



Profitability of Pharmaceutical Companies in the Visegrád Countries

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ABSTRACT

The pharmaceutical sector is one of the most profitable industries in the world, despite the very high proportion of the required research and development costs that determine the activity itself and the high risks involved in investing in them. In addition to a number of industry-specific characteristics, the innovation policies of each country might also have a significant impact on the efficiency of pharmaceutical companies. The primary aim of the research was to demonstrate this effect in the case of the Visegrád countries. The ROE seemed to best reflect the ownership interests and the combined effect of other profitability ratios and it was confirmed by analysis of variance. The analysis was based on the EMIS corporate database; multivariate statistical methods were applied to demonstrate the reaching of indicator trends, and from among those methods regression analysis was applied in particular. Based on the findings, it was concluded that primarily the more profitable pharmaceutical companies were able to utilize their assets more efficiently, while manufacturers in the latter category financed their operations with external capital to a lower extent. Although the indicators of the analysed companies showed a very high standard deviation in all four countries, the results of the regression were only outstanding in Slovakia, which had a very low number of cases. In addition, temporal tendencies have been almost the same in the entire region, which was also influenced by the fact that return on capital of the business entities within the sector decreased by 2016 throughout the region.

INTRODUCTION

As an economic and political entity, the European Union is an alliance of 28 Member States and an indispensable player in the global economy. The Member States of the European Union can be classified on the basis of various criteria, of which geographical divisions and date of their accession are the most common. EU Member States can also be classified on a political and regional

basis; such groups are the BENELUX countries, the Baltic States and the Visegrád Countries. From the point of view of the functioning of the European Union, the analysis of the operation and economic situation of each group of countries is of paramount importance. The purpose of present article is to analyse the economies of four EU Member States known as the Visegrad Four, namely the Czech Republic, Hungary, Poland and Slovakia, including the economic situation and profitability of active companies that operate in the pharmaceutical industry. The Visegrad Countries are the most dynamically developing group of countries in the EU-28. The group is likely to be further expanded with some countries from the West Balkan, some of which are current EU Member States and some of which are expected to join the EU in the near future. Moreover, the group of V4 countries might also be extended by the EU member states of the Baltic region. This potential expansion process could also result in the increased role of V4 countries within the European Union (Gál, 2018). At the time of joining the European Union, the V4 represented the seventh largest "economic block" of the EU28 (including the three Member States that joined the EU later), accounting for 3.8% of the GDP of the EU calculated at current prices. This rate rose to 5.4 percent by 2014, continuing to hold seventh place after the Netherlands (Buzás-Német and Tóth, 2015). The economic situation of the V4 has been increasing slowly and to varying degrees since 1995, with GDP per capita at EU-28 average showing that the Czech Republic has developed the most dynamically, followed by Slovakia, Hungary and finally Poland. GDP per capita of Poland increased by multiple fractures, similar to Hungary. The development was not as dynamic as in the case of the other two countries. However, the V4 countries are well below the EU-28 average. (Lipták, 2018).

1. LITERATURE REVIEW

1.1 Profitability and financing trends in the pharmaceutical industry

Calculation of profitability indicators (ROS, ROA, ROE) is of great importance in industrial and corporate financial analysis. Among other aspects, sector-level analysis serves to inform investors who are open to multiple areas, managers of industrial actors, and creditors: managers need to compare the financial performance of their companies with the benchmark, investors seek to achieve the highest return on capital, while creditors consider the probability whether companies will be able to repay the credits received from them (Finkler et al., 2019). The ROS indicator helps determine the effectiveness of activities managed by companies (Shah, 2010). In order to maximize ROA, it is necessary to effectively manage sales prices, marketing, R&D activities, production and numerous other business areas (Subramanyam, 2014). Index number-based evaluation of the effectiveness of corporate performance, the efficiency of capital movements, and profitability of the utilized tools can be somewhat distorted by uncertainties related to accounting and valuation methods, but together they might be able to provide rational conclusions about the performance of a company (Helfert, 2001).

