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Analysis of the Link Between Investment in Innovation and the Performance of Companies in the European Union

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Abstract:- Along with the evolution of technology, the need for continuous innovation has become a topic of great interest for companies, this being a key point, both in the struggle for competition and survival on the market, and from the desire of the managers, of the respective companies, to obtain increased financial performance, thus causing them to adapt to new conditions through continuous innovation, which is based on investments. The understanding of the diversity of definitions given to the term innovation is a very broad one in the scientific literature, being both modern and classic authors who define innovation in different ways. In the literature review, the common point of the understanding of innovation is change, which takes place continuously and unceasingly, leading to new results, creating new needs, and as a consequence, new markets for the products and services resulting from the change process. The research paper consists of analyzing the relationship between investments in innovation and the performance of companies in the European Union. The research method used involves panel data analysis, applied to sample data, determined using the EViews statistical program. The scientific approach carried out has as its objective the desire to highlight the link between the investments made by the companies for innovation and the performances obtained by them, following the investments, from a financial-accounting perspective. The research results indicate that investments in innovation have a positive impact on the performance of companies making such investments.

Keywords:- *Investment in innovation; intangible assets; research and development; operating profit; sales; goodwill*

JEL classification: *M41, M00, M21, O16.*

I. INTRODUCTION

The ability of companies to invest in innovation, in terms of maintaining and increasing performance, represents a challenge of the current economic system, investors being the most exposed to the 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 starting point of the research consists in discovering a result regarding how the innovation efforts carried out by the companies lead to an increase in their performance, as well as how both innovation and performance are viewed from the perspective of the companies.

Both investments in innovation and performance indicators of companies are decisive factors in the economic-social life of the company, therefore the economic environment in an increasingly accelerated evolution forces companies to make changes both in their internal structure and the way of recording and reporting accounting information.

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, we can say that they have as the final objective the achievement of performance.

II. LITERATURE REVIEW

Traditionally, land, labor and capital have been considered the most valuable assets in the economy, thus conventional physical assets have been considered the main determinants of the performance of any economic activity.

Investments in innovation can be considered expenditures on new technologies and knowledge that can influence the economic and stock market performance of companies. Research and development activities, both external and internal, are widely recognized as the engine of technological progress, and the level of growth in research and development expenditure is considered to be a reliable indicator of innovative capacity (Martin and Nguyen-Thi 2015, p. 1108).

Ahangar (2011, p. 90) provides further insight into the role played by intellectual capital in organizational performance, the performance indicators used in his study being profitability, employee productivity and sales growth. The study demonstrated the impact of intellectual capital, consisting of human capital and the structural capital and physical capital of the company, on performance. Also, the

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results of the study indicated that the relationship between intellectual capital, company profitability, employee productivity and sales growth is strong.

Sardo and Serrasqueiro (2018, pp. 6) analyze the influence of intellectual capital on the financial performance of small and medium-sized hotel companies, for the period 2004 - 2015. The data sample used is 934 small and medium-sized Portuguese hotel companies, and the results of the study demonstrate the positive influence of intellectual capital on the financial performance of hotels. Survival in market competition and long-term development of hotel companies is ensured by constant investment in intellectual capital and its effective management.

Romero et al. (2017, p. 10) analyzes the relationship between innovation obtained through outsourcing and performance, as well as the complementary role played by intellectual capital within companies. Based on a survey of 8,973 Spanish manufacturing companies, the results showed that outsourcing innovation, both strategically and financially, favors performance, as measured by the number of patents obtained by companies. To improve its financial performance, a company should first make investments in innovation, those made in intellectual capital being decisive for overcoming challenges in the economic environment.

Gunday et al. (2011, p. 27) analyze the relationship between product, process, organizational and marketing innovation and the financial performance obtained from them, in a study applied to 184 companies in Turkey, active in the manufacturing industry. In their study, innovative performance plays a mediating role between innovation activities and financial performance. Empirical research has established that corporate research and developement is strongly associated with earnings following productivity growth as well as earnings due to stock price growth. When companies invest in internal research and development, they engage in a learning and adaptation process that will allow them to acquire the ability to recognize the value of new information, assimilate it and apply it for commercial purposes (Dindaroğlu and Takim 2013, p. 28). The authors state that innovation is one of the fundamental tools of growth and new market entry strategies to increase existing market share and provide the company with a competitive advantage.

