange.*

H8: R&D intensity is positively associated with future firm value measured by Tobin's Q in pharmaceutical companies listed on The Egyptian Stock Exchange.

8.Research methodology

This section describes the empirical study methodology used to test the research hypotheses. Therefore, it will be presented as follows; the empirical study purpose, study sample and population, methods and procedures, variables measurement.

8.1 Empirical study purpose

The empirical study aims to investigate R&D intensity impact as an independent variable on two dependent variables financial performance and firm value using data of pharmaceutical companies listed on the Egyptian Exchange.

8.2 Study sample and population

The study population consists of listed companies in the Egyptian stock exchange. The study sample consists of all pharmaceutical companies listed on it. The researcher collected data on corporate R&D expenditures and other variables from the disclosure database such as mubasher misr [4] site, companies' sites, and company annual reports (separate and (or) consolidated financial statements and board of directors reports). The researcher used a sample consists of 13 Egyptians pharmaceutical companies, which are identified through the Egyptian stock exchange database for the years 2000 through 2019. The researcher focused on pharmaceutical firms as these firms are supposed to invest most heavily in R&D. Firms which don't disclose R&D expenditures were excluded. The initial sample consists of 88 observations. Certain observations are deleted because of existence of loss for repeated years and negative equity. The final sample for current performance consists of 72 observations. Table (3) presents the pharmaceutical companies listed in the Egyptian stock exchange. It shows that only 6 companies disclose R&D expenditure from total of 13

[4] www.mubasher.info

companies (46%). Based on future performance, the sample size was reduced to 45 observations because of unavailability of data.

Table (3): Pharmaceutical companies listed on the Egyptian stock exchange

Company name	R&D Disclosure
1-Alexandria Pharmaceuticals	√
2-Arab Drug company (ADCO)	√
3-Kahira pharmaceuticals	√
4-Egyptian International Pharmaceutical Industries Co. (EIPICO)	X
5-Glaxo Smithkline	X
6-Memphis Pharmaceutical	√
7-Mina Pharmaceutical	√
8-Nile Pharmaceutical	√
9-October Pharma	X
10-Riva Pharma	X
11-Sabaa International Company for pharmaceutical and chemical Industries	X
12-Ibnsina Pharma	X
13-DBK Pharma	X

8.3 Methods and procedures

As the objective of this research is to study the effect of R&D intensity on firm financial performance and firm value for pharmaceutical firms listed on Egyptian Stock Exchange, the researcher estimated the following regression models:

Model one: The regression model for the relation between R&D intensity and current return on assets (ROA).

$$\mathbf{ROA = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model two: The regression model for the relation between R&D intensity and current return on equity (ROE).

$$\mathbf{ROE = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model three: The regression model for the relation between R&D intensity and current return on sales (ROS).

$$\mathbf{ROS = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model four: The regression model for the relation between R&D intensity and current firm value (Tobin's Q).

$$\mathbf{Tobin's\ Q = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model five: The regression model for the relation between R&D intensity and future return on assets (ROA).

$$\mathbf{ROA_{(F)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model six: The regression model for the relation between R&D intensity and future return on equity (ROE).

$$\mathbf{ROE_{(F)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model seven: The regression model for the relation between R&D intensity and future return on sales (ROS).

$$\mathbf{ROS_{(F)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Model eight: The regression model for the relation between R&D intensity and future firm value (Tobin's Q).

$$\mathbf{Tobin's\ Q_{(F)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon}$$

Whereas:

β_0: Constant

β_1: β_7= coefficients of the regression variables.

ε = error term

X_1: X_7 = regression variables will be explained in the following section.

8.4 Variables Measurement

According to research hypotheses, there are three major variables: R&D intensity as an independent variable and firm financial performance as the first dependent variable and firm value the second dependent variable. R&D intensity (X_1) is measured as the ratio of R&D expenditure to total revenue as used in previous studies (e.g., Banker et al., 2008; Bae et al., 2008; Zhang et al., 2014; Lome et al., 2016). The researcher expects to have a negative relation with firm current performance.

