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The Effect of Financial Risk Taking on Profitability in the Pharmaceutical Industry

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Abstract: The significance of the pharmaceutical and commercial sectors in the national economy has noticeably intensified, as a result of the COVID-19 pandemic. The main objective of this study was to gain a better insight into the main management characteristics of the actors in the sector. It was assumed that more efficient management of financial investments (acquisitions, loans) caused higher risk financial investment decisions in the pharmaceutical industry in order to place companies in a better position in view of equity investors, illustrated best as the profitability of equity (ROE). This paper examined one possible means of covering the extremely high indirect costs (R&D, marketing) of pharmaceutical companies, also justified by the restructuring of the industry and the effect of investments in long term financial instruments on the ROE of the same business entities. Built on the EMIS database, the analysis only used the indicators of those companies operating in the pharmaceutical industry in Visegrad countries for 2019. The authors sought to draw conclusions about possible management characteristics of the entire pharmaceutical sector of these countries using cluster analysis and linear regression. The initial assumption, or main hypothesis of the study, was that in one of the countries studied or for those businesses operating above a certain revenue category, the impact of a company's risk-taking (which can also be expressed in terms of asset-based financial income) on profitability, may appear or intensify. The performed studies did not show a strong correlation between the explanatory and profit variables either at the national level or at the level of groups formed by regional market position. In other words, the extremely high level of indirect costs were mostly covered by sales of successful cash products, and companies not indebted to suppliers undertook significant risks in the field of financial investments, thereby offsetting the positive impact of the latter on earnings.

Keywords: financial risk; profitability; financial investment; ROE; pharmaceutical industry; cluster analysis; linear regression

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1. Introduction

1.1. Peculiarities of the Pharmaceutical Sector

The Global Database (Global Database—Pharmaceutical Medical Industry Database 2021) estimates that by 2022, pharmaceuticals will contribute about USD 1.12 trillion to the global economy. Meanwhile according to PricewaterhouseCoopers (2019) "the industry directly contributes 0.7% of the EU's GDP, and its total contribution is equivalent to 1.4% of the region's GDP" (PricewaterhouseCoopers 2019). In the Visegrad countries, this value was between 0.2% (in Slovakia) and 1.8% (in Hungary). This variation within regions is also reflected in the employment impact of the pharma industry. In a broader sense, the pharmaceutical sector includes, in addition to pharmaceuticals, the manufacture and sale of medical, biotechnological and medical devices, vaccines, and over-the-counter (OTC) medicinal products, which is taken as a reference in this paper. This industry has a number of characteristics that distinguish it from other economic sectors, both in their nature and

in their contribution to key macroeconomic performance indicators. At the end of the 19th century, the concentration of companies in the chemical sector, compared with the R&D and marketing-intensive sectors, remained relatively low for a long time. The market structure was dominated by companies with stable, but relatively small, market shares. According to Malerba and Orsenigo (2015), through acquisitions and mergers, these companies were able to seize more than 10% of total market turnover, and this achievement was partly due to the innovative processes of new product development, patent protection, and the low cumulative nature of technological development. However, there have been serious doubts since the turn of the millennium about the innovative performance and sustainability of traditional business models of industry players that already showed exceptional economic performance by the 1990s (Malerba and Orsenigo 2015), regardless of the specific nature of the pharmaceutical products and their manufacturing processes (Munos 2009).

According to Scherer (Scherer 2000), the main industry specifics are as follows:

- Some medicines, due to possible undesirable side-effects, can only be obtained from legally licensed pharmacists on the recommendation and with the permission of doctors taking professional responsibility, and are sharply separated from the groups of over-the-counter (OTC) products also available in retail outlets. Sales of OTC products generated in excess of USD 114 million in 2020 worldwide, accounting for less than 10% of total pharmaceutical sales (Statista 2021);
- The consumer prices of prescription medicines are reimbursed in part or in full by insurance companies, thus ensuring the demand for all products that patients in need would not ordinarily be able to buy from their own incomes. Medical decisions limiting substitution options and insurance reimbursement make demand for prescription products price inelastic, allowing prices for patented products to be kept high;
- As opposed to successful R&D, the ratio of the costs of dominantly unsuccessful R&D to sales is high. This can be covered from the high margins of successfully developed and protected original products, for which, in contrast to other industries, significant resources are reallocated to their promotion;
- Prices in the industry have significant budgetary implications through health care financing.

