

The Relationship between Investment in Innovation and the Performance of companies According to the Activity Sector

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Abstract:- The research article consists of analyzing the relationship between investment in innovation and the performance of companies depending on the activity sector. Different studies in the specialty literature have demonstrated that investments in innovation influence the performance of companies depending on the activity sector. In some sectors of activity the relationship between investment in innovation and performance is stronger, while in others the strength of the relationship between the two is weaker.

The purpose of the article is to study the relationship between investment in innovation and performance depending on the activity sector. The study was carried out on the basis of data from the EU Industrial Research and Development Investment Scoreboard 2020, using data from 198 companies over a 7-year period, between 2014-2020. The research method used for data analysis is correlation analysis and regression analysis performed using the SPSS statistical program. The research results demonstrate that investments in innovation influence the performance of companies differently depending on the activity sector.

JEL classification: M41, M00, M21, O16

Keywords:- Investment in innovation; intangible assets; research and development; operating profit; sectors; correlations, impact.

I. INTRODUCTION

The ability of companies to invest in innovation, in the conditions of maintaining and increasing performance, represents a challenge of the current economic system, investors being the most exposed to investment risk, because the results of the research expenses carried out by a company are uncertain, there is a risk that they not produce economic benefits or even not have a research result.

The topic addressed is a topical one, considering the increasingly frequent innovations appearing in the production process and the accelerating pace of replacement of the labor force in the primary execution area of companies, in order to increase productivity and optimize production costs, being an intensively debated and tested topic in the specialized literature by authors both from the economic field and from other fields.

Both the investments in research and development and the performance indicators of the companies are decisive factors in the economic and social life of the company, therefore the economic environment in an increasingly accelerated evolution forces the companies to changes both in their internal structure and and how to record and report accounting information.

Social responsibility and care for the environment are requirements imposed on large companies in order to have a positive image on the market. An increasingly accelerated trend of companies is that of investments in research and development, which are an important indicator in attracting investors and in the development of companies.

Investments in innovation can take many forms, from classic research expenditures, to intellectual property rights and improved employee skills. However, the way of registering and evaluating them at the enterprise level falls under the responsibility of accounting, which has the role of establishing the most appropriate evaluation method and obtaining a value that reflects the economic reality, taking into account both the immediate benefits of innovation, as well as the future benefits it could bring to the company.

Referring to the future economic benefits, we can say that they materialize in revenues for the company, which will later affect the accounting result and implicitly the fiscal result of the entity, so they have as their final objective the achievement of a performance. This can be of a financial nature, as it leads to obtaining profit, as well as of a non-financial nature, as it contributes to the efficiency of the activity, to the creation of a competitive advantage and to a good image in society.

II. LITERATURE REVIEW

An intensely debated topic in the specialized literature is represented by the time duration of the innovation process - financial performance, the question being asked:

How long will investments in research and development produce economic benefits?

Andries and Faems (2013, pp. 1092) state that their study generated rich insights into the short-term implications of patenting and licensing performance on financial performance. The authors acknowledge that the time frame over which the study was conducted, namely 2002-2004, is too short to fully understand the long-term

effects of patenting activities on financial performance indicators.

By exploring the links between patenting activities, licensing performance, innovation performance and financial performance, this study provides valuable insights into the potential benefits and costs of patenting for both SMEs and large companies.

Chen et al. (2019, pp. 2390) state that investments in research and development at the level of companies have a positive impact on financial performance, but not in the same year in which they were made, but in the long term.

It was also found that company size is positively correlated with business performance, that is, the larger the company size, the greater the investment in research and development, which in turn leads to more sophisticated technologies and profitable results, forming a positive and continuous cycle.

Both production process innovation and marketing innovation influence product innovation, having an impact on market performance which in turn has influence on financial performance. Several studies support the effect of investment in innovation on social and environmental performance.