This research employs two based performance measures, accounting based measures and market based measure. The first dependent variable is measured by using three accounting-based operating performance measures—return on asset (ROA), return on equity (ROE), and return on sales (ROS) to proxy for firm financial performance. ROA is computed as the ratio of earnings before interest and tax to total assets; ROE is the ratio of net income after tax to equity, and ROS is the ratio of net income after tax to net sales (e.g., Bae et al., 2008; Vithessonthia and Racela, 2016). On the other hand, the second dependent variable is firm value measured by Tobin's Q which is used as market based measure, and it is calculated as (market value of equity + book value of liabilities)/ total assets (Gupta et al., 2017). The market value of equity is calculated using stock price on the 90th day (after the firm's fiscal year end and financial statements had been audited by external auditors) × number of stocks at that date (Ahmed and Falk, 2006).

In line with prior studies (e.g., Tubbs, 2007; Rafiq et al.,2016), the researcher used six control variables. The first one – financial leverage (X_2) - which is computed as the ratio of total debt to total assets (e.g., Vithessonthia and Racela, 2016: Zhang et al., 2014), and the researcher expects to have a negative relation with financial performance, and Tobin's Q. The second is the fixed asset ratio (X_3), which is computed as the ratio of property, plant, and equipment to total assets (Vithessonthia and Racela, 2016), and is expected to have a positive relation with performance as a whole. The third –selling and administrative

expenses ratio (X_4)- which is computed as the ratio of total selling and administrative expenses to total net sales (e.g., Bae et al., 2008; Tyagi & Nauriyal, 2016), which is estimated to have a negative relation with performance as expenses reduce profit. Pindado et al. (2010) pointed out that some firm characteristics such as firm size, market share, and firm growth affect positively relation between R&D and firm value. On contrary, other characteristics like capital intensity, financial leverage, and free cash flows negatively affect that relation.

Consistent with the literature, the researcher includes sales growth rate (X_5) which is calculated as the total net sales in year t minus the total net sales in year $t-1$ divided by the total net sales in year $t-1$ (e.g., Ciftci & Darrough, 2015). This ratio indicates the stability increase of revenue, therefore, it is predicted to have a positive relation with performance. The sixth control variable is firm size (X_6), which is measured as the logarithm of firm's total assets (e.g., Bae et al., 2008; Rafiq et al., 2016). The last control variable is the firm's age (X_7) which is defined as the number of years elapsed since the firm was first incorporated (e.g., Tubbs, 2007). Both of big and old firms have the capability to achieve more profits compared to small firms, and it is expected that the two variables have a positive relation with financial performance and firm value. Table (4) presents research's variables measurement as follows:

Table (4):Variables measurement

Variables	Measurements	References
R&D intensity (X_1)	Ratio of R&D expenditure to total revenue	(Banker et al., 2008;Lome et al., 2016).
Financial leverage (X_2)	Ratio of total debts to total assets	(Vithessonthia and Racela, 2016: Zhang et al., 2014).
fixed asset ratio (X_3)	Ratio of property, plant, and	(Vithessonthia and Racela,

	equipment to total assets	2016).
Selling and administrative expenses ratio (X_4)	Ratio of selling and administrative expenses to total net sales	(Tyagi & Nauriyal, 2016)
Sales growth rate (X_5)	Total net sales for year *t* minus total net sales for year $_{t-1}$, divided by the total net sales for year $_{t-1}$	(Ciftci & Darrough, 2015).
Firm size (X_6)	Logarithm of firm's total assets	(Bae et al., 2008; Rafiq et al.,2016).
Firm's age (X_7)	Number of years elapsed since the firm was first incorporated	(Tubbs, 2007)
Return on assets- ROA	Earnings before interest and tax (EBIT)/ total assets	(Jaisinghani, 2016)
Return on equity- ROE	Net income/ total equity	(Wang, 2011)
Return on sales- ROS	Net income/ total net sales	(Jaisinghani, 2016)
Tobin's Q	(Market value of equity + book value of liabilities)/ total assets	(Gupta et al., 2017).

Taking into account the underlying nature of future benefits of R&D, the researcher followed (Pandit et al., 2009; Tong and Zhang, 2014) in taking a time lag of five years to measure the benefits of R&D expenditures. Thus, to measure future performance, the researcher used current R&D expenditures in year $_t$, and ROA $_{(F)}$, ROE $_{(F)}$, ROs $_{(F)}$, Tobin's Q $_{(F)}$, for year $_{t+5}$, whereas F refers to future time lag of five years t+5.

