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### **R&D Expenses and Their Effects on Firm Value**

#### **Abstract**

The positive impact of intangibles on economic performance and firm value in general is well documented in the literature. In the paper we research what kind of investment is more significant from the perspective of firm value. Either it is the purchase of intangible assets and own investment or development of these types of assets is important in a firm. To analyse the case, we use panel data of 313 European publicly traded companies from four time periods. The study finds that R&D expenses can significantly explain market capitalization of the selected companies. The study expresses that firm with higher intangible investment tends to have higher market capitalization and that investment in intangible assets is rewarded in the form of higher intangible capital as a part of the market capitalization. Specifically, the investment in the R&D is evaluated significantly and positively by the market.

**Key words:** Intangible Assets; Business Value; Research and Development; Intangible Fixed Assets; Intangible-intensive Firms.

### **Koszty prac badawczo-rozwojowych i ich wpływ na wartość firmy**

#### **Abstrakt**

Pozytywny wpływ wartości niematerialnych na wyniki ekonomiczne i ogólnie wartość firmy jest dobrze udokumentowany w literaturze. W artykule badano, jaki rodzaj inwestycji jest bardziej znaczący z punktu widzenia wartości firmy. Zarówno zakup wartości niematerialnych, jak i własna inwestycja lub rozwój tego rodzaju aktywów są ważne w firmie. Do analizy sprawy wykorzystano dane panelowe 313 europejskich spółek giełdowych z czterech okresów. Badanie wykazało, że wydatki na badania i rozwój mogą w znaczący sposób wyjaśnić kapitalizację rynkową wybranych firm. Firma z wyższymi inwestycjami niematerialnymi ma zwykle wyższą kapitalizację rynkową, a inwestycja w wartości niematerialne i prawne jest nagradzana w postaci wyższego kapitału niematerialnego w ramach kapitalizacji rynkowej. W szczególności inwestycja w badania i rozwój jest oceniana znacząco i pozytywnie przez rynek.

**Słowa kluczowe:** wartości niematerialne; wartość biznesowa; badania i rozwój; wartości niematerialne i prawne; firmy intensywne niematerialnie.

**JEL:** G30, M21, M41.

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## **Introduction**

Intangibles are significant factor of each firm. Intangibles are immaterial resources that are put in the production process and are necessary for the creation and sale of new or improved products or services. Usually they consist either from internally produced assets – like designs, in-house developed software, projects, brands – or from externally acquired assets – like patents, copy-rights, licences etc. Many of them, depend on definition, are incorporated in the company's balance sheet statement, or specifically reported within win and loss statement. The externally purchased are originally reported as asset items on firm's balance sheet. The internally produced assets are derived from firm expenditures such as R&D expenditures, training and innovation as mentioned in Arrighetti, Landini and Lasagni (2014). We can also use name expenditure-based approach for the internally produced intangibles. Both of them are based on managerial decision that open dilemma between making the purchase of intangible assets and own investment and the development of these types of assets is one of the key decisions in a company. This impact is also being enhanced by the development of information technologies and the related development of society. We can also talk about them as the fourth factor of production. Since the industrial revolution intangible assets have become the substantial foundation of the industrial corporation and indeed it is nowadays commonly believed that the value creation processes of the modern firm as well as of economic systems are largely founded on, and fostered by intangible assets. Also, European Commission in its Europe 2020 strategy proposes smart, sustainable, and inclusive growth, where the main determinant of the innovation is the knowledge that helps to strengthen economic growth and sustainable development, employment, and competitiveness in the European Union. Development of information technology also mirrors the importance of knowledge or intangibles. Considering globalization, deregulation of the key industries and exponential development in the area of technology stands behind the birth of economy of intangible assets or more often used a term the knowledge-based economy. Knowledge is anchored in a skilled

workforce, sophisticated processes, customer relationships or unique organizational designs and brands. No one would argue that an experienced employee brings more value to the firm than the newly hired one. Well established organizational processes are recognizably more valuable than disorganized management. Such considerations, however, raise the question: How to evaluate that difference? We can review all employee investments, we can look at the proportion of the profit an employee brings to the company, and we can compare profits of well and inappropriately managed firm. But will this be the reliable measurement procedure?

The fact that the topic of intangibles and intellectual capital is very popular and important is highlighted by the evidence that since the Millennium, the European Commission, through its different Directorate Generals, commissioned a number of studies and set up various expert groups devoted to various issues in the area.

In this article, the author provide an overview of relevant literature with a theoretical background of the researched topic. The study works with the hypothesis that intangible assets in the form of R&D expenditure as well as investments in long-term intangible assets have a positive impact on the market value of the enterprise. In the analytical part of the paper, the authors have performed analysis and based on empirical results the main findings are summarized.