According to Drews (2003), in addition to the restructuring of the industry, it is a problem that R&D activity has been degraded as a means of producing medications that are "blockbusters". As Bartfai and Lees (2013) explained, the product development cycle in the pharmaceuticals and vaccines market has led to a particularly long product development cycle, coupled with the potential for high risk but also high return. Meanwhile, competition forces industry actors to open a new market with a product focused on an untreated disease, or to further develop medicines in an existing class. According to Scherer (2001), investing in R&D can be related to the profitability of the companies involved in three different ways: revenues from newly developed products generate higher returns than traditional products, which make up the majority of the product portfolio, thereby providing an internal source of additional R&D. Additionally, managers' expectations of future profit opportunities may also increase demand for such investments. However, as Cockburn (2004) pointed out, the increase in R&D costs, especially since the late 1990s, has not been accompanied by a similar increase in new products introduced to the market. One of the reasons for this tendency is that market demands focus on the treatment of increasingly complex and difficult-to-understand diseases, while efficiency may even be affected by changes in industry structure, including that of the vertical relationships between non-profit and for-profit players, and by biotechnology equipment manufacturing companies appearing among academic research institutes and commercial actors. DiMasi and Grabowski (2007) estimated the present value of the total activated R&D cost of approved drugs produced exclusively with biotechnology, to be USD 1.3 billion, which was more than 60% higher than the USD 800 million cost related to new medications at the turn of the millennium (DiMasi et al. 2003). The estimated value of total R&D expenditure increased to USD 2.5 million by the beginning of 2010, as a result of recent data analyses

(DiMasi et al. 2016). However, even after the expiration of patents, the share of generic medicines that partially cover R&D in global pharmaceutical sales was not estimated to be higher than 20% by mid-2010, while prescription medicines were sold for almost 10% of their original prices. This development also meant a reduction in the profit margin, encouraging manufacturers to expand in developing regions that provided more cost-effective operations (Khanna 2012).

Overall, both the demand and supply sides of the pharmaceutical market are influenced by factors that are an external constraint on their long term profitable operation and need to be offset by the same non-market, external government instruments. On the demand side, such factors include the general demographic situation, patients' awareness of medicinal therapeutic products, the prevalence of health-conscious lifestyles, the income constraints of those in need of medicines, anti-vaccination campaigns and the substitution effects of public health programs. At the same time, on the supply side, industry players are under pressure from the capital and asset requirements of pharmaceutical manufacturing, the uncertainty of research success, entry into the pharmaceutical market, and administrative and financial constraints on investment and product development in the healthcare industry.

Supporting the leading sectors in product development through R&D&I-related tax incentives plays a key role in the economic policy of the Visegrad countries (Lengyel and Cadil 2009). Although successive Polish governments provided the least favorable conditions for the development of competitiveness, a strong change took place in 2010 (Molendowski and Żmuda 2013; Wojciechowski 2013). As Owczarczuk (2013) pointed out, the seemingly contradictory fact was that Poland had the least government incentives to develop innovation, although the Central European region had the highest rate of R&D investment. However, Hudec and Procházková (2015) emphasized that the analyzed countries were among the worst performing countries in the EU in terms of competitiveness, with the Czech Republic and Hungary standing out the most. IMS estimates also suggested that Central European EU Member States had significant potential in the pharmaceutical market: they forecasted an annual growth in the second half of the 2000s at around 8% in Poland over 5 years, 11.4% in the Czech Republic and 14.4% in Hungary (Filtration and Separation 2006).

1.2. Content and Disclosure of Financial Assets and Income in Accordance with IFRS

In financial statements, the volume and average return on financial investments made by companies can be inferred from the financial instruments row in the balance sheet used to record assets, and the value of financial income presented to derive profit or loss. According to the interpretation of Ramirez (2015), financial assets, according to the International Financial Reporting Standards (IFRS) 9 standard, which replaces IAS 39 from 2018, as published by the International Accounting Standards Committee (IASB), involves cash, the contractual right to acquire or exchange a financial asset on potentially favorable terms, or the equity instrument of another entity. Although the accounting for financial assets may vary depending on the category in which they are classified, they are always measured at fair value (Bakker et al. 2017; EY 2015).

As described by Bács et al. (2017) financial instruments and derivatives should be presented in a defined structure by their nature in the Notes to IFRS financial statements, distinguishing their effect on cash flow and income, and changes in their fair value revaluation reserve. Although IAS 39 (Lim et al. 2013), which previously regulated this field, was amended during the 2008 economic crisis, this change demonstrably reduced the accuracy of analyst forecasts for banks, which in part justified a subsequent full revision of the standard.

