University doctoral (PhD) dissertation abstract

COMPARATIVE RISK ANALYSIS OF HAJDÚ-BIHOR AND BIHOR COUNTIES' SMALL AND MEDIUM-SIZED ENTERPRISES

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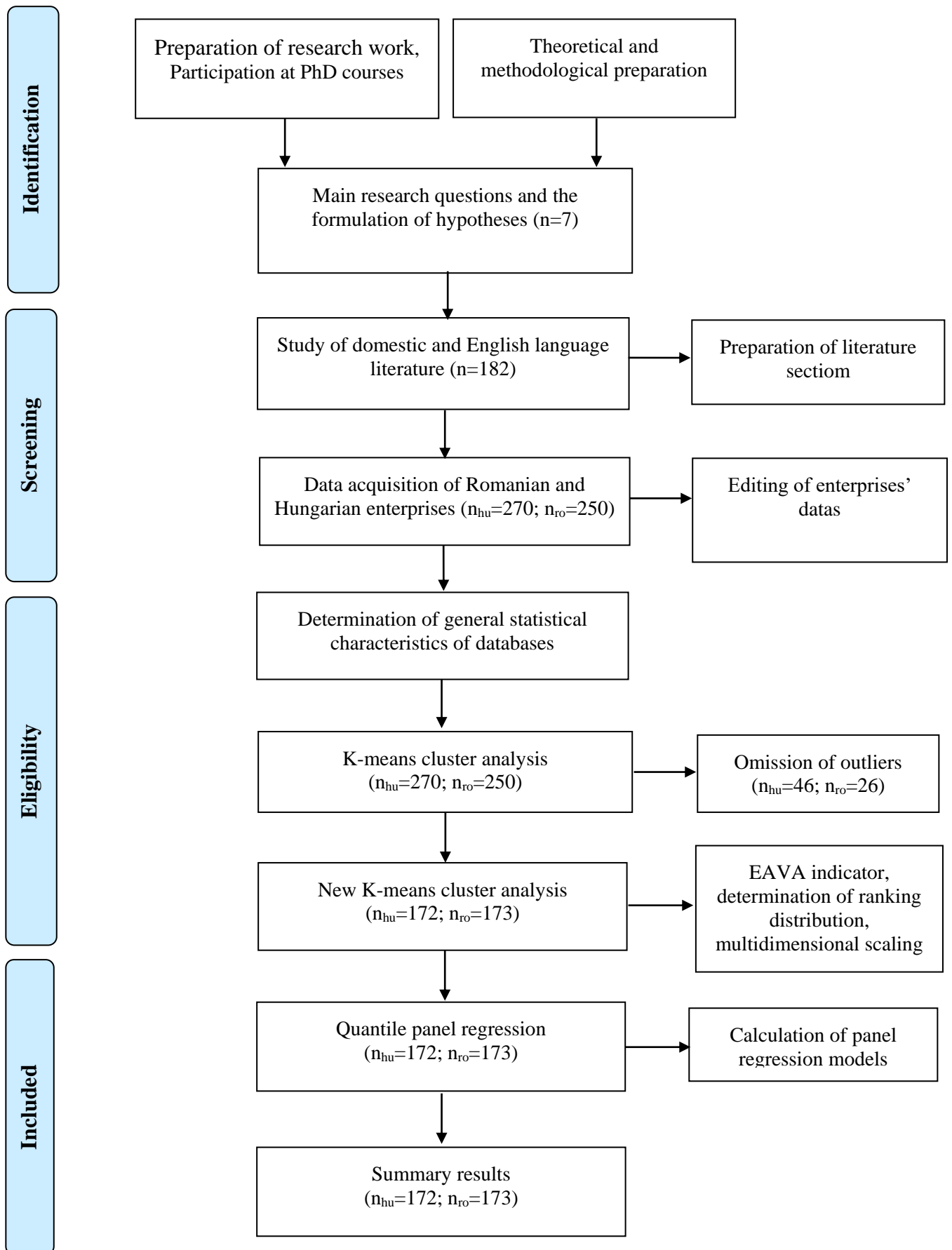
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Contents

1. Research questions and motivation of the dissertation

Risk is one of the most determinative, but at the same time, one of the most controversial questions of economics. Risk assumption is a key element of profit generation and hereby of shareholder capital maximizing. Therefore the determination and measurement of risk have become an essential task for companies. The rapid and often unpredictable changes in the economic environment, globalization and the strengthening of competition have place even more emphasis on the importance of risk-taking. Companies need to take risk to ensure their subsistence, the necessary performance, the continuous adaptation to economy and customers' needs, the profit achievement, briefly the competitive functioning. The balance between the performance and the risks involved in it can be decisive for companies.

In order to determine a tolerable risk level, it is essential to map and quantify risk factors. Moreover, working out activities for managing them should be important, as well. Expressing corporate risk with right values is not an easy task.