The general problem that arises is how long the company can sustain all this investment until it gets a profit from it. At the level of large companies, the volume of investments in innovation is higher because they have financial resources that can support expenses throughout the entire course of an innovation project. A study carried out by Pece, Oros and Salisteanu (2015, pp. 466) in Central and Eastern Europe quantifies innovation, through variables such as the number of patents, the number of trademarks and the research and development expenditure of the respective countries.

The authors claim that investments in technology and research and development expenditures are the prerequisites for ensuring competitiveness and progress, and through them sustainable economic growth is ensured. The results of the study demonstrated a positive link between economic growth and investment in innovation. It was thus also concluded that foreign direct investment has a major impact on economic growth through the transfer of knowledge and the improvement of technological processes.

Furthermore, the results highlighted that education and human capital have a positive and strong impact on economic growth. The study by Pala (2019, pp. 1124) investigates the impact of investment in innovation on economic growth in 25 developing countries, over the period 1996 - 2016.

The results of the study differed from one country to another, with investments in research and development having a negative effect on economic growth in several countries. The number of researchers had a significant and negative effect on economic growth in countries such as

Iran, Mexico, Tunisia, and Uzbekistan, and a positive effect in Ukraine, Turkey, Russia, and China.

Maradana et al. (2017, pp. 20) examine the long-term relationship between investment in innovation and economic growth per capita in 19 European countries over the period 1989-2014. The study provides evidence of a long-term relationship between innovation and per capita economic growth, finding the presence of both unidirectional and bidirectional causality between innovation and per capita economic growth.

Six different indicators of innovation are used in the study: the number of patents from residents, the number of patents from non-residents, R&D expenditure, researchers in R&D activities, high-tech exports and the number of journal articles scientific and technical. From the results of the study, it was found that all innovation indicators used are significantly related to economic growth per capita.

III. RESEARCH METHODOLOGY

The study is carried out starting from a sample of 198 companies from the European Union over a period of 7 years, namely the period 2014 – 2020.

The data required for the study were collected using two distinct databases, as follows: the company's sales, operating profit, research and development expenses, capital investment and average number of employees were collected from the industrial research and development investment dashboard from the EU.

Intangible assets, goodwill, total assets, net profit and equity were collected from the reuters.com website, information provided free of charge by the platform.

The methodology of data collection, selection and processing consisted of downloading them from the Economics of Industrial Research and Innovation (IRI) database, as well as manually collecting data from the reuters.com website of several indicators from the annual financial statements, which are not found in the initially specified database.

The first criterion by which the data sample was drawn was according to the R&D expenditure recorded in each consecutive year.

After selecting the companies from the first database, manual data collection followed from the reuters.com website, where data related to publicly listed companies were available.

After manual data collection, a sample of 198 companies was obtained over a period of 7 years, between 2014 and 2020.

In order to test the relationship between investments in innovation and the financial performance of companies, several indicators were selected in order to reflect both the performance of the companies and their investments in innovation. The variables selected to test the relationship

between investment in innovation and performance are presented in TABLE I

Variables	Symbol	Database	Unit
performance indicators			
Net sales	NS	IRI	mil. eur
Operational profit	OP	IRI	mil. eur
innovation indicators			
Research and development expenditure	RD	IRI	mil. eur
Goodwill	GW	REUTERS	mil. eur
Intangible assets	IA	REUTERS	mil. eur

Table 1: Variables used in the study

The sums related to the indicators collected from the first database are reflected in millions of euros, this being the measure kept for the absolute sum interpretation of the values from the regression models. The values taken from the reuters.com website are also expressed in other currencies, not only in euros, thus, in order to have the same unit of measure, we converted these values, from the related currency to euros, at the exchange rate of on the date of publication of the financial statements of each company.

A. Statistical method used

Analysis of the link between investment in innovation and performance in each sector of activity The link between investment in innovation and the performance of companies is conditioned by the sector of activity in which the company operates.

Some sectors of activity, due to the specifics of the market and the company's operating structure, companies periodically invest in research - development activity to maintain their competitive advantage and the attention of investors.