### **Value relevance of R&D expenditures**

Research and development (R&D), as well as expenditure and human resources, affect the value of companies as show several case studies and econometric analyses like Sánchez, Asplund, Stolowy, Roberts, Johanson and Mouritsen (2001). In the past, the relationship between R&D expenditure and market value was analyzed very often by the subject of economic. Sougiannis (1994), among the first, analyzed R&D expenditure as intangible assets and found that R&D expenditure significantly affected reported returns and market value of equity. The one unit investment in the R&D was, according to Sougiannis's analysis, reflected in an increase in the market value of four dollars. As mentioned by He and Wintoki (2016) and Di Cintio, Ghosh and Grassi (2017) R&D expenditures are often used as proxy variables for innovation intensity or intangible activity of companies as summarized by Boris and Brown (2013) and Peters and Taylor (2017). Griliches (1981) identifies a statistically significant positive relationship between historical R&D expenditure and market value. In one of the most recent publications, Nemlioglu and Mallick (2017) deal with the impact of R&D activities and pre-and post-crisis management practices on company performance, which is expressed in terms of profit. The best

performance by their empirical analysis is achieved by companies that invest in both activities at the same time. Canibano, Garcia-Ayuso and Sanchez (2000) have revealed that investments in intangible assets, especially those in R&D, are associated with higher business performance in the future. Positive addiction is also demonstrated by Boujelben and Fedhil (2011), examining the relationship between intangible investments (R&D investment, quality and advertising) and future operating cash flows on a sample of Tunisian companies. The causal relationship between R&D expenditure and the value of the company is also addressed by Harris and Li (2008) and Ito and Lechevalier (2010). Likewise, Aboody and Lev (2000) consider R&D to be a source of insider gain in insider gains. They point to substantially higher profits for firms that invest heavily in R&D when compared to firms that neglect investment into R&D. They mention a few characteristics that characterize the uniqueness of their use for further analysis. R&D activities are uniquely designed and subject to strict protection, so it is tough to imitate them. Therefore, it is not possible to derive information on the expenses of other companies from information on R&D expenditure of one company in the sector. Unlike physical and financial assets, intangible assets as R&D are not traded on an organized market, and therefore their price cannot be deduced from market prices. Active support for R&D investment can well indicate that the firm will continue to do so in the future. Firms investing heavily in R&D are expected to have a favourable market outlook but, on the other hand, they also bring a higher degree of uncertainty. The products, services, and processes to which investments are made must not always be successful. Decisions on investing in R&D are determined by several factors. Since R&D expenditure represents investments that are generated by generating the company's intangible assets. An alternative procedure is an external procurement from other companies that have already carried out research and development activities and provide returns for their investments, for example, in the form of patents or licenses. In the literature, a number of authors are devoted to examining factors that determine company decisions in relation to purchase (external acquisition) and the creation (internal acquisition) of intangible assets. Xue (2007) identifies the different goals of the make strategy and buy strategy for the procurement of intangible assets in the technology sectors. As a proxy variable creation strategy, it uses R&D investments, while a purchasing strategy is the external procurement of the final technology. The uncertainty of the creative strategy is associated with both systematic and non-systematic risk. Shareholders have the opportunity to diversify and thus minimize non-systematic risk and therefore the market only appreciates systematic risk. However, unlike shareholders, managers are exposed to different incentives, as their human

capital is usually invested in only one company. For this reason, Xue (2007), among the determinants of the company's tendency to acquire new technologies, includes, besides the market variables, the variables related to the remuneration of management personnel. Like Xue (2007), Ciftci and Darrouh (2015) apply a GMM method that takes into account endogeneity in choosing between R&D expenditure and intangible assets shown in the balance sheet. At the same time, they point to the inherent difference between firms that internally build and outsource intangible assets. Unlike previous research, Tsai, Lu, Hung and Yen (2016) apply machine learning techniques and identify the predictive model for the valuation of intangible assets. Determinants of intangible assets are divided into five groups: intangible capital, ownership structure, corporate characteristics, industry characteristics, and an analyst and customer feedback. All of these authors deal with a sample of US companies. Harris and Moffat (2011) have used the results of UK companies for their empirical analysis. They analyze the tendency of companies to invest in three activities: R&D, innovation and export. The limitation of their analysis is that they only have information about whether or not the company has implemented individual activities, but the amount of funds spent on individual activities is not known. The consequence and disadvantage of this nature of data are that companies that invest very little in one of the activities will have the same status in the analysis as those who are intensively allocating the funds to individual activities. On the other hand, the sample may also consist of companies that invest in individual activities, but this information does not appear relevant in the financial statements, therefore would not otherwise be included in the sample. It is assumed that each of the explanatory variables approximated the intangible assets capture a certain group of intangible assets and its change affects the value of the firm, taking into account market valuation. The hypothesis is about the relationship between R&D expenditure and business value. It is assumed that R&D expenditures are statistically significant while explaining the business value as a share of market and book value. R&D expenditure is representative of internally generated intangible assets. In most cases, large-scale accounting does not allow capitalization; research and development activities often include new technologies, patents, or designs that represent an essential component of the company's intangible assets. It is expected that *ceteris paribus*, there is a positive relationship between the intensity of R&D expenditure and the value of the firm.