Carol and Marvis (2007, pp. 115) examine the relationship between different types of innovation and financial performance in Taiwanese small and medium-sized enterprises in the manufacturing and service sectors. According to them, several researchers noted that SMEs are often more advantageous than large companies in terms of innovation activities, as they present advantages such as flexibility and speed of response to market changes.

Porter and Stern (2001, pp. 28) argue that companies should be able to create and commercialize a stream of new products and production processes that push the frontier of technology while staying several steps ahead of their rivals.

Due to the inherent uncertainty of innovation projects, such efforts must first lead to effective innovation results before they can contribute to a company's financial performance. The results show that efforts to invest in innovation have a positive and significant influence on innovation outcomes.

III. RESEARCH METODOLOGY

The statistical research approach started from the analysis of the methods used in the specialized literature, being selected an appropriate method for the realization of this study. In order to analyze the data both from one company to another and from one year to another, correlation analysis was applied, using the Pearson correlation coefficient, as well as regression analysis, using panel data. Baltagi in 2005, in his work entitled Econometric Analysis of Panel Data states that unlike the usual regression model, panel data show the evolution over time of some characteristics of individuals.

A. *Defining research hypotheses*

Referring to the fact that investments in innovation are recorded in the accounting as expenses in the year in which they occur, it is self-evident that the company's profit may be reduced by carrying out more research and development expenses. To test the relationship between innovation investments and companies' performance, the following research hypotheses were formulated:

H_1. *There is a link between investment in innovation and company performance:*

H_{1a}. *There is positive correlation between investments in innovation and the performance of companies;*

H_{1b}. *Investments in innovation have a positive and significant impact on the performance of companies*

B. *The variables used in the research*

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 expenditure, capital investment and average number of employees were collected from the industrial research and development investment dashboard from the EU[1].

Intangible assets, goodwill, total assets, net profit and equity were collected from reuters.com[2].

The EU Industrial R&D Investment Scoreboard is published annually to provide a reliable and up-to-date benchmarking tool for comparisons across companies, sectors and geographies, as well as to monitor and analyze emerging investment trends and patterns.

The reuters.com website provides information on the financial statements of publicly listed companies. The data

[1] https://iri.jrc.ec.europa.eu
[2] https://www.reuters.com

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available on the site is provided by the Thomson Reuters database.

The methodology of data collection, selection and processing consisted in downloading them from the Economics of Industrial Research and Innovation database, as well as manually collecting data from the reuters.com website of several indicators from the annual financial statements, which do not are found in the originally 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. In order to test the relationship between investments in innovation and the financial performance of companies, several indicators were selected to reflect both the performance of 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**
Employee productivity	**W**		**sales per employee**
Capital investments	**CAPEX**	**IRI**	**mil. eur**
Number of employees	**EMPL**	**IRI**	**number of employees**

Table 1: Variables used in the study

The amounts related to the indicators collected from the first database are reflected in millions of euros, this being the measure kept for the interpretation in absolute sum 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.

IV. RESEARCH RESULTS

Starting from the analysis of literature review, we wanted to highlight the relationship between investments in innovation and performance at the company level. In order to test this relationship, we developed a study on a sample of 198 companies from the European Union, using correlation analysis using the Pearson correlation coefficient, as well as regression analysis, using Panel data analysis. The results obtained following the application of the statistical methodology, reproduce the essence of the entire study and analyze the hypotheses proposed to be validated or invalidated.

A. Analyzing the correlation between investment in innovation and performance

In order to test hypothesis H1a, we used two performance indicators, respectively, net sales and operating profit.

The statistical link between performance indicators and innovation indicators was thus tested using the Pearson correlation coefficient.

	NS	OP
RD	0.779	0.520
Sig.	**0.0000**	**0.0000**
IA	0.316	0.314
Sig.	**0.0000**	**0.0000**
GW	0.124	0.204
Sig.	**0.0000**	**0.0000**
CAPEX	0.815	0.675
Sig.	**0.0000**	**0.0000**
W	0.218	0.162
Sig.	**0.0000**	**0.0000**

Table 2: Pearson correlation matrix

However, we observe a strong correlation, with a Person coefficient value of 0.779 and statistically significant (sig.=0.000), between research and development expenses and sales.

The practical purpose of research and development expenses in a company is to improve a product or service or to bring an innovative product to the market, thus contributing to increasing sales and implicitly the company's performance.

There is a low degree of association between sales and intangible assets, with a Pearson coefficient value of 0.314, a statistically significant association (sig.=0.000).

Taking into account the fact that investments in research and development, from an accounting point of view, end up being materialized in the stage of intangible assets, they contribute over time to the company's sales.