In this paragraph, the link between investments in innovation and the performance of companies is analyzed by means of correlation analysis, repectively regression analysis, which are presented next.

The statistical research in this paragraph was carried out in two steps, as follows:

- **Correlation analysis** – verifying the link between the innovation indicators and the variables considered influencing factors, using the Pearson correlation coefficient. Correlation analysis was performed using the statistical program SPSS version 15.0., using the Analyze menu, the Correlate command, the Bivariate option, checking the Pearson coefficient, the significance threshold being Two-tailed, selecting to display Means and standard deviations.
- **Regression analysis** - using the Analyze menu, the Regression command, Linear variant, the necessary testing was performed in order to obtain the regression equation. In the dashboard, the FORWARD method was chosen, thus obtaining relevant econometric models to quantify the influence of innovation investments on performance.

By applying the two statistical methods, we aim to obtain results regarding the link between investment in innovation and the performance of companies in each activity sector.

The research hypotheses to be tested by applying the two statistical methods are the following:

H_1 .The intensity of the influence of investment in innovation on performance is different depending on the activity sector.

H_2 .Sectors of activity with a higher research expenditure intensity show stronger correlations between investment in innovation and performance.

To ensure a better understanding of the content of this paragraph, the activity sectors have been ranked according to the intensity of innovation, presented in the previous paragraph.

Innovation is seen in numerous specialized studies as an effective method for improving the performance of a company depending on the sector in which it operates.

Starting from this idea, the research work aims to determine the nature of the inter correlation between the innovation activity of the companies and their performance level, how they can influence the position of the companies and to what extent the influence of innovation on the company is conditioned by the activity sector.

In order to achieve the objectives, empirical studies conducted at the level of different sectors were analyzed, studies that highlighted the existence of a positive intercorrelation between innovation activity and the level of performance of companies, with significant differences depending on the type of innovation used and the activity sector (Nica , Stancu and Stancu, 2016, p.325) In the present paragraph, the sectors of activity in which the companies operate are addressed, thus analyzing the intensity of the connection between investment in innovation and the performance of companies in ten sectors of activity.

Investments in innovation are different depending on the activity sector in which the company operates, and therefore the link between them and performance was analyzed. In order to reduce the workload and to obtain as homogeneous data samples as possible, we grouped the industries into activity sectors and thus their number was

reduced from 31 industries to ten sectors, which are present in TABLE II.

SECTOR		INDUSTRY	NUMBER OF COMPANIES
Telecommunications services	1	Fixed Line Telecommunications	6
	2	Media	
	3	Mobile Telecommunications	
Discretionary goods	4	Automobiles & Parts	14
	5	Household Goods & Home Construction	
Basic products	6	Beverages	14
	7	Food & Drug Retailers	
	8	Food Producers	
	9	Personal Goods	
Energy	10	Alternative Energy	6
	11	Oil & Gas Producers	
Financial	12	Banks	9
	13	Financial Services	
Health	14	Health Care Equipment & Services	27
	15	Pharmaceuticals & Biotechnology	
Industry	16	Aerospace & Defence	43
	17	General Industrials	
	18	Industrial Engineering	
	19	Industrial Transportation	
Information technology	20	Electronic & Electrical Equipment	45
	21	Software & Computer Services	
	22	Support Services	
	23	Technology Hardware & Equipment	
Materials	24	Chemicals	26
	25	Construction & Materials	
	26	Forestry & Paper	
	27	Industrial Metals & Mining	
	28	Mining	
Utilities	29	Electricity	8
	30	Gas, Water & Multiutilities	
	31	Oil Equipment, Services & Distribution	
TOTAL			198

Table 2: Distribution matrix of companies according to activity sector

Industries were grouped into sectors according to the Global Industry Classification Standard (GICS). This is a method of assigning companies to a specific economic sector and industrial group that best defines its business operations.

It is a system used by investors, analysts and economists to compare competing companies.