According to the estimates of Global Database (2019), global pharmaceutical sales are expected to reach \$ 1,170 billion by 2021, while the size of medical device markets are expected to exceed \$ 400 billion by 2023, while the number of business entities involved in the pharmaceutical industry currently approaches 316 thousand. Income that is the foundation of the profitability of companies operating in the sector is exposed to both direct and indirect negative risks. As Dickson and Gagnon (2004) summarized, direct income-reducing effects include the limited medical aids of insurance companies, while indirect effects primarily include the reduction of pension benefits, which will increase the number of people who have although retired but still do not have a health insurance, thus reducing the long-term scope of demand of manufacturers. Additional risks are identified by Dickson and Gagnon (2004): on the one hand the likelihood that, over a prolonged period of scientific research competing companies might gain a competitive advantage (by reducing return on investment and increasing their sunk cost) and on the other hand the time needed to approve new drugs delays product marketing and the subsequently incoming cash flow.

According to the calculations of Basu et al. (2008), in the case of companies that produce generic products manufacturing costs account for nearly half of their income, while in the case of brands, this ratio is 27%. In the case of biotechnical companies, gross margin remaining after the deduction of direct costs is the highest, however, within the industry these companies are mostly characterised by investing in R&D activities, therefore their related costs are the highest in the sector, as opposed to generic manufacturers, where the former costs represent only one third of the same values of biotech companies (Basu et al., 2008). The conclusion of the author is that overall, gross profitability of generic products is the lowest - compared to the sales of brands and biotechnology products, however the share of direct costs already showed a significant decline in the second half of the 2000s.

It is generally characteristic for capital intensive and investment intensive industries to achieve higher return on assets at low asset turnover rates. With an average turnover rate of 1.5 in the analysed sector business entities are able to provide a net return on sales (ROS) of almost 11%. Partly due to this, the highest (more than 15%) net operating return on assets (ROA) is characteristic of the pharmaceutical industry, followed by the sectors of agriculture, IT and clothing products. However, due to the high equity investments that are characteristic to the sector, return on equity is already lower in the sector than in the case of the agricultural or clothing sectors and is equivalent to the approximately 13% value of retail sales (Subramanyam, 2014).

In the study of DiMasi et al. (2016), mostly data of the top-25 companies and to lower extent other companies outside of it were analysed, showing that in the sector, expected returns for owners and creditors declined in the 2000s on after-tax nominal value, and this trend - despite the rate of inflation, which was also taken into account as declining - was detectable (by 2.4 percentage points) in real value. It has become common for research-intensive industries that the majority of their investments are funded through equity rather than foreign capital (DiMasi et al., 2016), which may have a negative impact on their return on equity. According to Belas et al. (2017), although the higher bank funding of R&D companies as compared to non-R&D companies cannot be detected, there is some difference among the Visegrád countries within the scope of developing firms: Hungarian firms typically take more bank loans for funding innovation than those based in Slovakia.

Management of working capital also plays a key role in the profitability of business entities within the sector: Chowdhury et al. (2018) demonstrated through the analysis of East Asian pharmaceutical companies that the length of operational cycles funded by suppliers has a significantly positive relation with ROA and a negative relation with ROE, while the operational cycle itself has a strongly negative correlation with both ROA and ROE. Thus, greater efficiency in working capital management is required to ensure profits.

Profitability indicators also proved to be suitable for evaluating the performance of pharmaceutical business entities: analysing biotechnological companies, Anghel et al. (2018) found that while the relationship of their Market-to-Book Value (MTB) (which demonstrates their market value) with ROA and ROE is strongly negative, as opposed to previously published literature, there is a strong positive correlation with the efficiency rate of R&D expenditures, which makes the latter indicator more suitable for measuring the performance of the industrial segment that is forced to carry out more research activities.

1.2 Sectoral characteristics and the role of R&D&I in profitability

The profitability situation of pharmaceutical companies is significantly influenced by R&D expenditures, even if these expenditures are capitalized by the company, since accounting of R&D for the given year still deteriorates its financial results (Takács, 2014, 2015). The cost of developing a new medicine can be planned at a relatively high risk: according to the estimations of English-language studies published between 1980 and 2009, the highest cost was 9 times higher than the

lowest cost, while the extent of capitalized costs was more than \$ 1.6 billion (Morgan, 2011). Di-Masi et al. (2016) estimated the total out-of-pocket and capitalized R&D costs for a new medical product between approximately \$ 1395 million and \$ 2560 million, calculated at 2013 values. By the end of the 1980s, the average pre-tax cost of USA-owned pharmaceutical companies for an approved product reached approximately \$ 114 million (DiMasi et al., 1991). However, according to Comanora and Scherer (2012), corporate mergers that took place in the second half of the 2000s contributed to the observed decline of the pharmaceutical innovation rate. Douglas et al. (2010) also point out that the pharmaceutical industry is currently forced to face a decline in R&D productivity, larger barriers to the commercial success of innovative medicines and a significant loss of revenue originating from successful products due to generic competition.