Between goodwill and net sales of the company we find a weak correlation of (R=0.124), statistically significant (sig.=0.000).

Goodwill is an indicator that includes the intangible part of a company's value, value that is obtained over time and which includes the experience and know-how of employees.

Given the fact that in the process of obtaining sales there are a lot of factors with a direct influence on them, goodwill indirectly contributes to obtaining sales.

We observe a direct and significant correlation with a Pearson coefficient value of 0.520, (sig.=0.000) between

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operating profit and research and development expenses. The operational activity of a company is closely related to investments in research and development, the products obtained as a result of innovation end up being marketed and thus enter directly into the exploitation activity of the company.

The link between operating profit and intangible assets is low, the Pearson correlation coefficient being 0.314, but statistically significant (sig.=0.000).

Intangible assets generated internally or acquired by the company contribute to the operational profit, but in a lower proportion compared to research and development expenses. Intangible assets are specific to the company's investment activity and contribute to long-term profit.

Between goodwill and operating profit, we encounter a weak correlation (R=0.204), but statistically significant (sig.=0.000). The weak correlation of its value with operating profit can be justified by the fact that the value of goodwill is a component of fixed assets and, like intangible assets, contributes to long-term profit. According to the analyzed data, we came to the conclusion that there is a positive correlation between investment in innovation and the performance of companies, thus the hypothesis H1a is validated.

B. Measuring the influence of investment in innovation on the performance of companies

To estimate the impact of investment in innovation on performance, a regression analysis is required.

In order to test the research hypothesis H1b, two regression models were estimated, presented in table III.

M1	$NS_{it} = \beta_0 + \beta_1 * RD_{it} + \beta_2 * GW_{it} + \beta_3 * IA_{it} + \beta_4 * CAPEX_{it} + \beta_5 * W_{it} + \varepsilon_{it}$
M2	$OP_{it} = \beta_0 + \beta_1 * RD_{it} + \beta_2 * GW_{it} + \beta_3 * IA_{it} + \beta_4 * CAPEX_{it} + \beta_5 * W_{it} + \varepsilon_{it}$

Table 3: The proposed econometric models

The estimated econometric models are based on the performance component of the companies, expressed by the company's sales and operating profit. The independent variables selected to explain the econometric model are R&D expenditure, goodwill, intangible assets, capital investment and productivity.

To determine whether an ordinary or a fixed-effects regression model is more appropriate, Chow tests were applied to select the best model, as follows:

Effects Test	Statistic	d.f.	Prob.
Cross-section F	76.771580	(197,1184)	0.0000
Cross-section Chi-square	3635.141662	197	0.0000

Table 4: Chow test result for model 1

The results of the Chow test indicate that the null hypothesis is rejected, thus the fixed effects model is preferred over the general one, the value of the Sig related to the test being 0.0000, a value lower than the assumed risk of 5%.

Thus, the null hypothesis is rejected and the alternative hypothesis is accepted, according to which the fixed-effects model is more appropriate.

The next test applied was the Hausman test with the purpose of verifying whether there are significant differences between the fixed-effects model and the random-effects model. The null hypothesis assumes that the random effects model is best while the alternative hypothesis assumes that the fixed effects model is best.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	253.011607	4	0.0000

Table 5: Hausman test result for model 1

The test results indicate that the Sig value (0.0000) is lower than the assumed risk value (0.05) and we can conclude that the best model for the analyzed data is the fixed effects model.

In order to validate the previously chosen model, it is necessary to apply some tests that have the role of verifying a set of hypotheses regarding the two components of the model: deterministic and stochastic, so to validate the deterministic component, the hypotheses regarding heteroscedasticity and autocorrelation of errors, and multicollinearity was tested to test the stochastic component.

Following the application of statistical model validation tests, the following results were obtained:

Hypothesis verified	The test used	Sig	Conclusion
homoscedasticity of errors	White	0.000	shows heteroscedasticity
autocorrelation of errors	Durbin-Watson	-	shows autocorrelation
multicolinearity	VIF	[1.120; 1.603]	does not present multicollinearity
	TOL	[0.624; 0.893]	

Table 6: Results of model validation hypotheses

According to the results in table VI, the hypotheses verified at the stochastic level are not fulfilled. In this case, a correction model can be estimated.

Since the number of periods (7) is less than that of companies (198) a corrected model can be estimated using the PCSE (Panel-Corrected Standard Error) estimator. The PCSE (Panel Corrected Standard Errors) estimator is based on the covariance matrix developed by Beck and Katz (1995, p. 638).