1.3. Impact of Profitability on Financial Investments in the Pharmaceutical Industry

Profitability trends have improved in the last year in terms of the most important corporate indicators (Fenyves et al. 2019). By measuring the revenue-to-cost ratio, prof-

itability indicators such as gross, net or operating profit margin (Paramasivan and Subrahmanyan 2020) reflect a company's ability to grow, although these indicators may already be double-edged swords for a non-profit actor involved in medication research, as their low or high values can generate criticism from the community or the governing body, respectively (Nowiczki 2018). Industry-level analysis of profitability rates as described by Finkler et al. (2019) also strengthens and assists managers in assessing the financial performance of their companies and in comparing them with the market leader, while it also helps creditors in assessing the future solvency of companies. The results, in terms of sales revenue, help to determine the efficiency of the activities managed by the given companies (Shah 2012). In contrast, according to Subramanyam (2014), in order to maximize the results projected on the assets of a company, it is already necessary to effectively manage, among other things, the marketing and R&D activities that are generally characteristic of the pharmaceutical industry. In the analysis of profitability indicators, examining a company on its own is neither expedient nor relevant, i.e., it is necessary to set up rankings and compare several companies (Sheela and Karthikeyan 2012). The importance of the sectoral analysis of the different profitability ratios of capital and turnover (ROA, ROE, ROS, CROA, CROE, CROS) was highlighted in the comparative analysis of enterprises belonging to a similarly sized category in the case of decision support IT applications. In this paper the main reason for preferring ROE was that it best reflected the return expectations of investments in companies, compared with other indicators, based on the studies of several authors who analyzed the DuPont correlation (Fenyves et al. 2019; Paramasivan and Subrahmanyan 2020; Subramanyam 2014; Palepu and Healy 2013; Bunea et al. 2019). Dashboard-based illustration of indicators effectively aids managers with benchmarking-type analyses (Lakatos et al. 2020). Although the assessment of profitability with indicators may be distorted by uncertainties related to accounting and valuation methods, together they can provide reasonable conclusions for external and internal stakeholders to assess the management of the company (Helfert 2001). The main hypothesis of this paper is that pharmaceutical companies make higher risk financial investment decisions (and thus realize higher financial returns on their total asset) in order to place their company in a better position in the equity investment market, which, expressed by the return of equity (ROE) indicator, best approximates the dividend expectations. Therefore, the ROE in the pharmaceutical industry in the Visegrad countries is significantly affected by the indicator of the financial income per all assets.

The high margin is mostly reduced by the significant indirect (sales, marketing, research and development) costs typical of industry players, resulting in relatively low operating ROS values for the original producers. Based on the DuPont correlation, which sheds light on the relations between profitability ratios, this may also have an impact on the values of return on all assets and on the owner's equity (Palepu and Healy 2013; Wahlen et al. 2015). The profit-reducing effect of high production costs in the industry can be offset by investment in financial instruments in addition to sales revenue from the sale of successful cash products. However, this is only true if the realized return on the former investments is high enough compared, on the one hand, to the size of the capital invested and, on the other hand, to the cost of borrowing used for financing. Due to the fact that, unlike other assets that are used permanently and within a year, the result of investing in financial instruments is not realized in sales. Capital invested in financial assets alone usually reduces the velocity of circulation of assets calculated in the traditional way, resulting in a lower ROA relative to return on sales—as if all the company's assets had been pledged solely in connection with its operations. The contribution to the return of the owner's equity also depends on their return: the same return on assets can be ensured with a lower equity investment only if it involves borrowing to finance the company's activities, which are typically accompanied by an interest payment obligation recognized in financial expenses. An exception may be to make better use of free supplier financing. However, the scope for pharmaceutical manufacturers to increase their payment deadlines is increasingly limited, due to the rarity of the more specialized compounds used and, as a result,

their weakening bargaining position with suppliers. Fulfilment of investor expectations can thus only be achieved by increasing the amount of borrowed funds, the costs of which companies have to extract partly from the return on their own investment—ultimately forcing manufacturers to further acquisitions, market expansions and riskier behavior in pursuing financial investment strategies. Among financial investments, equity securities and shares are typically riskier, thus providing fluctuating but higher returns (dividends) than loans or borrowings, which would result in lower but predictable interest income (Myers 1984; Brigham and Houston 2016). As a result, due to the fierce competition in the market, which is reinforced by the effects of the COVID-19 pandemic, the trend of acquisitions is expected to further intensify. As also described by Fenyves et al. (2020), industry players are less likely to finance their operations with creditors, which means that the financial risk is borne only by producers who are already operating at a loss.