Taking into consideration the above mentioned information, the main aim of my research is to find those factors that affect corporate risk and to identify the standards that measure corporate risk properly. Regarding to this, I have chosen to analyse the leverage ratio of Hungarian and Romanian companies. Taking into consideration the length limits of my doctoral dissertation and the complexity of the research questions mentioned above, I have set apart the following issues in my research:

1. Which are the main factors that influence corporate risk?
2. With regard to the risk factors, can we identify significant difference between the investigated companies from the two countries?
3. What degree of homogeneity/heterogeneity is specific to the enterprise databases of the two mentioned countries?
4. Could we establish a specific relationship between leverage indicators (DOL, DFL, and DCL) and some financial ratios?
5. Regarding to the obtained results, is there a significant difference in risk levels expressed with some risk measurements (degree of leverage, dispersion measures, and financial ratios)?

Identification

| Preparation of research work, Participation at PhD courses | Theoretical and methodological preparation |

Main research questions and the formulation of hypotheses (n=7)

Screening

Study of domestic and English language literature (n=182) → Preparation of literature sectiom

Data acquisition of Romanian and Hungarian enterprises (n_{hu}=270; n_{ro}=250) → Editing of enterprises' datas

Determination of general statistical characteristics of databases

Eligibility

K-means cluster analysis (n_{hu}=270; n_{ro}=250) → Omission of outliers (n_{hu}=46; n_{ro}=26)

New K-means cluster analysis (n_{hu}=172; n_{ro}=173) → EAVA indicator, determination of ranking distribution, multidimensional scaling

Included

Quantile panel regression (n_{hu}=172; n_{ro}=173) → Calculation of panel regression models

Summary results (n_{hu}=172; n_{ro}=173)

1. figure.: A flow chart of systematic research based on the PRISMA recommendation

In order to answer the formulated hypotheses, I followed the steps which could be seen in the 1st Figure. (It is illustrated with PRISMA flow chart)

To answer my research aim, I have formulated the following hypotheses:

1. **Hypothesis:** There is a high degree of heterogeneity in enterprise databases of both countries

2. **Hypothesis:** Regarding to the indicators, we can observe no significant differences between investigated years.

3. **Hypothesis:** Homogeneous groups could be created in which the values of enterprise risk indicators can be supported by financial ratios.

4. **Hypothesis:** Using financial ratios, we can define indicators that are related to leverage ratios.

5. **Hypothesis:** There is no difference between the results of risk analysis based on dispersion measures and leverage ratio.

6. **Hypothesis:** The differences between the clustered data can be better described with a multilevel regression model.

7. **Hypothesis:** Panel regression can be used to explore the relationship between cross-sectional enterprises and time series data.

Before the comparative analysis of corporate risk, I consider it is important to review and understand the literature related to risk. The first step of my primary research stands in reviewing the general concept of risk (the economic and financial risk) and presenting the most determinative theories about it. During the elaboration of literature, it became clear to me that the definition of risk and financial risk can vary from author to author. In this section, I also dealt with many controversial concepts of risk and uncertainty. In the literature review I presented the specific economic risks of companies (the operating and financial risk), then I highlighted the effects of macroeconomic factors, which have become even more necessary after the financial and economic crisis of 2008. The starting point for answering the research questions was the study of literature dealing with risk measurement. In this context, I presented the most important dispersion measures (standard deviation, absolute-mean deviation, semi-deviation) and the degree of leverage (DOL, DFL, DCL).

Since risk quantification appears often in international literature as a subtask of the enterprise risk management (Enterprise Risk Management), I considered that it is important to present its main tasks. Most approaches include risk mapping, risk quantification and developing of

risk minimizing strategies. Since people often set equality between risk assessment and risk management concepts, I thought that it is essential to present the major differences between them.

The database used for the comparative analysis is based on data from financial statements of registered (settled) SMEs from neighbouring countries (Romania and Hungary) and from neighbouring counties (Bihor and Hajdú-Bihar). Firstly I used k-means cluster analysis and I made a grouping of too heterogeneous corporate databases according to the two degrees of leverage (DOL, DFL). In the comparative analysis of the enterprises, I tried to express risk with several indicators: degree of leverage, dispersion measures and the MDMR (**M**ean **D**eviation to **M**ean **R**atio) generated from financial ratios. Then I used multidimensional scaling to analyse the differences and similarities between clusters in terms of risk. In this method I used financial ratios and the DOL, DFL and DCL dispersion measures. Then I carried out a panel regression analysis to investigate the relationship between the financial ratios and the two degrees of leverage.

Since I examined companies from two different countries, I considered it is indispensable to present in the third section of my dissertation the essential features of their SME sector.

The fourth part contains the empirical analysis in which I carried out a risk analysis of the Romanian and Hungarian SME sectors, which contains the following:

- a presentation of main statistical features of investigated companies from the two countries;
- a k-means cluster analysis of the investigated Romanian and Hungarian companies;
- a comparative risk analysis of Romanian and Hungarian companies;
- a study of relationship between degree of operating/ financial leverage (DOL, DFL) and certain financial ratios. Therefore I used the method of panel regression.

Finally, I drew conclusions, confirmed/disproved formulated hypotheses, answered my research question and then summarized the most important results of my dissertation.

2. The methodology and database of the research

Variability and uncertainty are the most dominant features of today's economic environment. It is difficult to find an area where the decision making process and the pursuit of economic activity is risk free. The economic crisis, which has not been completely solved yet, has brought to surface significant economic and financial risks in the economy, which caused serious problems for small and medium-sized enterprises (SMEs).