However, according to Cockburn (2004), the cost of medicine development will not decrease in the future, therefore any policy that would keep the increasing cost burden of research far from consumers could lead to the financial collapse of the biotechnology sector (Cockburn, 2007). Studies conducted by Berndt et al. (2015) also confirm that the returns of medicine development that peaked around 2000 has fallen to its lowest level in two decades due to rising development costs and declining demand for revenue that affected revenues, therefore maintaining medical innovation in the long run might be doubtful from a financial and economic standpoint.

However, it can be observed in the case of international pharmaceutical that their core business and business model shifted from research and development of innovative substances towards the marketing of pharmaceuticals, making it easier for them to maximize profits in developed countries (Henry and Lexchin, 2002; Lanjouw, 2002).) and by which they are able to diversify their activities. The future success of non-innovator pharmaceutical companies also depends on the focus of their business models on exploiting the growth opportunities offered by generic products and emerging markets (Schuhmacher et al., 2016). To ensure a higher level of profit over the longer term, manufacturers also apply multiple market techniques to extend patents of their products, such as vigorously distributing new formulations of earlier products before putting generic products on the market or cooperation with generic manufacturers to keep certain products out of the market (Henry and Lexchin, 2002).

Companies that contribute to the creation of major patents at a lower extent, might still be strategically or economically successful (Henderson and Cockburn, 1994). According to the standpoint of Kremer (2002), through the exploitation of price discrimination profitability of business entities within the sector can be further increased, since it allows that the ones that value the product to be higher than the marginal cost of production can obtain it and thus the product reaches more people than it would at a single, monopolistic global market price. In addition, the theory of strategic intent also prevails in the pharmaceutical industry according to which aggressive companies absorb all the capabilities that are required for them to stay on the market (Brown, 2015). According to Powell (1998), business entities in innovation-oriented sectors are committed to becoming familiar with competitive situations. Bramhandkar (2007) also confirms the above by concluding that, regardless of financial performance, higher profitability can be achieved through market relationships and human capital and the better management of intellectual capital.

Pharmaceutical regulatory policies can also have a significant impact on the profitability ratios of the sector. As described by Hutton et al. (1994), it is also clear from European examples that policy changes within the health sector, through more flexible pricing, might have a significant impact on both the current revenues of pharmaceutical companies and future R&D decisions and expenditure (even if they will not become apparent for several years). Companies have also become able to recognize the features of the innovation process even for developed products that hardly contribute to the profitability of the company (Hutton et al., 1994). In addition, patent-based protection of intellectual property rights is of paramount importance in order to maintain the effectiveness of intensive R&D expenditures (Kovács, 2018).

According to studies of Sherer (2001), changes in profitability measured with gross margin also affect changes in R&D costs, as long as decision-makers of the sector are able to forecast

the changes in general industry conditions within 2 years or more. Based on the growth trends observed since 1962, Sherer (2001) estimates that by 2025 R&D expenditures will exceed the gross margin. By 2030, the process from the discovery of new formulations at an early stage to their commercialization will be largely outsourced, while manufacturers will seek to reduce the high costs of clinical trials and data collection (Sancheti et al., 2018). As stated by Sancheti et al. (2018), sales of generic products within global pharmaceutical sales increased by 4 percentage points to 10% by 2017, as the industry focused on blockbuster drugs, which are main source of recurring revenue of the sector (Paul et al., 2010). However, the number of marketed pharmaceuticals has fallen nearly 30-fold over the past 40 years for \$ 1 billion R&D costs, bringing the current return on such investments to only 3.2%. Higher levels in R&D spending result in the significantly higher market value of companies (Nord, 2011). According to the calculation of Schulze et al. (2014) involving the top 20 pharmaceutical companies, 25%-35% of R&D spending is required to return for achieving a revenue level equivalent to a 9% cost of capital within the pharmaceutical industry, namely it is required to increase corporate revenues through the release of new pharmaceuticals at an equivalent value (Schulze et al., 2014).