2. Materials and Methods

The results of the survey were based on the EMIS database. Within the Central European region, data was collected on companies operating in the Visegrad countries (i.e., Hungary, Slovakia, the Czech Republic and Poland), which, according to the North American industry classification system, were coded as 3254 (manufacture of medicines and other medicinal products) and 4242 (wholesale trade of medicines and other medicinal products). The data in the analysis were based on data from the most recent annual financial statements available for companies, where the units of measurement were in euros. Financial data retrieved from EMIS's broader corporate database included all assets, equity, non-current financial assets or financial instruments in the balance sheet, as well as sales revenue, net or after-tax profit and financial income from the income statement. The narrower database on which the analysis is based contains data from 77 Czech, 71 Hungarian, 87 Polish and 48 Slovak companies.

This analysis used IBM SPSS Statistics ver. 21. Examination of the hypothesis that the return on equity of a company is affected by the average return on its financial investments, did not require a longitudinal analysis of time-varying indicators, therefore—due to the limitations of the EMIS database—a cross-sectional analysis of the indicators derived from the retrieved data was performed for the year 2019. According to Yee and Niemeier (1996), the application of cross-sectional analysis is more advantageous than longitudinal, if, in addition to the methodological difficulties in following the same corporate sample elements and the resulting negligible results, only the marginal probabilities are interesting, while sampling is unweighted or unstructured, which was the case for this study. The return on owner's equity, i.e., the ROE indicator, as defined in the initial hypothesis, was determined on the basis of Equation (1), the average return on financial investments was determined based on Equation (2), and the ratio of financial investments was based on Equation (3).

$$\text{Return on equity (ROE)} = \text{Profit after tax (Net)}/\text{Equity} \quad (1)$$

$$\text{Average return on investments} = \text{Financial income}/\text{Fixed and short term financial assets} \quad (2)$$

$$\text{Ratio of financial investments} = \text{Fixed and short term financial assets}/\text{All assets} \quad (3)$$

In the course of the analysis, only the financial instruments after which financial income (yields, interest, exchange rate gains) was generated for the company were taken into account, and the values accounted for as financial income were assumed to fully include returns on fixed and short term investments. Due to the static nature of the balance sheet, for a significant part of the sample, financial income was shown in a way that fixed or short term financial assets were no longer registered in the company by the end of the year—in this case, the average return on investments was considered to be 0%, as if the company had no investments previously.

In the course of analysis, the aim was to examine the main statistical characteristics, quartiles and distributions of each financial variable together and for each country, using

descriptive statistical tools. Correlation analysis was used to explore the closeness of the relationship between the analyzed financial indicators, while linear regression analysis was used to verify possible causal relationships. Using a K-medium cluster analysis, it was examined whether there was a difference between the ratio of investments in financial instruments and the average return on investments in these instruments, based on the sales revenue criterion that best captures the market position and the relationship with the benchmark company. Additionally, a one-way analysis of variance was used to reveal how much of the total variance in the financial indicators could be explained by this potential difference. In order to confirm or reject the hypothesis, the ratio of financial investments and their average return were chosen as explanatory variables in the multivariate linear regression method, while the return on equity was taken as the result variable. This method alone was suitable for determining and confirming whether explanatory variables were significantly related to the dependent variable (MacInnes 2017; Leech et al. 2014; Gray and Kinnear 2012; Stockemer 2019; Wagner 2015). To correct the statistical biases resulting from the misleading presentation of financial assets and the limited query database for more reliable results, the regression model separately examined the product of the input variables defined by Equations (2) and (3), which determined the return on financial investments in comparison with the total assets of companies, according to Equation (4).

$$\text{Asset-proportionate financial income} = \text{Financial income} / \text{All assets} \quad (4)$$

The higher values shown by the latter indicator similarly indicated the pursuit of better financial investment strategies—either because a significant part of the assets was invested in financial assets, because the latter's return increased, or because of a combination of these two reasons. The hypothesis assumed that more efficient management of financial investments (acquisitions, loans) meant higher financial income, therefore more favorable profit after tax, which could cause—with no change in interest expenditure—higher dividend expectations, therefore higher ROE indicator. In this way, pharmaceutical companies would be using their financial investment policy as a means of increasing their equity financing. The formulation of the hypothesis is:

$$\text{ROE} = \beta_0 + \beta_1 * \text{ Financial income} / \text{All assets } + \varepsilon \quad (5)$$

The higher financial income depended on both variables defined by Equations (2) and (3), so the statistical relationship between the ROE indicator and these factors were also examined separately. There were more companies that realized financial income, but the values of their financial instruments showed 0 in the balance sheet. The relationship of the financial instruments ratio and the average return of the financial investments with ROE indicated a weaker correlation. This is the reason why these factors as input variables have not been involved in the regression model. The reliability of the obtained models was checked by regression ANOVA, and the explanatory power of the obtained models was examined with a coefficient of determination, multicollinearity (VIF), normality and homoscedasticity of the residues.