B. Analysis of research and development expenditure intensity

In order to determine the intensity of research and development expenses, the average of research and development expenses was reported to the average of sales for each activity sector.

T The intensity of research and development expenses in 2020

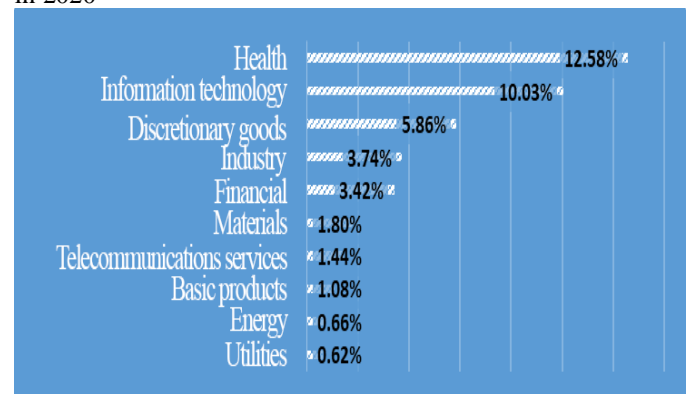


Fig. 1: The intensity of research and development expenses in 2020

As can be seen in fig. 1, the highest share of the intensity of research and development expenses is found in the health sector (12.58%), pharmaceutical companies having very large research and development budgets. Medical technology research and development is responding with new products and services to the ever-changing healthcare landscape, especially due to the COVID-19 pandemic. Investments in research and development open up new vistas of innovation by broadly searching for ideas that can be implemented in the healthcare industry. Collaboration between governments, companies, universities and investors is a necessary feature for these new perspectives to succeed.

In second place in terms of investments in research is the information technology sector, with a weight of 10.03%. The growth of companies in the technology sector is based on the exploitation of innovative products and services, thus forcing them to invest heavily in research and development. (Lantz and Sahut, 2005, p.1).

In third place is the discretionary goods sector with a research intensity of 5.86%. Traditional approaches are increasingly ineffective as automakers face the challenge of designing and developing electric vehicles. In the face of an industry downturn, the effort is to reduce costs and improve efficiency at all levels, which requires substantial investment in research and development.

The fourth place is occupied by the industrial sector with an intensity of research and development expenses of 3.74%. Although all industries develop new products and methods of reaching customers, industrial companies rely on industrial research and development projects to produce new products or improve existing ones.

In fifth place we have the financial sector with an intensity of investments in research and development of 3.42%. Existing banking products are becoming obsolete at a very fast pace as new technologies are being developed at an accelerated pace. Keeping up with technology in this sector requires constant investment and product updates, requiring a research and development department.

IT systems developed in the financial services sector are known to have complex technological requirements, especially when it comes to data security, high volume transaction processing, scalability and regulatory compliance, all of which require specialized support.

The sixth place is occupied by the materials sector with a weight of 1.80%. From metallic materials to mineral or inorganic materials, plastics and ceramics, the materials sector is ubiquitous. Substantial improvement in the performance of products in this sector often requires the

development and adoption of new materials. Research is quite intense in this field because it also aims at innovative processes for obtaining the desired characteristics of the developed materials.

Seventh place is occupied by the telecommunications services sector with an intensity of research and development expenditures of 1.44%.

According to TIA, investment in telecommunications research benefits the wider economy. Advances in telecommunications are dramatically transforming the way people live, work, learn, communicate and conduct business, and long-term research is essential to ensure that these transformations serve human needs, are productive for society and sustainable in the long term.

In eighth place we find the basic products sector with an intensity of 1.08%.

These companies must constantly invest in research and development to keep up with changing customer preferences and fend off competition. Incumbents are under attack from all sides as companies create unique products that resonate with modern consumers.

The energy sector and the utilities sector register the lowest research investment intensity of 0.66% and 0.62%, respectively. Energy is the basis of any economic activity and therefore the basis of the economic development of countries. According to economists, the increase in energy demand of countries is a sign of economic development, hence the constant effort to increase its production (Guzowska, et al. 2021, p. 16).