Some events that took place in several countries have influenced the risk in our region. This appears in the behaviour and performance of markets and market players. Risk is an influential factor of economic environment. There are many theories about risk in literature, but I present only the most determinative ideas. ALASTAIR (2009) defines risk as a chance, probability of loss, in his book gives more definitions of the risk and the most commonly mentioned: the probability of variant results, the deviation from the expected results, the symmetrical chance of gain and loss. GALLATI (2003, p. 8) defines the risk as "a situation in which there is a possibility of deviation of expected result from the desirable result". Despite the fact that risk is mostly a symmetric concept, when we are talking about the deviation from the expected result, it is mostly used in a negative sense, as a "probability of negative event occurring". An important feature of the risk is that the time of occurrence of unfavourable events, the consequence and the gravity of its impact are uncertain and unpredictable. According to BÉLYÁCZ (2004, p. 1) "Risk and uncertainty are the most controversial phenomena in economics. It has never been the subject of controversy that both of them affect economic decisions..."

One of the most well-known theories of risk is formulated by KNIGHT (1921) who thinks that there is a difference between risk and uncertainty. In his opinion, the main difference between risk and uncertainty lies in measurability: he considers that risk is measurable and uncertainty is not measurable. One of the strongest criticisms of KNIGHT's risk concept stems from KEYNES (1937) who states that "the uncertainty of economic future cannot be solved by monitoring of the past values" and "the future human decisions (…) cannot depend on strict mathematical expectations, because these kind of calculations have no basis " (BÉLYÁCZ, 2011, p. 380). According to SZÁSZ (2011) one of the most representative components of uncertainty is surprise and suddenness/randomness. Other authors consider that risk has two components, namely uncertainty and variability (MOLAK, 1997; CULLEN-

FREY, 1999). WILSON and SHLYAKHTER (MOLAK, 1997) deem that variability is the temporal, spatial heterogeneity of values.

According to CONKLIN (2002) the economic risk is reflected in the fluctuations of corporate's outputs, that cannot be predicted by company's management. Many researchers think that economic risk means negative change in revenue, cost and market share. GABRIEL and BAKER (1980) consider that economic risk is appears in the dynamics of net operating results and net cash flow. According to them, the relative standard deviation of operating profit is in close connection with the level of economic risk, so if the indicator shows a high value the economic risk is high. Depending on content and nature of the business, should be risks that may threat companies periodically or permanently. I deal with those that are in close connection with the objective of my research.

In the empirical research part of my dissertation, I present only the most relevant corporate risks, namely the risks based on financial and operating degree of leverage. Despite the fact, that many English articles and books deal with risk we still have not found a consistent approach to it. THOMSON and his co-authors (2005) consider that financial risk is that risk group that has value creating ability.

According to HORCHER (2005) the rapid growth of international financial markets has highlighted the importance of financial risk. The immediate, anywhere accessible information can speed up the processes of international markets. This generates rapid and unexpected reactions, as exchange rate, interest rate and price changes. STOCKHAMMER and GRAFL (2010) deal with the concept of financial uncertainty, which they think it is identical with the uncertainty and variability (volatility) of financial markets. According to HAMPTON (2009) the financial risk means the probability that a company does not have sufficient capital to continue its economic activity. He considers that the source of the problem is insufficient capital and cash flow generated by its activities.

Considering the distinct interpretation of corporate risk, including the concepts of financial and operational risk, I consider that it is indispensable to clarify in my empirical analysis the concepts and interpretations, on which I have built the overall risk of enterprises' functioning, including operational and financial risks.

In the recent decades, there have been significant changes in the lives of Central and Eastern European countries such as accession to the European Union, the creation of the European

Economic and Monetary Union, the rapid development of international financial markets, the global financial crisis, the collapse of world famous corporations and financial institutions. All these have had major impact on the development of macroeconomic factors.

Recent events have confirmed that unpredictability, uncertainty and variability appear in the macroeconomic environment too, which also poses threat to corporate activity. According to ALASTAIR (2009) the macroeconomic risk differs from the other types of economic risks in term that a company cannot directly influence it. In the determination of macroeconomic risk, OXELHEIM and WIHLBORG (2008) distinguish the macroeconomic, the company-specific and the sector-specific risks. According to them, the macroeconomic risk includes interest rate risk, currency risk and country risk.

According to the literature, the risk management is a holistic and integrated system of activities that affects all departments of a company. The main tasks of risk management vary from author to author, but I think that mapping and quantifying of major risk factors are key activities. Related to risk, the question is how we can measure something that we do not know with complete certainty. Based on the review of literature related to the risk it is difficult to determine what can be the coherent measure of corporate risk, because the opinions on this term are significantly different. Another difficulty in risk quantifying is that the risk itself is difficult to grasp. Therefore, in most cases, we reflect risks through the fluctuation of some economic variables.

However, standard deviation is a non-coherent measure of risk it is still among the mostly used risk measures. Neither variance nor the standard deviation measures the risk directly. Since the standard deviation keeps the units of the original data, the comparability may become problematic. The outliers can significantly affect the value of standard deviation.