3. Results and Discussion

3.1. Descriptive Statistical Analysis of Financial Indicators in the Visegrad Countries

First, a descriptive statistical analysis of the data was carried out. Based on the results, the standard deviation of the sample data for all countries was several times the arithmetic mean. For this reason, arithmetic averages were less suitable for characterizing the multitude of enterprises statistically. However, if only the averages were considered, pharmaceutical companies in Poland—being the country with the largest number of companies in the sample—invested in financial assets which provided the highest level (close to 15%) of dividends, interest income or foreign exchange gains. By comparison, this value was above 9% of all assets in Hungary and less than 5% in the Czech Republic and Slovakia in 2019. In contrast, the average returns on the value of the same investments recorded in the

statements were, on average, more than five times higher than the similarly high average of 228.19% for Hungarian companies and the average for Poland (79.30%). Companies operating in Slovakia invested in financial assets with an average rate of 4.51% and with an average return of only 7.25%. However, the latter averages were still lower than the real ones, as in the course of the investigation the ratio of many companies that realized financial returns on their investments liquidated in the current year or previously, was taken as 0%, considering that invested and short term financial assets were no longer recorded in the balance of their annual financial statements. The resulting distorting effect was mostly reflected in the data of Czech and Slovak companies, where the indicators suggested that more than half of the pharmaceutical companies and traders did not even try to partially offset their indirect costs of product development and marketing with their current assets and cash reserves, by partially investing them for long term income. This can certainly be said for only a quarter of the Hungarian and Polish pharmaceutical companies on the basis of the results calculated in this way, although half of the companies in the sample still did not invest in securities to an extent higher than 0.1% in Hungary and 3% in Poland. The same differences in value were shown in terms of average returns: although half of the Hungarian companies did not realize a higher average return on their investments than 0.55%, and the highest return that Polish enterprises realized was 2.68% on average, 25% of companies did not realize and return due to the lack of investment. The values of companies that invested the largest proportion of their assets in securities and other assets that were equity instruments of affiliated companies showed the largest variance for both financial indicators, which also resulted in a distribution of data strongly extending to the right. At least 15% of Polish companies in the top 25% of the companies in the sample, and at least 7.8% of those operating in Hungary, were invested this way. The lowest average return realized by players in the Hungarian pharmaceutical sector (27.16%) was almost three times higher than that of Poland (13.49%), while the Slovak companies with the lowest risk share also realized the lowest average returns in the region (listed in Table 1).

If the distortions resulting from the incomplete accounting of invested or short term financial assets were filtered out and only the financial income was examined (Table 2) on all assets, it could be concluded that Hungarian pharmaceutical manufacturers and traders pursued the relatively best financial investment policy in the region, while the least risk undertaken by the industry was in Slovakia, although, due to the higher standard deviation, the data series could not be characterized by the averages and the differences between them were equally insignificant. Polish and Czech companies realized almost 1% of their total committed assets as an average return on their securities. The order of the average values was also observed in the case of mean values: while half of the Slovak pharmaceutical companies did not realize a return of more than 0.15% of their total assets, this value was twice as high in the case of Poland and close to half a percent in the case of Hungary. Although the results of pharmaceutical companies with the lowest financial risk varied widely in the countries of the region (the data of Slovak companies in the worst performing quarters in terms of the indicator were approximately one tenth of those of Poles), in all countries, the variance of indicators of companies in the upper quarter was multiple times higher than those of companies in the other quarters. It also follows that median values were usually lower than the mean in the sample, resulting in a positive skew and right distribution of the examined data. It was also noteworthy that the indicator of a Slovak company which realized the highest financial income in terms of its assets (4.46%) was 4.5 percentage points lower than the Czech value (9%), almost a third of the Polish value and about a tenth of the indicator of a Hungarian company which had an otherwise unprofitable year in 2019 (43.7%). The average value of the Hungarian companies was significantly increased by the value of the latter company, while only one company in Hungary (a subsidiary of Bayer) was able to record a return on total assets of more than 10%, while in Poland, a total of 3 companies reached this level.

Table 1. Descriptive statistical analysis of financial investment ratios and average returns broken down by Visegrad country, 2019.