Major international oil companies see research and development as the key factor in securing a future in oil and gas, especially in a resource-constrained environment.

After analyzing the data, we can say that the intensity of research and development expenses is higher in the health sector and in the IT sector, compared to the rest of the sectors, these being the sectors with the highest intensity.

In TABLE III and TABLE IV, the results of the correlation analysis and those of the regression analysis are centralized in order to determine the type of impact of innovation on the performance of the companies. In order to test the hypothesis that the intensity of the influence of investment in innovation on performance is different depending on the activity sector, it was necessary to determine a total score of the impact of innovation on performance.

	SECTORS	RD		IA		GW	
		R*	β^{**}	R*	β^{**}	R*	β^{**}
NS	HEALTH	0.8685	1.033	0.2361	-	0.191	-
	IT	0.8158	2.806	0.0255	-	0.0916	-
	DISCRETIONARY GOODS	0.9910	20.432	0.9321	-1.806	0.6694	0.856
	INDUSTRY	0.7059	4.237	0.4483	-1.143	0.7333	0.902
	FINANCIAL	0.9322	12.658	0.6337	1.414	0.8663	0.683
	MATERIALS	0.6660	-	0.4344	-	0.5954	-
	TELECOMUNICATIONS	0.1229	-19.392	0.9719	-	0.45	0.726
	BASIC PRODUCTS	0.1869	-	0.6675	-	0.583	-0.185
	ENERGY	0.2018	-	0.0548	-	0.1601	8.071
UTILITIES	0.7498	-	0.2508	-	0.4825	1.861	

Table 3: Centralization of the results obtained from the correlation analysis and the regression analysis for the net sales variable

where:

* R represents the correlation coefficient;

** β represents the regression coefficient.

	SECTORS	RD		IA		GW	
		R*	β^{**}	R*	β^{**}	R*	β^{**}
OP	HEALTH	0.542	-	0.0861	-	0.0903	-
	IT	0.648	-	0.012	-	0.0834	-
	DISCRETIONARY GOODS	0.822	-	0.7213	-	0.4736	-
	INDUSTRY	0.552	-	0.5846	0.172	0.6584	-
	FINANCIAL	0.451	-2.597	0.1348	-	0.7711	0.514
	MATERIALS	0.562	0.765	0.4318	-	0.5792	0.118
	TELECOMUNICATIONS	0.236	-	0.9681	0.061	0.5214	-
	BASIC PRODUCTS	0.179	-	0.9057	0.215	0.8254	-0.041
	ENERGY	0.271	-	-0.019	0.089	-0.024	-
UTILITIES	0.784	-	0.1162	-	0.1065	-	

Table 4: Centralization of the results obtained from the correlation analysis and the regression analysis for the operating profit variable

where:

* R represents the correlation coefficient;

** β represents the regression coefficient.

In order to determine this score, it was essential to develop a calculation methodology, which is presented in the following.

In table V, the methodology for calculating the score was elaborated, with value ranges adapted to the values resulting from the correlation analysis being defined.

The data needed to determine the score related to the correlation analysis were taken from TABLE III and TABLE IV.

0	<	R	\leq	0.333	1
0.333	<	R	\leq	0.666	2
		R	>	0.666	3
		R	=	0	0

Table 5: Scoring methodology for correlation analysis

Table VI present the score calculation methodologies related to the results of the regression analysis, value ranges being established according to the values obtained in TABLE III and TABLE IV.

0	<	β	\leq	0.75	1
0.75	<	β	\leq	1.5	2
		β	>	1.5	3
		β	=	0	0

Table 6: Scoring methodology for regression analysis

The calculation formulas used to determine the score are as follows:

$$S_R = R_{RD} + R_{IA} + R_{GW}$$

$$S_\beta = \beta_{RD} + \beta_{IA} + \beta_{GW}$$

$$S = S_R + S_\beta$$

where:

R_{RD} = the correlation coefficient related to research and development expenses;

R_{IA} = the correlation coefficient related to intangible assets;

R_{GW} = the correlation coefficient related to goodwill;

β_{RD} = the regression coefficient related to research and development expenses;

β_{IA} = the regression coefficient related to intangible assets;

β_{GW} = the regression coefficient related to goodwill;

S_R = correlation score;

S_β = regression score;

S = total score.