9.Empirical results

9.1 Descriptive statistical for research variables related to the current performance

Table (5) shows descriptive statistics for research variables related to regression model values for the current performance. It includes the mean for all sample observations in addition to standard deviation, and the minimum and maximum amounts. Results show that R&D intensity's mean amounted to about 2.4% of total sales, and its minimum and maximum to some extent equal 0.1% and 6% respectively. Those values show that pharmaceutical companies listed on Egyptian stock exchange don't have large investment in R&D. In addition, the standard deviation equals 1.4% which shows homogeneous values between sample observations.

Table (5):Descriptive statistics results for current performance

	Mean	Std. Deviation	Minimum	Maximum
R&D intensity	.023701	.0141958	.00111	.06148
Financial leverage	.38722	.1395017	.0488210	.66186
Fixed assets ratio	.155322	.066094	.008660	.290026
Selling & administrative ratio	.147056	.035142	.0209144	.23430
Sales growth ratio	.113936	.119251	-.144363	.589755
Firm size	8.65551	.297082	8.176850	9.45190
Firm age	41.57	10.320	21	56
ROA	.139458	.069814	.0077063	.347784
ROE	.163742	.0885210	.0036017	.445088
ROS	.123032	.0582911	.00185255	.221249
Tobin's Q	1.03229	.3382948	.4870366	2.210209
Number of observations	72			

Moreover, the table clarifies data related to mean, minimum, maximum, and standard deviation for all control variables and dependent variable measures. For example, the mean for some control variables such as Financial leverage is approximately 39%. The ratio of fixed assets to total assets was approximately 16%, which indicates the importance of current assets in this sector. In addition, the percentage of selling and administrative expenses to net sales was with average 15% for the total sample, and the value of Maximum and minimum was 23%, and 2% respectively, with standard deviation equals 3.5%.

On the other side, For the dependent variables as shown in table (5); the first measurement of financial performance was ROA, whereas its mean was 14%, and its maximum and minimum values were 35% and 0.8 %, which reflects different level of financial performance with a standard deviation equals 7%. While ROE average was 16%, and maximum and minimum values were 45% and 0.4% respectively, and standard deviation equal .09. Regarding to ROS, its mean, maximum, and minimum are; 12%, 22%, and 0.2%, and standard deviation .06. Finally, Tobin's Q mean is 1, and its maximum, minimum, and standard deviation are; 2.2, .49, and .34 consistently.

9.2 Correlations results for research variables related to the current performance

Pearson Correlation is used as a parametric test to measure correlation relation between research variables using SPSS version 15 to proceed required statistical analysis for actual data collected from financial reports of research samples companies. As reported in table (6) there is significant correlation between R&D intensity and both of return on equity and return on sales. In addition, R&D intensity has a significant correlation with some control variables such as: financial leverage, fixed assets ratio, firm size, and firm age.

Table (6) :Correlation matrix for the current performance

Variables	ROA	ROE	ROS	Tobin's Q	X_1 R&D Int.	X_2 F-LEV	X_3 Fixed ratio	X_4 S&A Ratio	X_5 Sales growth	X_6 F- size	X_7 F-Age
ROA	1				-.179	-.149	-.058	-.567**	.105	-.229	.055
ROE	.722**	1			-.309**	.052	-.022	-.506**	.003	-.292*	.128
ROS	.697**	.785**	1		-.437**	-.324**	-.170	-.511**	-.071	-.302**	.118
Tobin's Q	.081	.332**	.198	1	-.064	.371**	.239*	-.225	.197	.018	-.325**
X_1 R&D Int.					1						
X_2 F-LEV					.309**	1					
X_3 Fixed ratio					.341**	.178	1				
X_4 S&A Ratio					.070	-.030	.406**	1			
X_5 Sales growth					.148	.193	-.239*	-.362**	1		
X_6 F- size					.247*	.294*	-.520**	-.306**	.495**	1	
X_7 F-Age					-.258**	-.451**	.080	.166	-.250*	-.463**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

9.3 Regression models results for the current performance

Multiple regression using ordinary least square method is used to test research hypotheses and show the independent variable impact on dependent variables for the research sample. Table (7) indicates the model validity to present the relationship between first dependent variable (ROA) and the independent variable and control variables. F-test was used to identify significance level of the model as a whole, which reflects that the model is significant whereas the P. Value of the model as a whole is less than 5%, and this means that the linear regression model is relevant to present a relation between dependent variable and explanatory variables. The results indicated that P. Value for the first model is 0.000.