One of the major inadequacies of the traditional risk measurement methods is that there are symmetrical methods. This means that the two sided of deviation from the average are treated equally and consequently the corporate profits are as risky as the losses. Semi-variance and semi-deviation bring the solution for the problem, but they consider risky only the values below a given value, and calculate only with them. In this approach, the corporate losses are unfavourable, risky output event, so it is a one-sided or asymmetric indicator. One of the weaknesses of the variance and semi-variance as risk measures is that they are relatively sensitive to outliers (EFTEKHARI et al., 2000). The mean absolute deviation (MAD) can be

the solution for this problem, which measures the risk as an arithmetic average of absolute deviation from the mean. Although that the mean absolute deviation (MAD) is less sensitive to the outliers, BUGÁR - UZSOKI (2006) thinks that this is a disadvantage because it underestimates the occurrence of high losses in period of crisis. The mean absolute deviation (MAD) is also a symmetric, two-sided measure, like variance and standard deviation. In addition to these, I also calculated in my dissertation the median absolute deviation, which is the arithmetic average of the absolute values of deviations from the median. This latter indicator can be useful when the range and variability of investigated data is high.

One of the most important theorems of financial management is the "return- risk trade off", which means that higher risk must be assumed only if higher return belongs to it. According to this, the increase of return (profit) is in close connection with risk.

According to Modigliani's and Miller's proposition II., the extent of return on capital depends on two factors, on the one hand on the return on assets, on the other hand on the capital structure of the company:

$$r_e = r_a + \frac{D}{E} * (r_a - r_d) \tag{1}$$

1^{st}component. 2^{nd}component

where:

r_e – Return on equity

r_a – Return on assets

r_d – Cost of debt

D/E – Debt-Equity ratio

The 1st component from the formula (1) may be linked to the company's assets side and it is significantly influenced by the nature of company's operating activities, so it is called operating leverage, which can be considered as operational risk (business risk). The 2^{nd}component is determined by the company's financing policy and on cost of debt. The 2^{nd}component from formula (1) includes de D/E ratio, of which name in English literature is *leverage*. The 1^{st}formula shows that if the company does not use debt financing the r_e is equal with r_a. Therefore, the 2^{nd}component appears and has great importance only if in the company's capital structure appears debt financing, which means greater risk exposure.

According to BERK and DₑMARZO (2014, p. 489) the 1ˢᵗcomponent can be called *risk without leverage*, while the 2ⁿᵈcomponent is the *additional risk due to leverage*. The literature says that, the 2ⁿᵈcomponent can be considered financial risk (financial leverage). Debt financing may increase the return on equity if the $r_a > r_d$, but with this the financial leverage, and the financial risk (ROSS et al., 2013, p. 532) also increase.

In the narrow sense, we can divide the firm's total risk into two parts: the first is the risk of the company's assets side, which depends on firms' operating activities (its name is operational business). The second one depends on companies' capital structure, namely on the debt ratio, so it is called corporate financial risk (ROSS et al., 2010, p. 518). Taking into account the above-mentioned things and those affirmed by THOMSON (2005), it gives a relatively narrow interpretation of corporate financial risk and it is an important component of a company's total risk beside the corporate operational risk (business risk). In my dissertation, I made an analysis by taking into consideration the above-mentioned corporate risk sharing.

Based on Modigliani and Miller proposition II., the total risk of company has two components: the operational and financial risk. In almost all of the English and Hungarian books dealing with corporate finance, I have found that firm's risk measure is the degree of combined leverage (DCL) which consists of two basic elements: the degree of operational leverage (DOL) and the degree of financial average (DFL). In the literature, the DOL and DFL indicators belong to the category of sensitivity indicators.

The investigation of leverage ratios provides a comprehensive income statement analysis because the two leverage ratios are based on income statement, as an accounting information source. The operating leverage is dealing with the top of income statement (ending to EBIT) and the financial leverage with the bottom of it (from EBIT) (TAKÁCS et al., 2012). Based on this, EHRHARDT and BRIGHAM (2017) called the degree of operating leverage first-stage indicator and the degree of financial leverage second-stage indicator.

The DOL is an elasticity indicator, which reflects the ratio of the changes in Sales and changes in Earnings Before Interest and Taxes (EBIT). According to BREALEY et al. (2014) the degree of operating leverage can be written with the following formula:

$$DOL = \frac{\dfrac{\Delta EBIT}{EBIT_0}}{\dfrac{\Delta S}{S_0}} \qquad (2)$$

where,

EBIT (*Earnings Before Interest and Taxes*) – according to the Hungarian accounting terminology corresponds the best with Operating profit.

$$\Delta EBIT = EBIT_1 - EBIT_0$$

S – Sales

$$\Delta S = S_1 - S_0$$

The DOL indicator shows the percentage changes in operating income caused by 1% changes in sales. Therefore, the sensitivity of sales to economic cycles and changes in macroeconomic rules can significantly affect the company's profit. Degree of changes in operating profit means how sensitive is the operating profit to the changes in the level of fixed costs. The higher proportion of fixed cost in the total cost results in higher sensitivity in operating profit, which leads to a higher operational risk suggested by greater DOL value (DAMODARAN, 2015, p. 117). Thus, the proportion of variable and fixed cost in the total costs can have a determinative impact on the operating profit. Therefore, the changes in fixed costs cause positive (similar way) changes in the DOL's value. We can say the value of DOL is the function of a company's fix costs (TARNÓCZI - FENYVES, 2010).