Indicator	Financial Investment Ratio (%)				Average Return on Financial Investments (%)			
Country	HU	PO	CZ	SK	HU	PO	CZ	SK
Mean	9.76	14.84	3.55	4.51	228.19	79.30	1519.20	7.25
Median	0.07	2.73	0.00	0.00	0.55	2.68	0.00	0.00
Std. deviation	20.38	24.50	11.95	12.49	774.13	392.7	1030.72	27.66
Maximum	86.37	91.63	90.67	63.69	4987.25	3532.30	76,605.13	186.32
Q1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q3	7.81	15.41	1.36	1.16	27.16	13.49	7.10	3.12
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skewness	5.31	2.60	38.75	14.52	23.01	76.81	49.45	39.36
Kurtosis	2.47	1.92	5.78	3.72	4.57	8.57	6.79	6.08

Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: own calculation based on database EMIS, 2019.

For the ROE indices included in the regression study as a dependent variable, their mean values were statistically as characteristic for the sample as a whole, as all previously studied variables treated as input in the regression model (Table 2). Nevertheless, it was interesting to note that while Czech and Hungarian pharmaceutical companies, which recouped a relatively larger share of their total assets as the return on their investment, were the most profitable on average in the region (realizing a return of almost one third of their owner's equity on average), the Polish sector, which follows these countries' financial policies, was unprofitable, which was also expressed as an average return on equity of −12.7%. By comparison, reflecting the trend in their financial investments, Slovakia had a moderately positive return on equity of over 8% in the year before the COVID-19 pandemic. In terms of averages, only the Hungarian sector differed significantly from the rest of the region: while in the Czech Republic, Slovakia and Poland, the after-tax or net profit of half of the companies on their equity did not exceed 9–12%, the Hungarian industry's higher profitability was already reflected in the worst-performing half of companies, in which category the best value was 4 percentage points higher than the second highest median in Poland.

Table 2. Descriptive statistical analysis of asset-based financial income and ROE values broken down by Visegrad country, 2019.

Indicator	Financial Income per Asset (%)				ROE (Return on Equity, %)			
Country	HU	PO	CZ	SK	HU	PO	CZ	SK
Mean	1.73	1.02	0.88	0.48	31.86	−12.76	33.09	8.35
Median	0.46	0.30	0.25	0.15	15.82	9.87	11.68	8.96
Std. deviation	5.47	2.70	1.53	0.91	59.61	372.90	96.79	55.54
Maximum	43.75	12.05	9.00	4.46	334.90	1324.90	619.58	166.65
Q1	0.06	0.10	0.04	0.01	2.99	2.99	3.09	0.06
Q3	1.17	0.67	0.89	0.51	20.84	20.84	19.32	1.17
Minimum	0.00	0.00	0.00	0.00	−46.79	−3155.89	−116.91	−180.85
Skewness	51.35	15.28	11.44	9.04	12.71	64.77	40.65	4.82
Kurtosis	6.83	3.80	3.30	2.97	3.30	−6.72	−4.53	−0.69

Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: own calculation based on database EMIS, 2019.

It was characteristic of all Visegrad countries that loss-making pharmaceutical companies did not account for even a quarter of all industry players, i.e., the return on equity in the vast majority of cases was positive for investors in the region. In addition, all countries were characterized by an exceptionally high variance in the indicators of upper-quarter companies, although this did not result in a right-sided distribution in the Hungarian and Czech cases, as a significant proportion of the sample performed below the industry average (even if only 8–9 companies realized loss, and this tendency was significant in Poland only). The relatively higher profitability of companies in Hungary was also reflected in the

fact that even the company producing the worst indicator realized more than four times smaller losses, in terms of equity, than the worst-performing Slovak competitor. Although Poland had the highest proportion of financial assets invested and the Czech Republic the highest average return of more than 15 times, the same countries also had the largest losses in the current year as a proportion of their equity. At the same time, it was also true that the pharmaceutical companies realizing the highest return on their equity in the region also operated in the same countries, which led to a high volume of corporate data there.

3.2. Descriptive Statistical Analysis of Financial Indicators with Cluster Analysis

If the entire database of pharmaceutical companies surveyed for the Visegrad countries was classified not into countries, but into groups separated according to their market positions, examining only the financial return on assets ratio and ROE, the observed results may lead to conclusions which may affect managerial decision making more closely. In the K-means cluster analysis, the names of the clusters also express the degree of distance from the regional level benchmark player, i.e., a higher number means a lower regional market share. In the course of the analysis, it was assumed that all companies in the cluster were in competition with each other, i.e., the subsidiaries of larger pharmaceutical companies established in the Visegrad countries were also considered to be competing and separate entities. The statistical characteristics of the sample population divided into two clusters based on logarithmic application to sales revenues due to excessive standard deviation are presented in Table 3. After excluding companies with no turnover, 115 companies were included in the first group with higher turnover and 160 companies were included in the second cluster. On average, companies with a stronger regional market position tended to invest in a higher proportion of promising financial instruments and performed their operations with a higher return on equity. In contrast, in the cluster that also included market leaders, the profitability of the best-performing firm was only a quarter of the highest value in the other group—although they were able to achieve a maximum of three times the financial return on all assets. The former apparent contradiction is somewhat overshadowed by the fact that the largest losses were among companies with relatively low market shares, and behind the outstanding ROE in the positive range, there may have been a high level of indebtedness, negative equity with negative returns or negative accumulated profit reserves as a result of loss-making management, thereby reducing the amount of equity.