SECTOARE	SCOR	IMPACT TYPE
DISCRETIONARY GOODS	25	STRONG
INDUSTRY	23	
FINANCIAL	23	
TELECOMUNICATIONS	17	MEDIUM
ENERGY	17	
MATERIALS	15	
BASIC PRODUCTS	15	
UTILITIES	15	
IT	12	LOW
HEALTH	11	

Table 7: The type of impact of innovation intensity according to the obtained score

From the data obtained in TABLE VII, innovation intensity scores were obtained, these being divided into sectors with low impact, sectors with medium impact and sectors with high impact. As can be seen in table 5.48, the intensity of the influence of innovation on performance is different in each activity sector, in the discretionary goods sector, the industrial sector and the financial sector, investment in innovation presents the strongest intensity, having a score between 23 and 25 points.

SECTORS	INTENSITY	SCORE
DISCRETIONARY GOODS	5.86%	17
INDUSTRY	3.74%	14
FINANCIAL	3.42%	14
ENERGY	0.66%	14
BASIC PRODUCTS	1.08%	13
MATERIALS	1.80%	12
TELECOMUNICATIONS	1.44%	12
UTILITIES	0.62%	11
HEALTH	12.58%	9
IT	10.03%	9

Table 8: Correlation analysis score results by business sector

In the telecommunications, energy, materials, commodities and utilities sector, we find a medium impact of innovation investment intensity.

IV. RESEARCH RESULTS

At the level of the activity sectors, innovation, although it is an investment present in each sector, it presents different intensities, depending on the particularities of the activity sector. The sector with the highest intensity of research and development expenses is that of health, where research expenses with the highest share in sales are recorded. The particularity of this sector consists in the fact that any pharmaceutical product that appears on the market goes through a process of research, development and testing, all these expenses being carried out from the research and development budget of the companies and supported by the revenues generated by the operational activity.

In the health and IT sectors, R&D spending has a higher share of sales, thus they experience a higher intensity of innovation. It is thus demonstrated that innovation has a positive impact, both on sales and on operating profit, in each sector of activity, statistical significance being present only on certain indicators of innovation and performance, but at the level of each sector of activity it was proven that investments in innovation activity influence the performance of companies.

Following the performance of this total score of innovation investment intensity, we can conclude that hypothesis H_{1} , according to which the intensity of innovation investment influence on performance is different depending on the activity sector, is accepted, innovation investment having a different intensity of influence on performance from one activity sector to another.

Analyzing the impact of investments in innovation on the performance of companies is a complex process, as there are many factors that can influence the performance of a company, both from the company's internal environment and factors from its external environment. In the analysis of the correlation between investments in innovation and the performance of companies, we find that the sectors of activity that present a high intensity of research and development expenses do not present a higher degree of correlation, therefore the hypothesis H_{2} , according to which the sectors of activity, with a higher intensity of research expenditure, shows stronger correlations between investment in innovation and performance, is rejected.

V. CONCLUSIONS

In a business environment characterized by continuous innovation, companies are required to make investments in innovation to stay in the market and maintain performance growth.

Growth performance is a goal of large, publicly traded companies, and those that fail to sustain continuous growth are taxed by shareholders and investors.

The scientific approach carried out, through the present case study, results in the validation of the existence of the relationship between investments in innovation and performance, both by validating the existence of the correlation and the impact between the two. Also, the results are extended from the general analysis of all companies to a detailed analysis according to the sectors of activity. Following this approach, the differences between the activity sectors are highlighted and the hypotheses regarding the link between the intensity of innovation and its impact on performance are tested.

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