BREALEY and his co-authors (2014) in one of their studies deal with the average DOL values of companies operating in different sectors. The study embraced 20 years' time interval, between 1990 and 2010. The authors classified companies in two large groups. One group constituted the companies with lower DOL value and the second group the companies with larger DOL values. The analysis shows that lower DOL values were present at companies operating in electric utilities (0.39), food (0.97) and clothing industries, while companies that were operating in steel industry (2.31), in the paper industry (1.50) and in the machinery industry (1.49) had the larger average DOL value and higher operating risk.

DFL shows the percentage changes in net income, which results from changes in operating profit. ROSS et al. (2013), consider that the degree of financial leverage can described by the following formula:

$$DFL = \frac{\dfrac{\Delta EPS}{EPS_0}}{\dfrac{\Delta EBIT}{EBIT_0}} \qquad\qquad (3)$$

where:

EPS - Earning per Share

$$\Delta EPS = EPS_1 - EPS_0$$

EHRHARDT and BRIGHAM (2017) use the following formula to determine the degree of financial leverage:

$$DFL = \frac{EBIT}{EBIT - I} \qquad\qquad (4)$$

where:

I - Interest

The (4th) formula of DFL highlights the close relationship between the degree of financial leverage and cost of debt. If there is no debt in a company's capital structure, the value of DFL is 1, which means that 1% changes in operating profit causes 1% changes in net income (EPS). If interest expenses appear in Income Statement, the DFL value is greater than 1, which also means a higher financial risk level. In the analysis carried out in my dissertation, I do not use the (4th) formula, because interest expenses do not appear in the Income Statement of Hungarian simplified annual report. So, DFL is really relevant when the company uses debt financing such as credit, for which fix costs can be linked (ILLÉS, 2007). There is a direct, positive relationship between DFL value and the cost of debt. The credit financing can provide many advantages. Firstly, it has a positive effect on the variability of profitability, but only up to a certain point (TAKÁCS et al., 2012). The degree of financial leverage can also be an essential tool in determination of borrowing limit and tolerable risk level because the exceeding of them may pose serious threats to the company's overall activity and its financing policy. In my dissertation, I examine how much the degree of leverage ratios can be used to measure corporate risk and which financial ratios may have impact on them.

In favourable circumstances, the higher DFL value provides an opportunity to corporate's profit increase when the return on assets (Return on Assets) is greater than the cost of debt. However, this also leads to an increase of a company's financial risk. According to

DAMODARAN (2015), under favourable circumstances, the cost of debt may increase the EPS. At the same time, in case of companies with debt financing, the volatility of EPS influences the EBIT in a greater way. This increases the risk of capital investment of company (DAMODARAN, 2015, p. 119, BERK - DeMARZO, 2014, p. 496).

KUMAR (2017) analyses the companies operating in Indian steel industry. He tries to find out whether there is a relationship between degree of financial leverage (DFL) and earnings per share (EPS). He based his analysis on the financial statements of the companies operating in steel industry between the years 2006-2015. The result of the study shows there is a strong but negative relationship (-0.7779) between DFL and EPS in case of Indian steel companies. This means that if the degree of financial leverage increases, namely the cost of capital increases the earnings per share (EPS) decreases. This confirms that DFL has an effect on companies' profitability.

The firms' total risk expressed by degree of combined leverage (DCL) is the product of degree of operating leverage (DOL) and the degree of financial leverage (DFL). This shows the effect of 1% changes in sales on the earnings per share (EPS), which is well illustrated in Figure 2. The interpretation of leverage ratios may differ because they are totally industry and activity dependent (PÁLINKÓ – SZABÓ, 2006).
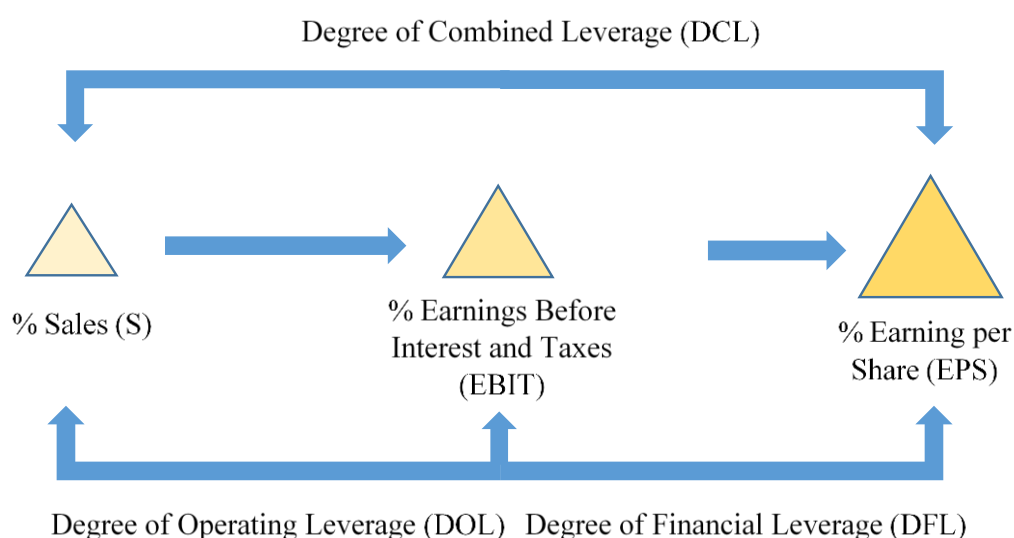

Figure 2.: The relationship between DOL, DFL and DCL
Source: Keown, A. J. – Martin, J. D. – Petty J. W. (2014): Foundations of Finance - The Logic and Practice of Financial Management, Eighth Edition, Pearson Education, Inc., p. 392.