Table (7) also shows that the explanatory power (adjusted R^2) is 46% for the first model, which means that independent variable and control variables explain 46% of changes in the dependent variable ROA. Moreover, the calculated F value is 9.691 with a high significance level where as P. Value, less than 5%.

The second model shows the regression relationship between second dependent variable (ROE) and independent variable and control variables. F-test of the model is significant where P. Value is 0.00 (less than 5%), and F value is 11.436. Similarly, adjusted R^2 for the second model is approximately 51%, which indicates to that the independent variable and control variables interpret 51% of ROE changes.

Table (7): Regression results coefficients' values and significances for impact on current performance

Variables	Model one -ROA			Model two -ROE			Model three- ROS			Model four- Tobin's Q		
	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF
R&D intensity	-.031	.780	1.577	-.214	.045	1.577	-.251	.013	1.577	-.393	.002	1.577
Financial leverage	-.075	.476	1.464	.272	.009	1.464	-.189	.051	1.464	.232	.048	1.464
Fixed assets ratio	.020	.884	2.460	.012	.927	2.460	-.022	.860	2.460	.528	.001	2.460
S&A ratio	-.673	.000	1.328	-.644	.000	1.328	-.615	.000	1.328	-.296	.009	1.328
Sales growth ratio	.105	.318	1.437	.009	.931	1.437	-.050	.596	1.437	.146	.207	1.437
Firm size	-.481	.001	2.756	-.476	.001	2.756	-.422	.002	2.756	.039	.807	2.756
Firm age	-.072	.500	1.499	.084	.414	1.499	-.136	.162	1.499	-.261	.029	1.499
Sig.(p-value)	.000			.000			.000			.000		
Adjusted R^2	.461			.507			.561			.355		
F	9.691			11.436			13.961			6.577		

With regard to third model, the model is significant, whereas its p. value equals .000, and F value is 13.961. In addition, adjusted R^2 for the third model is 56%, which indicates to that the independent variable and the control variables explain 56% of ROS changes.

Finally, fourth model as shown above is significant, whereas p. value equals .000, and F value is 6.577. In addition, adjusted R^2 for the model is approximately 36%, which indicates that the independent variable and the control variables cause 36% of changes in Tobin's Q.

As reported in table (7) there isn't a multi-collinearity problem between independent variable and other control variables. This was shown by the value of The Variance Inflation Factor (VIF) that does not exceed 10.

For the first hypothesis which tests the relation between R&D intensity and ROA, it is rejected because p. value for the X_1 is 0.780 (greater than 0.05), and coefficient of beta equals (-.031) which indicates an insignificant negative relationship between the two variables, and this leads to reject the first hypothesis.

According to relation between control variables and ROA, as shown from table (7), there is a significant negative relationship between both of S&A ratio and firm size and ROA, and this is unexpected. On the other side, there is an insignificant positive relationship between both of fixed assets ratio and sales growth ratio and ROA, which matches with expected sign. Moreover, there is an insignificant negative relationship between financial leverage and firm age and dependent variable ROA.

Results for second regression model as shown in table (7), show a significant negative relationship between R&D intensity (X_1) and ROE, where its p. value equals .045, and the coefficient of beta equals (-.214). This supports the second hypothesis, and therefore the second hypothesis is accepted.

For the relation between control variables and ROE, there is a significant positive relationship between ROE and financial leverage. While there is a significant negative relationship between ROE and both of S&A expresses ratio,

and firm size, which supports prior estimation. At the same context, there are insignificant positive relationship between ROE and fixed assets ratio, sales growth ratio, and firm age.

For the third hypothesis, there is a significant negative relationship between R&D intensity (X_1) and ROS, where its p. value equals .013, and the coefficient of beta equals (-.251). This supports the third hypothesis, and leads to accept it.

Both of S&A ratio and firm size has a significant negative relationship with ROS. At the same direction, there are insignificant negative relationship among ROS and each of; Financial leverage, fixed assets ratio, sales growth ratio, and firm age.