The global development of research-oriented sectors would be significantly facilitated if the interests of manufacturers and developers operating on different continents became relatively easy to harmonize, however, as Dunning and Lundan (2009) points out, in the case of the promotion of patented technology standards that are the framework for innovation, which is largely based on community investments, state interests will still be significant. The segment of the industry which operated in developed regions is also heterogeneous: European manufacturers are demonstrably more likely to launch new products than their North American competitors, while the non-biotechnology sector performs better if the revealed patents can be linked for at least one third to Europe and at least the same proportion to the USA (Pammolli et al., 2011).

1.3 Innovation policy in the Visegrád Group

Promoting corporate innovation plays a key role in the economic policy of the Visegrád Group: both Hungarian and Czech tax laws provide an opportunity to deduct R&D expenditure from the tax base (Lengyel and Cadil, 2009). From among the Visegrád Group, Slovakia has benefited the most from the advantages of the EU accession, while Poland has provided the least comfortable conditions for developing a competitive business environment, however this tendency has strongly improved in the last decade (Molendowski and Żmuda, 2013; Wojciechowski). Owczarczuk (2013) also confirms that Poland has the least governmental incentives for promoting innovation, although R&D based investments are carried out with the highest proportion in Poland among the V4 countries. In a broader context however, Hudec and Prochádzková (2015) points out that countries of the Visegrád Group countries are among the worst performing countries of the EU in terms of innovation and competitiveness, however the Czech Republic (followed by Hungary) stand out as Central European countries with the best innovation performance.

2. DATA AND METHODOLOGY

The data of the companies involved in the survey were selected from the EMIS system; companies having the 3254 NAICS (North American Industry Classification System) code, and operating in the "Manufacturing of Pharmaceuticals and Medicine" sector during the three years of the survey (2015-2017) were selected from all four countries. The data included in the analysis was based on the data of the annual statements of the companies, where the unit of measure was always indicated in million EUR. The database contains data of 37 companies from the Czech Republic, 63 from Hungary, 164 from Poland and 21 from Slovakia.

In the scope of the analysis, the IBM SPSS Statistics software package was applied. First, descriptive statistic elements were used. Each country was examined separately and the statistical

characteristics of 4 important financial variables were analysed in each country in the available years. The most important of these are the mean, standard deviation and α_3 skewness, which follows a right skewed distribution (left leaning curve) for positive values, meaning that lower values are more often included in the data than high values, while in the case of negative values, the distribution is skewed to the left (right leaning curve), which means that in this case, higher values occur more frequently. In addition, we also examined the values of the quartiles. Correlation analysis and linear regression analysis were performed to explore the relationship among the data. When constructing the model, some variables were logarithmized and the multivariate linear regression analysis was run on these variables. In the course of the multivariate linear regression analysis the Backward procedure was applied, the most important elements of which are as follows: In the case of the Backward procedure, in the first step, all the specified explanatory variables are included in the model, and then the procedure continues by selecting (by means of a with a partial correlation value) the explanatory variable that has the smallest absolute direct effect on the dependent variable and then examining whether this explanatory variable has a significant correlation with the dependent variable. This test is performed using the partial t-test. By default, level of significance was set to 10% in our case. If, on the basis of the partial t-test, it is decided that this variable is not significant, then the explanatory variable is removed from the model and the previous step is performed again on the remaining explanatory variables. However, if the variable is considered to be significant, it is not removed from the model, the process stops and the final model is formed. The reliability of the obtained models was confirmed by means of regression ANOVA, and the explanatory power of the obtained models was tested by a coefficient of determination, with the R^2 index. The coefficient of determination provides the percentage of the standard deviation of the dependent variable that can be explained by the explanatory variables included in the final model. This index is always between 0 and 1, and the closer it is to 1, the better the explanatory power of the model.