After the literature review, I carried out an analysis in order to answer my research questions related to the aims of dissertation. I used different statiscal methods. To confirm my

hypothesis, in the comparative analysis of corporate risk I used as database the simplified financial statements of SMEs registered in two neighbouring counties from Romania and Hungary. An important aspect during the data collection was the distribution of countries' annual net sales between economy's sectors. Accordingly, the major parts of the two counties corporate database were trading companies and firms acting in processing industry. In Hungary, I used 172 SMEs' statements registered in Hajdú-Bihar County, of which 128 companies operate in trading (74.42%) and 44 companies in the processing industry (25.58%). In the Romanian Bihor County, I used 173 SMEs' statements, of which 135 were trading firms (78.03%) and 38 processing firms (21.97%).

I got the Romanian corporate data from the Directorate of Public Taxation and Public Administration based on submitted request. The Hungarian corporate statements were downloaded from the Electronic Reporting Portal (e-beszamolo). Before this, the selection by activities of Hungarian companies was done in OPTEN database. I've chosen SMEs because more than 90% of companies in the European Union are classified in small and medium-sized enterprises. Similar situation can be seen in the chosen two neighbouring countries. The SME sectors have key economic roles in both countries. This is manifested in the high GDP contribution and the high employment rate. The great part of calculations that were made during the comparative corporate risk analysis was carried out using the modules of R statistics system. The problem with above mentioned risk measures is that the results may vary; sometimes we can obtain contradictory results. So the choosing of the right measure may be difficult. In order to eliminate this, in my dissertation I defined corporate risk through several measures. These include the degree of operating, financial and combined leverage (DOL, DFL, DCL), the dispersion measures of its (standard deviation, semi-deviation, mean absolute deviation and median absolute deviation), and the MDMR (**M**ean **D**eviation to **M**ean **R**atio) generated from financial ratios.

In the first part of comparative corporate risk analysis, I calculated the degree of leverage ratios (DOL, DFL) and financial ratios (liquidity, indebtedness, working capital, profitability indicators). I used the two countries corporate's databases. Then I determined the general statistical characteristics for four years (2009-2012). After that, I carried out heterogeneity studies for both of corporate data, using figures.

In order to answer the research questions, I analysed the relationship between operational and financial leverage and financial ratios for Romanian and Hungarian companies. I used the method of panel analysis. Panel data analysis can be viewed as a multilevel hierarchical modelling because allows examining different variables. Compared to traditional data analysis methods one merit of panel data analysis is that very heterogeneous variables can be included in the sample (BALTAGI, 2005). The panel model combines the analysis of cross-sectional and of time series data. Besides taking into consideration the time effect, panel data analysis makes possible to investigate the casual analysis of different processes. It is widely used in social science and its great merit is the introduction of idiosyncratic effect, which means both the individual and time effect on the dependent variable (TARNÓCZI et al., 2015, p. 2). Due to high heterogeneity of the data, the results of panel regression show that appropriate relationship between investigated variables cannot be determined. During the investigation, I calculated the fixed / the random panel regression and the one-way / two-way variants, as well.

Due to the high heterogeneity of data, I grouped the data using k-means cluster analysis. I determined the average degree of leverage for each cluster. Therefore, I calculated the Sales / Sales in break-even point, the Interest coverage ratios and financial ratios, which are related with degree of leverage ratios.

Using the financial ratios, I've generated the **M**ean **D**eviation to **M**ean **R**atio (MDMR) and the distribution of ranking to mean. The k-means is one of the oldest and commonly used non-hierarchical clustering methods, developed by STEINHAUS (1956), MACQUEEN (1967) and HARTIGAN (1975). The method operates on iterative principle, like other non-hierarchical clustering procedures. In k-means clustering method the analyst is the person who determines the number of desired clusters and groups. This step is outstanding important because the result of k-means method may vary significantly depending on numbers of clusters we want to divide the sample (RENCHER, 2002). The distance is also a key concept in the k-means method. In grouping the items, the distance measuring is usually performed according to the Euclidean distance. I carried out metric multidimensional scaling of leverage ratios' dispersion measure and the average of financial ratios. This made clearer the distance between clusters. The great merit of multidimensional scaling is that it visualizes the similarities and differences between the examined elements. The investigated elements are represented by dots in the figure and the similarities and differences between the individuals are indicated by distances (KRUSKAL – WISH, 1978).

In my dissertation, I used the classic two-dimensional scaling. I also examined the effect of clustering for the three leverage ratios (DOL, DFL and DCL). For this, I used multilevel regression calculation in case of all companies from the two counties.

Using of multivariate variance analysis, I examined if there was a significant difference between degree of leverage ratios (DOL, DFL, DCL) of Romanian and Hungarian companies. Then, I explored separately the cluster and country effect for each leverage ratios and for the investigated four years.