Finally, for the fourth hypothesis, there is a significant negative relationship between R&D intensity (X_1) and Tobin's Q, where its p. value equals .002, and the coefficient of Beta is (-.393), as shown in table (7). This result supports the fourth hypothesis, and it is accepted.

Both of financial leverage and fixed assets ratio has a significant positive relationship with Tobin's Q. On the other direction, both of S&A ratio and firm age has a significant negative relationship with Tobin's Q. In addition, there is an insignificant positive relationship between Tobin's Q and both of sales growth ratio and firm size.

9.4 Descriptive statistical results for future performance

For analyzing the effect of R&D intensity on future performance and firm value. Following Pandit et al. (2009), They used average net income and cash flow for future five years. In addition, Tong and Zhang (2014) used sum of adjusted earnings per share (EPS) for next five years of analysts' forecasts as a proxy for expected future cash flow related to R&D expenditures. Moreover, Freihat and Kanakriyah (2017) used data for R&D expenditures during period

2006 – 2015, and from 2011-2015 for performance data. Mazzi et al. (2019) used the time lag of five years for future earnings and they obtained a positive relationship between R&D and firm performance.

Table (8) reports descriptive statistics for regression model for performance after five years. Results show that there are smaller changes in values of mean, maximum, minimum, and standard deviation for all variables after reducing number of observations to 45, because of the unavailability of data.

Table (8): Descriptive statistics results for the future performance

	Mean	**Std. Deviation**	**Minimum**	**Maximum**
R&D intensity	.020689	.013773	.00111	.06148
Financial leverage	.38130	.150763	.0488210	.61851
Fixed assets ratio	.16859	.06469	.008660	.28442
Selling & administrative ratio	.15089	.030216	.102517	.23164
Sales growth ratio	.086349	.09046	-.0482286	.3971811
Firm size	8.556650	.2239412	8.176850	8.98652
Firm age	40.04	9.568	21	51
$ROA_{(F)}$	.143633	.0725568	.0077063	.347784
$ROE_{(F)}$	.157043	.0716208	.0402011	.302568
$ROS_{(F)}$	.1154850	.05505933	.0208835	.221249
Tobin's $Q_{(F)}$	.9014283	.2079983	.4889019	1.5297700
Number of observations	45			

9.5 Correlations results for the future performance

As reported in table (9) there is insignificant correlation between R&D intensity and all measurements of the future performance. In addition, R&D

intensity has a significant positive correlation with other control variables such as: financial leverage, fixed assets ratio, and firm age.

Table (9):Correlation matrix for future performance

Variables	$ROA_{(F)}$	$ROE_{(F)}$	$ROS_{(F)}$	Tobin's $Q_{(F)}$	X_1 R&D Int.	X_2 F-LEV	X_3 Fixed ratio	X_4 S&A Ratio	X_5 Sales growth	X_6 F-size	X_7 F-Age
$ROA_{(F)}$	1				-.242	-.162	-.011	-.053	.170	-.369*	.132
$ROE_{(F)}$	.806**	1			-.054	-.152	-.035	-.068	.139	-.559**	.345*
$ROS_{(F)}$	.679**	.864**	1		-.228	-.210	-.217	-.312*	-.188	-.471**	.303*
Tobin's $Q_{(F)}$	.429**	.503**	.380**	1	.198	.251	-.142	-.340*	.107	-.014	-.108
X_1 R&D Int.					1						
X_2 F-LEV					.388**	1					
X_3 Fixed ratio					.481**	.493**	1				
X_4 S&A Ratio					.045	-.018	.298*	1			
X_5 Sales growth					.304	.167	.086	-.043	1		
X_6 F- size					.201	.128	-.301*	-.257	.409**	1	
X_7 F-Age					-.368*	-.332*	-.016	352*	-.531**	-.602**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Regarding the dependent variables, $ROA_{(F)}$ has a significant negative correlation with firm size. Future return on equity and return on sales have a significant correlation with firm size, firm age and return on assets.

9.6 Regression models results for the future performance

Regression results, for the future performance of the four models are presented in table (10) reports the significance of all those models whereas values of adjusted R^2 are 44.1%, 36.3%, 43.9%, and 24.7% respectively.

Regarding the relation between R&D intensity and $ROA_{(F)}$, table (10) indicates a significant positive relationship, which means that the relation between the two variables is converted significantly from negative to positive when performance after five years is used. This result supports that the expected

benefits from R&D investment are gained in the future periods. This indicates that the fifth hypothesis is accepted.