Table 3. Descriptive statistical analysis of asset-based financial income and ROE values broken down by revenue clusters.

Indicator	Financial Income per Asset (%)		ROE (Return on Equity, %)	
Cluster	**Low Turnover**	**High Turnover**	**Low Turnover**	**High Turnover**
Mean	1.37	0.86	14.27	12.46
Median	0.36	0.22	10.07	12.91
Std. deviation	4.06	1.63	41.50	336.78
Maximum	43.75	12.37	334.90	1324.90
Q1	0.09	0.03	4.45	2.88
Q3	1.00	0.91	20.23	34.53
Minimum	0.00	0.00	−303.35	−3155.89

Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: own calculation based on database EMIS, 2019.

3.3. Impact Assessment of the Risk of Financial Investment Policy

To verify the correctness of the main hypothesis, the ratio of financial investments within assets and their average return as input variables were used in the regression model, and then in a separate model the values of asset-proportionate financial income indicators were used to eliminate biases. The hypothesis in this case was that the financial investment ratio and/or the average return on financial investment had a significant impact on the ROE

in each country. To obtain more reliable results, outliers were filtered from the corporate database of all countries using the first and third quartiles before running the model.

In the case of examining the ratio and return on financial assets with regression models run on national databases, as can be seen from the results shown in Table 4, none of the explanatory variables treated as input had a significant effect on the return on equity in either country. Regression models run at the national level generally did not show a reliable, strong correlation between the explanatory and outcome variables in any case, which indicated that the highest value of the coefficient of determination expressing the effect of regression estimation on the behavior of the dependent variable did not even reach 6%.

Table 4. Values of financial investment ratio and average return coefficients in multivariate linear regression models.

Visegrad Country	Constants		Fin Investment Ratio		Average Return on Financial Investment		R Square
	Beta	Std. Error	Beta	Std. Error	Beta	Std. Error	
CZ	0.121 *	0.017	−0.176	0.124	0.000	0.001	0.031
PO	0.115 *	0.016	−0.015	0.054	−0.001	0.001	0.008
HU	0.196 *	0.028	−0.176	0.113	−0.004	0.003	0.058
SK	0.109 *	0.021	−0.111	0.191	−0.006	0.061	0.009

* The values indicated in the table are significant at the 95% confidence level ($p < 0.05$). Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: Own calculation based on database EMIS, 2019.

The former results could already be deduced due to the discrepancies seen in the descriptive statistical analysis, i.e., while remaining at the national level breakdown of the sample population, an attempt was made to replace the two input variables with the asset-proportionate value of financial income, with the hypothesis that the financial income per asset had a significant impact on ROE in each country. The results are summarized in Table 5. Contrary to expectations, the results of the linear regression model reduced to a univariate model did not differ in their explanatory power from the values of the previous analysis: The effect of the riskier financial investment policy—which could lead to realizing higher returns—on the profitability of the examined companies' equity could not be shown separately in either country. In this case, even weaker correlations were detected between the explanatory and the outcome variable than in the case of the original two variables: the model had the relatively highest explanatory power in the Czech industry, however, the coefficient of determination was only slightly above 3%, but it did not even reach 1% in the case of the Hungarian and Slovak indicators.

Table 5. Values of asset-based financial income coefficients in linear regression models.

Visegrad Country	Constant		Financial Income per Asset		R Square
	Beta	Std. Error	Beta	Std. Error	
CZ	0.126 *	0.017	−1.297	0.863	0.034
PO	0.104 *	0.015	0.640	0.568	0.016
HU	0.173 *	0.025	−0.289	0.495	0.008
SK	0.108 *	0.021	−1.383	2.999	0.006

* The values indicated in the table are significant at the 95% confidence level ($p < 0.05$). Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: Own calculation based on database EMIS, 2019.