In order of better analysis, I made the companies' samples more homogenous. I divided it into deciles, in order to create more homogenous groups. In this way, I managed to carry out a more detailed panel data analysis of the relationship between the selected financial ratios and the two degree of leverage ratios. I used coefficient of determination (R^2) to test the goodness of fit of the panel models. The coefficient of determination reflects the part of the total variance explained by the created model (ANDREß et al. 2013; PARK, 2011). In the panel regression, I filtered out the variables showing collinearity by using of variance inflation factor (VIF). This is why we can see the variables may vary from country to country. The difference can be caused even by dependent variables (DOL, DFL). I used the Hausman test in order to compare the results of different model variants (fixed or random effects, one- or two-way panel, and Swamy-Arora-Amemiya's transformation). To avoid multicollinearity, I took into consideration the rule defined by BELSLEY et al. (1980) and GREENE (1993) according to which the independent variables with variance inflation factor greater than 10 must be abandoned.

Table nr.1 presents the results of the panel analysis based on companies' samples for the two counties. This analysis provided the opportunity to compare the Romanian and Hungarian companies in term of factors, which influence the two degree of leverage ratios. Looking at the panel regression model of the two degree of leverage ratios, can be seen that there are similarities between two countries in terms of financial ratios used as explanatory variables. As we see in Table nr.1, in both countries' DOL panel model we can find: Receivables turnover ratio, Quick ratio (liquidity), Net working capital / Current assets ratio. We can also see, excepting one variable (Net working capital/Current assets), that the common used explanatory variables in both countries' DOL models affect operational risk differently. While in case of one country affect positively the operational risk, in the other country they have negative effect on it.

In both countries' DFL panel model we find as explanatory variables the following: Net working capital to Current assets ratio, Return on equity (ROE) and Debt ratio. In this case, we also see there is an opposite relationship between the two countries' companies.

Table 1. Results of degree of leverage ratios panel regression for Romanian and Hungarian enterprises

Independent variables	Dependent variables			
	DOL		DFL	
	Romanian SMEs	Hungarian SMEs	Romanian SMEs	Hungarian SMEs
Intercept	-12,154***	-1,183	0,597*	-24,145*
Inventory turnover ratio	0,011***			
Receivables turnover ratio	-0,107*	0,009***		
Sales/Employee expenses	0,360***			
Operating profit/Total expenses		2,190***		
Net income/Operating profit			2,342***	
Quick ratio	-8,906***	0,683		
Net working capital/Current assets	19,346***	21,611***	0,910*	-17,622***
Current assets/Total assets		-8,692*		
Return on equity			3,268***	-4,974***
Debt ratio			-3,145***	44,608***
Debt/Equity				0,125**

Source: Own calculations

I consider this is one of the most important findings of my research, which can be considered a newsy and meaningful achievement. In my opinion, the panel regression model of operating and financial risk can be included in the further corporate risk analysis. In one hand it can support the mapping of key factors affecting corporate risk. In the other hand it could be useful in minimizing and preventing of the operational and/or financial risk. The results also indicate that panel regression, as an econometric procedure can successfully be used in corporate risk analysis.

3. Theses and statements of the dissertation

The main aim of my research was to answer the question of how we can determine the factors that influence a company's risk and which risk measurement may suit best for the proper measurement of corporate risk. Companies should take the risk level that ensures their survival, the proper performance and continuous adaptation to the economy and customers' needs and the profit necessary for development. Determining and managing risk necessary to fulfil these aims are vital for companies. These represent quite serious tasks for a company manager and for the employees of financial department.

Since my dissertation deals with risk comparison of the two neighbouring counties' SMEs from Central and Eastern Europe, I put the emphasis on the risk quantification. This is organic related to the above-mentioned problematics, because risk quantifying is one of the important steps in risk determining.

The most commonly used risk measure is variance, its square root, the standard deviation and the coefficient of variance determined by them. The degree of operational leverage (DOL), the degree of financial leverage (DFL) and the degree of combined leverage (DCL) are relatively widely used in quantification of corporate risk. One of the major inadequacies of the dispersion measures is that they do not measure risk directly. In my dissertation I used three methods for expressing corporate risk: the dispersion measures, the elasticity leverage ratios and the financial ratios.

H1. There is a high degree of heterogeneity in enterprise databases of both countries
The results of main statistical characteristics of risk / financial ratios and of the analysis of the four years heterogeneity figures suggest that the investigated indicators are strongly heterogeneous in both countries. In the case of Romanian companies, at the 80% of investigated indicators the coefficient of variance shows values greater than 100%. In the case of Hungarian companies, the situation is a little bit worse, because at the 90% of calculated indicators the coefficient of variance was greater than 100%. By this I answered the hypothesis.

H2. Regarding to the indicators, we can observe no significant differences between investigated years

Excepting some indicators and some years, the p values of t-test was above 0.05 in both countries' companies, which shows that calculated financial and leverage ratios vary significantly from year to year. So the results of two-sample t-test also indicate the temporal inhomogeneity of two enterprises' samples. I drew similar conclusions on basis of heterogeneity tables. Based on these, this hypothesis can be rejected.