3. RESULTS AND DISCUSSION

3.1 Comprehensive analysis of the indexes of companies operating in V4 countries

Although the significance of profitability ratios for revenues and total assets is considerable in making financial and investment decisions and preparing sectoral analyses, it was evident from the results of the analysis of variance for the three variables that while no significant difference was found between ROS and ROA among the countries (the significance of F values in both cases was $p > 0.05$), in the case of ROE the difference was confirmed ($p < 0.05$). For this reason, subsequently the different temporal development of ROE for each country was examined.

From 2015 to 2017, the number of companies manufacturing pharmaceutical or medical products in the Visegrád countries increased by 8.7%. If both extreme and standing out values are taken into account, standard deviation gives a multiple of the mean value for each indicator and year, therefore the latter values are less able to represent the population of enterprises. The standard deviation of the sample was influenced by the fact that it also includes entities of the sector that have ceased their activities or are currently going out of business because they have no sales revenue and, according to the data recorded in the database, they have no accounted assets or profit. Although companies in the examined region reported overall revenue growth by 2016, which was also reflected in the mean values, these values have already declined significantly by 2017: half of the business entities still had sales of more than EUR 5.4 million in 2015; this threshold increased by almost EUR 1 million by the following year. However, in the last analysed year, the increase in the number of new producers in their initial phase, entering the market with lower turnover had an impact on the distribution of the indicators. Nevertheless, in the case of the producers achieving the highest turnover, the opposite tendency was observed, which resulted in

an increase in the maximum turnover of the industry in the region by more than EUR 1 billion compared to 2015 (which was achieved throughout the examined period in the Czech Republic).

However, with regard to the assets of the companies, the same trends indicated in the distribution of revenues can be observed, for which the maximum values were no exception. In each of the three analysed years, the lowest performing 25% of the manufacturers were showing a deficit; the growth of revenue mostly affected the better-performing half of the population as the minimum detectable profit level increased by EUR 35,000 in 2016 and then decreased by EUR 140,000 in the case of the latter half of the sample. As indicated by the indexes of kurtosis, mean is multiple times higher than the median values, with the standard deviation being the highest in the top 25% of all companies. Larger fluctuations can be detected in the case of the financial performance indicator ROE (Return on Equity), which expresses the return on equity: due to their operation resulting in deficit, 25% of the lowest performing manufacturers also reported negative ROE values, although in 2015 and 2017 companies with negative equity were included in the database, therefore in some cases a positive return on equity of 1-2% was observed in the lower quarter.

Table 1. Analysis of the main indicators of pharmaceutical companies operating in V4 countries in 2014-2017.

Financial data in million EUR

Financial year (data in million euro)			Net revenue	Total asset	Profit after tax	Return on equity (ROE) (%)
2015	N	Valid	262	262	262	262
		Missing	0	0	0	0
	Mean		54,3274	67,1055	3,8734	2,6873
	Std. Deviation		170,48960	318,46535	26,43710	219,74056
	Skewness		5,856	10,578	8,185	-11,855
	Std. Error of Skewness		0,150	0,150	0,150	0,150
	Minimum		0,00	0,00	-124,41	-3153,42
	Maximum		1659,75	4275,88	327,55	476,42
	Percentiles	25	0,7600	0,9525	0,0000	1,5650
		50	5,4050	5,3900	0,2650	11,3350
		75	25,9950	30,7225	1,5525	30,2650
2016	N	Valid	268	269	269	269
		Missing	1	0	0	0
	Mean		59,6463	71,3204	4,0792	-485,1092
	Std. Deviation		180,36451	356,38794	18,20703	7328,02319
	Skewness		5,287	11,168	8,097	-16,274
	Std. Error of Skewness		0,149	0,149	0,149	0,149
	Minimum		0,00	0,00	-26,09	-119906,31
	Maximum		1621,85	4950,84	215,19	167,26
	Percentiles	25	1,0975	1,3950	0,0100	2,7650
		50	6,3250	7,3500	0,3400	9,6900
		75	26,9625	32,3800	1,6550	25,7150
2017	N	Valid	285	286	285	286
		Missing	1	0	1	0
	Mean		56,5296	66,0880	2,7299	20,1765
	Std. Deviation		187,44987	281,34360	12,53011	86,18008
	Skewness		5,824	9,510	6,848	4,802
	Std. Error of Skewness		0,144	0,144	0,144	0,144
	Minimum		0,00	0,00	-42,57	-487,97
	Maximum		1757,81	3599,87	143,65	881,67
	Percentiles	25	0,8000	0,9800	0,0000	1,3850
		50	5,1400	5,3550	0,2000	9,6550
		75	23,2850	29,9850	1,5850	26,3350