For the control variables, results show significant negative relationship between each of fixed assets ratio and firm size and future ROA, and a significant positive relationship between sales growth ratio and ROA, which matches the expected relation.

Table (10):Regression results coefficients' values and their significances for impact on future performance

Variables	Model one –$ROA_{(F)}$			Model two –$ROE_{(F)}$			Model three– $ROS_{(F)}$			Model four– Tobin's $Q_{(F)}$		
	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF
R&D intensity	.575	.000	1.652	.272	.087	1.652	.111	.448	1.652	.405	.021	1.652
Financial leverage	-.098	.439	1.586	.040	.794	1.586	.046	.746	1.586	.398	.021	1.586
Fixed assets ratio	-.443	.013	2.281	-.362	.054	2.281	-.380	.032	2.281	-.568	.007	2.281
S&A ratio	-.170	.0196	1.319	-.221	.118	1.319	-.434	.002	1.319	-.325	.037	1.319
Sales growth ratio	.4194	.004	1.503	.198	.187	1.503	.158	.261	1.503	.188	.249	1.503
Firm size	-.734	.000	2.040	-.753	.000	2.040	-.682	.000	2.040	-.392	.043	2.040
Firm age	.144	.412	2.367	.179	.340	2.367	.179	.310	2.367	.142	.485	2.367
Sig (p-value)	.000			.001			.000			.012		
Adjusted R^2	.441			.363			.439			.247		
F	5.967			4.581			5.915			3.063		

As it is noticed from table (10), the relation between R&D intensity and ROE is insignificant (p. value greater than 5%), but it turned to a positive relationship. This leads to reject the sixth hypothesis. For the control variables, firm size is the only variable which has a significant negative relationship with $ROE_{(F)}$.

At the same context, there is an insignificant positive relationship between R&D intensity and $ROS_{(F)}$ (p. value greater than 5%), and this relationship

turned to be positive compared with the current performance model. The researcher believes that insignificancy in the relation may be due to the small size of the sample after five years compared to sample in the initial analysis. This results may be changed if the sample increases or profit in this sector increases. In the light of this result, the seventh hypothesis is rejected.

In addition, there is a significant negative relationship between each of following control variables; fixed assets ratio, S&A ratio, and firm size and dependent variable $ROS_{(F)}$.

For the firm value, results show a significant positive relationship between R&D intensity and firm value. This means that the relation between the two variables becomes positive when the company gains benefits from R&D in the future. So, the eighth hypothesis is accepted. In addition, there is a significant positive relationship between financial leverage and Tobin's $Q_{(F)}$. While there is a significant negative relationship between Tobin's $Q_{(F)}$ and three control variables; fixed assets ratio, S&A ratio, and firm size.

The researcher concludes from analyzing results of current and future performance that the accounting treatment of R&D cost that considers it as expenses when it occurs negatively affects financial performance, and results assured that issue in pharmaceutical companies listed on Egyptian stock market. In general, R&D activity gains its benefits in the future, and this leads to not achieving matching accounting principle. Table (11) summarize results of test of the hypotheses.

Table (11):Summary of test of the research hypotheses

Hypothesis	Results	
	Current performance	Future performance
H_1	Rejected	
H_2	Accepted	
H_3	Accepted	
H_4	Accepted	
H_5		Accepted
H_6		Rejected
H_7		Rejected
H_8		Accepted

9.7 Additional analysis

To test the robustness of previous results, and to make sure that five years lagged is a sufficient time that reflect the future benefits of R&D, the researcher replicates the main regression analysis for four years lagged. Table (12) shows regression results, and it shows an insignificance for the first model and significance for the other three models. The explanatory power for the first model is smaller (adjusted R^2) is 9.6%. While the adjusted R^2 for the remain models are 37.4%, 46.6%, and 17.7% respectively.