Corrected models estimated by FGLS or PCSE remove problems caused by violation of one or more assumptions about model validation: cross-sectional

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dependence between individuals, autocorrelation of errors, or heteroscedasticity of errors.

The results of applying the correction model are presented in table VII.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6400.629	897.4618	7.131924	0.0000
RD	5.203616	0.783392	6.642413	0.0000
IA	0.030725	0.013750	2.234591	0.0256
CAPEX	1.943759	0.524546	3.705604	0.0002
W	9183.492	2456.549	3.738371	0.0002

Table 7: The result of the regression analysis by the method with fixed effects, using PCSE

Based on the results in table VII, considering a 5% risk, the following regression equation was estimated:

NS = 6400.62 + 5.20 · RD + 0.03 · IA + 1.94 · CAPEX + 9183.49 · W

It can be seen in table VII, that regardless of the influences of economic factors, both from one company to another, and their evolution from one year to another, sales are significantly influenced by research and development expenses, intangible assets, capital investments and employee productivity.

The results of the corrected regression model show that the predictor variables explain 98.7% of the sales variation of the companies, a significant value to validate the model. Also, when the research and development expenses increase by one unit, it is estimated that there will be an increase of 5.2 million euros in the company's sales, which denotes the fact that those expenses were materialized in products or services at a given time and thus contributed to the sales of the companies. Intangible assets also have a significant impact on sales, when they change by one unit, an increase of 0.03 million euros is estimated.

The increase in sales, influenced by the increase in the value of intangible assets, is lower than in the case of the change in the value of research and development expenses, which denotes the fact that intangible assets have a somewhat lower influence on sales.

Effects Test	Statistic	d.f.	Prob.
Cross-section F	8.077328	(197,1184)	0.0000
Cross-section Chi-square	1180.645253	197	0.0000

Table 8: Chow test result for model 2

The results of the Chow test indicate that the null hypothesis is rejected, thus the fixed effects model is preferred over the general one, the value of the Sig related to the test being 0.0000, a value lower than the assumed risk of 5%.

Thus the null hypothesis is rejected and the alternative hypothesis is accepted, according to which the fixed-effects model is more appropriate.

In order to test for the selection between a fixed-effects or a random-effects model, the Hausman test was applied to check if there are significant differences between the two models.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	84.247328	4	0.0000

Table 9: Hausman test result for model 2

The test results indicate that the Sig value (0.0000) is lower than the assumed risk value (0.05) and we can conclude that the best model for the analyzed data is the fixed effects model.

Hypothesis verified	**The test used**	**Sig**	**Conclusion**
homoscedasticity of errors	White	0.000	shows heteroscedasticity
autocorrelation of errors	Durbin-Watson	-	shows autocorrelation
multicolinearity	VIF	[1.028; 1.542]	does not present multicollinearity
	TOL	[0.648; 0.973]	

Table 10: Results of model 2 validation hypotheses

According to the test results, the hypotheses verified at the stochastic level are not fulfilled. In this case, a correction model can be estimated.

Since the number of periods (7) is less than that of companies (198) a corrected model can be estimated using the PCSE estimator.

The modeling results are presented in table XI.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	942.2500	339.8258	2.772744	0.0056
RD	-1.153411	0.488043	-2.363338	0.0183
GW	0.013395	0.006085	2.201440	0.0279
CAPEX	0.630103	0.266612	2.363368	0.0183
W	1289.240	610.6443	2.111278	0.0350

Table 11: The result of the regression analysis by the method with fixed effects, using PCSE

Based on the result in table XI, considering a 5% risk, the following regression equation was estimated:

OP = 942.25 - 1.15 · RD + 0.01 · GW + 0.63 · CAPEX + 12,89.24 · W

It can be seen in table XI, that regardless of the influence of other factors both from one company to another and from one year to another, the operating profit of companies is significantly influenced by research and development expenses, the value of goodwill, investments of capital and employee productivity.

In the corrected regression model, we observe that the predictor variables explain 78.9% of the variation in operating profit.

When the research and development expenses are modified by one unit, there is a decrease of 1.15 million euros in the operating profit.

This decrease is justified because the innovation activity requires constant and long-term investments, this being supported most of the time from own financing sources, respectively from the operational activity of the companies.

When the value of goodwill changes by one unit, there is a 0.01 increase in operating profit.

Given that innovation influences performance, both in the case of companies' sales and in the case of operating profit, hypothesis H1b. Investments in innovation have a positive and significant influence on the performance of companies, it is accepted.

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