Source: own calculation using the SPSS statistical software

For the lower performing half of the population, the achievable highest ROE values followed a clear declining tendency: there was a 2 percentage point decrease from the 11% value of 2015 and then it stagnated at that level (see Table 1). Although the highest ROE indicator increased more than seven times compared to the previous year, this rise only increased the standard deviation of the values of the upper quarter indicators and not their number.

3.2 Analysis of the development of ROE indicators in countries of the region

Amongst the Visegrád countries, Poland has by far the largest number of companies active in the pharmaceutical sector, which is mainly explained by the relatively large size of the national economy compared to other countries in Central Europe. Poland also had the highest standard deviation, with Polish companies having the lowest and highest ROE indicators for the analysed period. The minimum values indicated several thousands of negative values in 2015 and 2016, which were attributable to losses due to non-remunerative investments in innovation, but this value increased to -80% by the last examined year. The standard deviation of companies belonging to the quarter providing the weakest indicators - the majority of which are in deficit - changed significantly in 2016, but mostly in a negative direction. Although, unprofitable Polish manufacturers became more profitable by 2017, the highest profit fell by nearly 1 percentage point. In 2016, the company providing the best return on equity had an indicator only one-third of the value of the previous year, but for the last year, with the improving profitability of manufacturers from the top quarter it also multiplied. Half of the Polish pharmaceutical companies achieved and exceeded 8-10% return on equity each year.

Hungary has the second highest number of pharmaceutical companies, not least due to its innovation policy and support for research and development. Both the distribution of quartiles and the development of extreme values indicate that the performance of the sector in Hungary decreased significantly by 2016, similarly to the other countries of the region. However, compared to Poland, indicators of the best performing companies in 2017 also fell by more than half, but this was due to declining standard deviation and lower profits of companies belonging to the top quarter, rather than to a decline in overall profitability of manufacturers. While half of the business entities of the sector achieved a return on equity of at least 19% in 2015, it has fallen by 6 percentage points in 3 years, even though it is still the highest in the region.

Throughout the examined period the number of pharmaceutical companies operating in the Czech Republic accounted for nearly half of Hungarian companies and nearly a quarter of Poland, despite the fact that support of innovation is the most prevalent within the economic policy of this country in the region. Although the same trend is observed for Czech manufacturers in terms of minimum values, the increase in the lowest ROE by 2017 did not even approach the rate of change recorded in Hungary in this field, with the indicators of the best performers falling from 114% to 70%. While some of the companies belonging to the top quarter achieved higher profitability levels in 2016, this level has remained significantly below the minimum values achieved by the top quarter companies of other countries within the region. Half of the pharmaceutical companies were able to generate returns of over 5-8% for their owners during the analysed period, which was still below the figures for all other countries within the region (it only managed to approach the results of the similarly weakly performing Polish manufacturers).

Although Slovakia has the lowest number of business entities within the sector, by 2016 it has already risen one and a half times due to newly entering enterprises. Still, in the same year, even the lowest performing manufacturer managed to achieve better results than the minimum value of the Czech Republic indicating almost 750% of negative ROE, and the average profitability of the enterprises belonging to the lowest 25% exceeded that of neighbouring countries. However, this tendency does not apply to the entire population: while half of the business entities within the sector were able to provide at least a 22% return on equity in 2015, a decline of more than 10 percentage points led to a drastic decrease to 14% and 11% in the in the following years; the majority

of previously more profitable Slovakian companies experienced a significant decline in the last year (see Table 2).

Table 2: Descriptive statistical analysis of ROE values broken down the Visegrád countries in 2015-2017.