### **Data and methodology**

We investigated the selected and an improved sample of 313 European public listed companies, which reported profit within the whole period of years 2014-2017 from the database Thomson Reuters. The initial data sample consisted of 5113 observations. However, due to missing values of R&D expenses and intangible fixed asset, the authors had to exclude them from our sample.

The author started their analysis by analyzing a typical panel data model with many individual observations across several time periods. The researchers analyze the effects of three variables expressed by research and development expenses scaled by total assets (RDAS), intangible assets scaled by total assets (IntAS), Rota Rank Measure (RotaRM) on dependent variable expressed by the firm value (MTB). The authors do not consider goodwill to be a part of intangible assets IntAS. The Cross-sectional dimension of our data frame covers 313 individual firms. Time series dimension involves, as mentioned above, four years, from 2014 to 2017. Applying a Chow test for the poolability of the data suggests considering panel data structure of the model. Time effects are statistically significant. To decide whether fixed or random effects model is more appropriate, Hausman test has been applied, according to which fixed effects model is more relevant. As the model suffers from serial correlation and cross-sectional dependence, the authors have applied the heteroscedasticity robust variance-covariance matrix to estimate unbiased regression coefficients under asymptotic properties.

The results of the model in Table 1, the authors empirically affirm that of their three variables expressing the intensity of intangible assets. Only the variable RDAS has a statistically significant positive effect on the value of the firm with a regression coefficient of 11.233 and a p-value of less than 0.001, which means that R&D expenditures can be used to explain the present value of the company. The regression coefficient of the RDAS variable is several times higher than the other regression coefficients. In addition, unlike Clausen and Hirth (2016), the analysis of the study does not confirm any statistically significant relationship between the ROTA rank measure and the present value of the firm. As Table 1 shows there is a statistically significant negative dependency between the intangible assets on the balance sheet and the value of the publicly traded companies. The regression coefficient of -1.104 is statistically significant; indicating that the market evaluates the balance sheet intangible assets differently from R&D expenditures and their increasing value may have a negative impact on the market value of examined companies.

**Table 1. Estimated Results for the Pooled Model (PM) and Fixed Effects Model (FE)**

<b>Dependent variable: MTB</b>	<b>PM</b>	<b>FE</b>
Intercept	1.689***	1.812***

	(0.072)	(0.218)
RDAS	10.838*** (0.736)	11.233*** (3.287)
IntAS	-0.872*** (0.182)	-1.104** (0.231)
RotaRM	0.653* (0.259)	0.623* (0.248)
Years	2014 – 2017	2014 – 2017
Firm's effects	No	Yes
Time effects	No	Yes
Clustering	No	Yes
R2	0.148	0.087
R2 adj	0.141	0.085

Source: own calculation.

The results presented in the paper are in accord to the earlier results and findings based on different datasets of European publicly traded companies published by Glova and Mrázková (2018) and Mrázková (2018).

### Conclusion

We explore value creation through intangibles in publicly traded companies within Europe, taking into consideration investment in the research and development as well as intangible fixed assets. It is stated that research and development expenses bring an extra increase in the market capitalization of selected companies and make managers and investors' goals more aligned. We consider that there is a positive relationship (*ceteris paribus*) between the intensity of R&D expenditures as well as investment in intangible assets to total assets in comparison with the increase in relation to other factors. We use a panel data model of endogenous market capitalization to test how intangibles affect outperforming of a company. The research is carried out on a sample of 1252 observation of 313 European publicly traded companies covering the period from 2014 to 2017. The study has revealed a positive impact of the proportion of R&D expenditures on total assets on firm value. So, it can be proved that internal or own research and development is evaluated by the market. From the perspective of practical implications, the research emphasizes the importance of awareness of companies' top managers about the outcomes of their decisions in regard to market assessment. It is proved that internal or own research and development is evaluated by the market. However, the strategy of externally acquiring intangible assets instead of their development is evaluated by the market negatively.

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