Table (12):Regression coefficients' values and significances for four years lagged

Variables	ROA model			ROE model			ROS model			Tobin's Q model		
	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF	Coefficient (Beta)	P. Value	VIF
R&D intensity	.172	.326	1.664	.015	.915	1.664	-.104	.438	1.664	-.030	.859	1.664
Financial leverage	.161	.345	1.562	.258	.072	1.562	.076	.559	1.562	.360	.030	1.562
Fixed assets ratio	-.253	.221	2.292	-.247	.153	2.292	-.183	.250	2.292	-.184	.349	2.292
S&A ratio	-.134	.409	1.430	-.346	.013	1.430	-.550	.000	1.430	-.328	.699	1.430
Sales growth ratio	.071	.672	1.510	.178	.202	1.510	.054	.676	1.510	.386	.662	1.510
Firm size	-.574	.005	2.080	-.638	.000	2.080	-.511	.001	2.080	-.338	.481	2.080
Firm age	-.079	.705	2.389	.280	.113	2.389	.238	.144	2.389	.114	.419	2.389
Sig (p-value)	.121			.000			.000			.028		
Adjusted R^2	.096			.374			.466			.177		
F	1.760			5.267			7.228			2.533		

For ROA model, the relation between R&D intensity and ROA is insignificant, but it becomes positive. Results elaborate that there are insignificant relationships between all control variables (except firm size) and ROA. Firm size has negative significant relationship with ROA.

Regarding the ROE model, there is insignificant relationship between R&D intensity and ROE, and it turned to be positive too. As reported in table (12), there is a negative significant relationship of both S&A ratio, and firm size with ROE. Similarly, for ROS model, there is insignificant relationship between R&D intensity and ROS, and it is still negative. According to other control variables, there is a negative significant relationship of both S&A ratio, and firm size with ROS, while insignificant relationship with the remain of the control variables.

Finally, the relationship between R&D intensity and Tobin's Q is insignificant and remains negative. While there is a positive significant relation between financial leverage, and sales growth ratio with Tobin's Q. For the other control variables, the relations are insignificant.

The pervious additional analysis supports results from testing relation between R&D intensity and both current performance and future performance lagged by five years.

10. Conclusion

This study aimed to investigate the effect of regression model R&D intensity on financial performance and firm value using all listed pharmaceutical companies listed in Egyptian stock exchange that reported R&D expenditures in their financial statements for the period 2000-2019. Findings suggest that the effect of R&D intensity on financial performance (measured by ROE and ROS), and firm value (measured by Tobin's Q) is negative in the current period, and becomes positive specially for ROA and Tobin's Q in the future performance.

Additionally, empirical results report that the average of R&D intensity in pharmaceutical sector in Egyptian market is 2.4%, and this matches the average rate in developing countries like Indian pharmaceutical of 1.8% as reported by (Jaisinghani, 2016). According to the time lag for R&D's future benefits, Usman et al., (2017) mentioned that the positive relation between R&D and performance occurred after one year lagged in developed country like USA, UK, and France. Paracharids and Varsakelis, (2007) found positive relation between the two variables after two years in Athens stock market. In Middle East, Freihat and Kanakriyah, (2017), found positive relationship between the two variables in Jordanian pharmaceutical companies using five years' time lagged, which matches the findings of current study.

Moreover, this paper contributes to the academic literature by highlighting the importance of innovation and R&D activity in Egyptian business environment in general, and specifically in pharmaceutical sector. Beyond this academic contribution, results support that the accounting treatment of R&D

expenditures as period expenses negatively affects financial performance and firm value in current period. But taking into consideration future benefits of R&D, this relation becomes positive on the long- run.

In accordance to these results, it is recommended for companies to make more disclosure about R&D expenditures in financial statements in most Egyptian industrial sector, number of patents, announcements of new products and services, separate item about revenues earned from those new products and patents, success rate of R&D activity, and which of R&D costs will be capitalized as intangible assets. This will aid researchers to conduct more accurate studies and getting robust findings for these relationships.

As is the case with each study, the current study has also many limitations. The main limitation is that data is limited to pharmaceutical firms, and this leads to focusing on one industrial sector instead of all manufacturing sectors, in addition to concentrating on specific period from 2000 to 2019, and using small sample size. Another limitation related to using time lagged of five years, which may lead to different results in other sectors or when using different sample size.

The above limitations can provide future directions and certain extensions for future research. Future study can be done on another Egyptian industrial sector, using larger sample size. Another future study can be conducted by investigating factors that interact with R&D activity and firm performance. Moreover, some future papers can be done as a comparative study between Egyptian firms and firms in other countries in emerging economies. Also, a lot of studies can be performed using different methodologies.

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