2015		CZ	PL	HU	SK
Mean		-2,6397	-12,3674	40,5273	16,6081
Std. Deviation		59,90679	285,5455	56,6384	32,49464
Minimum		-293,03	-3153,42	-54,1	-73,22
Maximum		114,6	476,42	246,93	60,11
Percentiles	25	0,58	0,465	6,43	2,775
	50	6,01	9,645	18,92	22,46
	75	14,52	28,99	50,97	32,7925

2016		CZ	PO	HU	SLO
Mean		-14,4454	-71,7642	-2,8425	-4972,05
Std. Deviation		133,9327	712,4586	193,4795	24480,91
Minimum		-749,28	-7881,86	-1506,55	-119906
Maximum		84,05	167,26	122,72	94,07
Percentiles	25	3,48	2,1575	3,9475	5,1725
	50	8,79	8,24	15,37	14,325
	75	20,23	23,565	30,4775	31,855

2017		CZ	PO	HU	SLO
Mean		-14,3976	31,2134	14,5063	13,5571
Std. Deviation		99,04034	99,16099	30,10435	36,37687
Minimum		-487,97	-80,01	-104,25	-114,38
Maximum		70,34	881,67	67,45	85,7
Percentiles	25	0	1,3325	2,16	5,97
	50	5,255	8,675	13,05	11,18
	75	13,74	30,775	31,62	26,625

Source: own calculation using the SPSS statistical software

4. RESULTS OF THE REGRESSION ANALYSIS

According to the literature dealing with the correlation among financial performance indicators (Du Pont system of index numbers), development on the return on equity can be influenced by return on sales (ROS), the turnover rate reflecting the efficiency of asset management and the rate of indebtedness (external capital/equity), however, this is not proven to be significant for all factors. The explanatory power of the models established between ROE and the above independent variables proved to be strongest in Poland (where the value of R-square was close to 66% with the inclusion of only significant variables), but in the case of the Czech Republic and Hungary a strong correlation was observed as well (in the former case the coefficient of determination was 63.5%, in the latter case it was more than 57%), while the weakest but still moderately strong correlation was found in the case of Slovakian manufacturers (31.3%). The significance values of the F-test confirmed the adequacy of all the set up models. As return on equity has fluctuated significantly over time and did not show a clear increase or decrease in any country, financial years did not remain in any of the final regression models as significant factors.

As shown by the values of the standardized coefficients, the return on equity of Czech companies was mainly influenced by the development of their profits and their debt exposure at 10% level of significance: with a 1 percentage point change in return on sales, the ROE would increase by about 4.9 percentage points and the structure of liabilities would shift towards debt. It is com-

mon in the models set up for Czech Republic, Poland and Hungary that return on sales has a decisive influence on the profit variable, i.e. the return on equity is primarily determined by the efficiency of the use of resources, cost management and the success of the sales policy. The shift of liabilities towards debt only approached the effect of ROS in the case of Czech companies. Although this effect was prevalent in Poland, the increase in leverage in both countries was accompanied by a noticeable decrease in ROE, meaning that primarily the loss-making companies (realizing negative profit) had debt exposure accompanied by higher interest expense that increases loss, while this was not clearly demonstrated in the case of profitable manufacturers. However, this is somewhat modified by the fact that on the basis of the Chi-square test performed for pharmaceutical companies categorized on the basis of their level of indebtedness and their effective operation, the null hypothesis concerning the independence of the former category variables cannot be rejected (see Table 3).

The utilization of assets had a significant effect on the return on equity in all the countries of the region except the Czech Republic. Opposite to dependence on external funds, the coefficients of this variable have already proved positive in all cases: more efficient use of assets has been achieved by profitable businesses, since the value of ROE can only be increased by this efficiency indicator if the financial profit is positive. However, this effect was manifested to varying extent in each country: a one order of magnitude increase in the turnover rate increased the ROE of Polish pharmaceutical companies by more than 34.5 percentage points and their Hungarian competitors by 11.7 percentage points (see Table 4). In Hungary, the return on equity in the pharmaceutical industry was not significantly influenced by the level of indebtedness, but the role of the quality of asset management can be attributed to a much larger role.

The latter is also confirmed by the Chi-square test of independence, which was conducted between two possible categories of the profitability of companies (profitable and unprofitable if zero-profit companies belong to the latter) and the categories of assets based on their turnover rate (see Table 3). The results show a significant correlation, namely profitable pharmaceutical companies were characterized by the more effective utilization of their assets. However, it is noteworthy that there are differences in terms of the performance of the Visegrád countries (if it is considered a new category variable), namely the profitability of pharmaceutical companies is also indirectly influenced by their country of residence and its innovation policy.