As the development of ROE is not strongly determined on a country level by any indicator characterizing financial investment policy that can be interpreted on an interval scale, the same regression models were set up within the clusters formed according to the sales revenues indicating the regional market position. Based on this, the clusters were named as Low and High Turnover. Initially in this study it was assumed that the previously undiscovered effect of financial risk-taking on the return on equity may appear, or be strengthened, among the players in the sector with a stronger market position. In this case the hypothesis is that the financial income per asset had a significant impact on ROE in the two clusters of companies, based on turnover. The results shown in Table 6, which

indicate the coefficients of the regression models for each group, similarly showed no clear correlation between the size of financial risk-taking and return on equity, which may appear or even intensify with a turnover closer to a market region benchmark company. The results of the model study performed within both clusters clearly refuted the correctness of the initial hypothesis.

Table 6. Values of asset-based financial income coefficients in linear regression models.

Cluster	Constants		Financial Income per Asset		R Square
	Beta	Std. Error	Beta	Std. Error	
Low turnover	0.061 *	0.007	0.000	0.000	0.000
High turnover	−0.168 *	0.144	0.003	0.015	0.000

* The values indicated in the table are significant at the 95% confidence level ($p < 0.05$). Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: own elaboration.

The reliability of the regression model was checked with the examination of multi-collinearity (VIF), normality and homoscedasticity of the residues and based on that, it was concluded that the regression model had not proved to be reliable enough, so the impact of the variables for all companies was then examined (Table 7). In this case, the hypothesis was that aggregate financial income per asset had a significant effect on ROE.

Table 7. Values of asset-based financial income coefficients in linear regression model.

Constants		Financial Income per Asset		R Square
Beta	Std. Error	Beta	Std. Error	
0.133	0.141	0.194	4.062	0.000

Note: HU—Hungary, PO—Poland, CZ—Czech Republic, SK—Slovakia. Source: Own calculation based on database EMIS, 2019.

If all companies were examined, the strength of the cause-and-effect relationship between variables remained unchanged: the financial income per asset had no role in the variation in ROE indicators, so the theoretically plausible initial hypothesis was not confirmed. The lack of correlation and the low reliability of the model suggested that better management of financial assets and therefore, the higher financial income, did not lead to higher pre-tax profits. This may be because more efficient lending, acquisition and financial investment decisions were forced by the need to cover rising interest costs or indirect costs (R&D, marketing) specific to the industry, so the impact on pre-tax profit, and hence ROE, would not be detectable. Although Paramasivan and Subrahmanyan (2020), Subramanyam (2014), Palepu (Palepu and Healy 2013) and Helfert (2001) also formulated the theoretical proposition that, overall, the profitability of firms is influenced not only by their operational efficiency but also by the proper use and investment of their financial resources, the results of this study did not confirm the latter effect in the pharmaceutical sector. This could be partly explained by the fact that companies which realize riskier investments are more indebted, thus higher interest expenses offset the positive effects of financial returns, which is also partly supported by the results of Fenyves et al. (2019), who showed that the level of indebtedness has a not significant effect on the size of the after-tax profits of profitable firms.

4. Conclusions

The aim of this study was to confirm or refute the initial hypothesis, namely that in one of the Visegrad countries or above a certain revenue category, more efficient management of financial investments (acquisitions, loans) in the pharmaceutical industry generates higher profitability on equity. Contrary to expectations, the investigations showed that there was no strong correlation between the explanatory variables and the outcome variable included in the regression model, neither at the national level nor at the level of regional market position groups. Since statistical relationship is not detectable between the ROE express-

ing dividend expectations and the financial income per asset indicator, it is not typical for pharmaceutical companies to make higher risk decisions in the financial investment market in order to achieve a better position in view of equity investors. As a consequence, the extremely high level of indirect cost is mostly financed by the management of the pharmaceutical companies, besides the sales revenue of the successful products, from financial income. Additionally, as suggested by Malerba and Orsenigo (2015) and Scherer (2000), companies that are not indebted to only suppliers tend to take on risks associated with higher returns on financial investments, thereby offsetting the positive effect of the latter on earnings, which would be reflected in the regression estimate. Spatial and temporal limitations of the financial analysis included that the queried corporate database covered only the Visegrad countries with a different number of industry players in each country, and that only data from the most recently published financial statements were considered in the study. In addition, it was a limitation that the statistically exceptionally high ROE value was driven by persistently adverse management decisions rather than profitable operations. Further investigation of this research question is warranted using newer firm databases, multi-year periodic data, and building on this, panel regression analysis methods, which may even modify the above model results. As it would have been justified from a management point of view to confirm the initial hypothesis, further research on the profitability impact of higher financial risk-taking may also be appropriate by including time series data as well as indicators from Western European and North American pharmaceutical companies.

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