Table 3. Results of the Chi-square tests performed amongst category variables

1st category variable	Profit after tax (+/-)	Profit after tax (+/-)	Profit after tax (+/-)
2nd category variable	Total asset turnover	Debt/equity ratio	Country
Pearson Chi-Square	40,523**	1,074	11,107*
Likelihood Ratio	37,553**	1,099	12,033**
Linear-by-Linear Association	29,131**	0,892	7,893**

** The values shown in the table are significant at a 99% confidence level ($p < 0.01$).

* The values shown in the table are significant at the 95% confidence level ($p < 0.05$).

Source: own calculation using the SPSS statistical program

The financial results of Slovakian pharmaceutical companies, which differed significantly from other countries, were influenced by the fact that the number of examined business entities within the sector was far below that of the neighbouring countries, and the sample population also had extremely low extreme values, therefore the values of coefficients can be interpreted with a fairly high standard error. In Slovakia, the impact of the return on sales and the amount of results were offset by asset efficiency and financing policies. Despite the smaller sample size, the negative coefficient of leverage - similarly to that of the Polish and Czech pharmaceutical companies - shows

that unprofitable companies tended to have higher proportions of external funding, while asset utilization had a decisive impact only on profitable companies.

Table 4. Values of coefficients of significant factors affecting the development of ROE in multivariate linear regression models.

Country, Model		Unstandardized Coefficients		Standardized Coefficients	Sig.	Correlations		
		B	Std. Error	Beta		Zero-order	Partial	Part
CZ	(Constant)	9,902	24,614		0,690			
	ROS (%)	4,899	0,975	0,533	0,000	0,660	0,647	0,513
	log_debt_vs_equity	-28,587	6,541	-0,464	0,000	-0,610	-0,594	-0,446
PO	(Constant)	45,409	20,455		0,028			
	ROS (%)	0,965	0,064	0,733	0,000	0,799	0,735	0,633
	log_asset_turnover_ratio	34,715	16,498	0,101	0,037	0,471	0,149	0,088
	log_debt_vs_equity	-14,833	5,648	-0,111	0,009	-0,229	-0,185	-0,110
H U	(Constant)	0,470	2,673		0,861			
	ROS (%)	2,009	0,231	0,707	0,000	0,685	0,734	0,706
	log_asset_turnover_ratio	11,720	2,933	0,324	0,000	0,275	0,444	0,324
SK	(Constant)	1926,382	2675,883		0,476			
	log_asset_turnover_ratio	4093,852	2400,732	0,234	0,096	0,352	0,263	0,226
	log_debt_vs_equity	-2245,861	684,707	-0,451	0,002	-0,512	-0,465	-0,435

Source: own calculation using the SPSS statistical software

CONCLUSION

The aim of the analysis was to examine the profitability situation of pharmaceutical companies operating in the Central and Eastern European region through the values of return on equity (ROE), which is, which is the most appropriate performance indicator from the aspect of equity interest and division of factors breakdown. Among others, the limitations of the financial analysis included the fact that a different number of business entities operate in the sector in the Visegrád countries, and in Slovakia (which the lowest sample size) companies representing extreme figures accounted for a significant proportion of the total population, which sharply distorted the values of the regression coefficients. In addition, we included in the analysis the values of every company (especially due to the small ample size of certain countries) that had not been established in the first analysed year or had ceased to exist by the las year. Overall, correlation analyses confirmed that the financial risk of indebtedness and higher leverage within the industry mostly afflicts manufacturers that are already unprofitable, and that profitability is financed less by creditors, rather by private equity investors or internal funding resources. However, due to the higher fixed asset ratios of manufacturers, only those who could maintain a stable level of sales with well-functioning cost management and market embeddedness were able to turn their assets into a better turnover. All in all, profitability trends have improved in the last year in terms of the most important corporate indicators, therefore further convergence of the innovation policy of Visegrád countries towards Western Europe, stopping the decline of the region in this field, and promotion of equity investors are the most important factors that could contribute to turning the pharmaceutical industry to a leading sector in Central Europe.

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