H3. Homogeneous groups could be created in which the values of enterprise risk indicators can be supported by financial ratios

Regarding to extremely high dispersion (high coefficient of variance), the regression analysis was not suitable for the proper exploration of relationships between leverage and financial ratios. The large dispersion made difficult the analysis of other calculated financial ratios. Therefore, I divided the populations into 12 groups by using k-means cluster analysis according to the two degrees of leverage (DOL, DFL). From the created groups, I analysed in detail only those, which contain more than 10 enterprises. I performed an analysis of clusters based on dispersion measures of leverage ratios and financial ratios. I also determined for each cluster the Sales / Sales in break-even point and the Interest coverage ratios strongly related with leverage ratios. I analysed the effect of clustering by comparing the dispersion measures of each cluster with the dispersion measures of whole population. It can be stated that in the investigated period, in the case of Hungarian enterprises the dispersion measures of each cluster is smaller than the dispersion measures of whole population. A different situation can be seen in Romania. In 2011 and 2012, the dispersion measures of each cluster shows higher values than the dispersion measures of whole population. For DFL and DCL ratios, in all of the investigated years, we can find clusters, whose dispersion measures exceeded the values of whole population. In case of Hungarian companies, the positive effect of clustering is clear because the dispersion measures have significantly reduced. Because the subject of my dissertation is a comparative analysis, in order to get more homogeneous samples I had to apply a method which ensures the comparability. It can be stated that in term of analysability, I have only partially received homogeneous groups by clustering. This situation is typically characteristic for corporate data, therefore due to the high dispersion measure, the adequately analysis of two populations can carried out only by taking into consideration a distribution by greatness ordering. So the above-formulated hypothesis is only partially confirmed.

H4. Using financial ratios, we can define indicators that are related to leverage ratios

For the created clusters, I calculated the financial ratios that I considered relevant to the analysis. In order to compare the clusters easier, I took into account the risk expressed by

financial ratios. I assigned rankings for each of ratios and then I determined the ratios' ranking proportion. By dividing the deviations from mean to mean I created the MDMR indicator (**M**ean **D**eviation to **M**ean **R**atio). This ratio made the risk position of each cluster more suggestive in term of financial ratios. In both Romanian and Hungarian cases, for all clusters I experienced relatively high synchrony between MDMR indicator and the three leverage ratios. It can be stated that we can create simple (MDMR) or composite indicators (distribution of ranking to mean ratio), which can help defining the risk. Based on these, this hypothesis is largely confirmed.

H5. There is no difference between the results of risk analysis based on dispersion measures and leverage ratio

I also defined the companies' risks with dispersion measures of three degree of leverage ratios. The used dispersion measures are the standard deviation, the semi-deviation, the mean absolute deviation, and median absolute deviation. The dispersion measures were determined also for clusters including more than 10 enterprises and for the entire population. To compare the clusters and for their graphical representation I used metric multidimensional scaling. By using of this method, I displayed yearly the clusters in a two-dimensional coordinate system. During the scaling, I used the dispersion measures of leverage ratios and the average of financial ratios (AFR). The corporate risk expressed by different measures (MDMR, degree of leverage ratios, dispersion measures), with certain exceptions (between MDMR and degree of leverage ratios), is different and in many cases contradictory. Based on the obtained results, the formulated hypothesis could be rejected because in most of the cases the leverage ratios of each cluster and the dispersion measures did not indicate the same risk levels.

H6. The differences between the clustered data can be better described with a multilevel regression model

I examined the effect of clustering in the case of both countries and the positive effect on DFL was more and less highlighted because the variance of indicator was greater than the value of the error. For the other two ratios, the examined four years period can be divided into two parts. In the first half of investigated period (2009-2010), in the case of the Romanian and Hungarian enterprises the variance of three degree of leverage ratios exceeded the value of error. In 2011, in case of DCL in Romania, in 2012, in case of DOL and DCL the value of error exceeded the value of variance in Hungary. So the hypothesis can be partly confirmed.

H7. Panel regression can be used to explore the relationship between cross-sectional enterprises and time series data

During the analysis of Romanian and Hungarian companies' MDMR indicator and the degree of leverage ratios, in case of several clusters, I found that where the operational and financial risks were unfavourable, the financial ratios and the MDMR indicator of each cluster showed a bad situation. Based on this, I examined in my dissertation the potentially relationship between the two leverage (DOL, DFL) and each financial indicator. I did not find proper relationship between the degree of leverage and financial ratios computed from the basic data. Therefore, I divided the population into deciles. In this way, became possible the panel analysis of the relationship between the selected two leverage ratios and selected financial ratios. For both countries, I calculated the fixed and random effect of panel regression, then I used Hausman test to compare the results. In case of operating leverage (DOL), the one-way random effect of panel regression was consistent in the two countries. In the case of Romanian and Hungarian SMEs, the high value of correlation coefficient confirmed the strong relationship between operating leverage and each financial ratio. In the case of Romanian SMEs, operating leverage could be explained by five financial ratios: Inventory turnover ratio, Sales / Employee expenses, Net working capital / Current assets, Receivables turnover ratio, Quick ratio (liquidity). The first three of these have positive, and the last two have negative impact on operating leverage. With regard to Hungarian SMEs, operating leverage could also be described by five financial indicators. Excepting one, (Current assets / Total assets) each financial ratio has positive effect on DOL. The explanatory variables of DOL panel regression model are the following: Current assets / Total assets, Receivables turnover ratio, Operating profit / Total expenses, Quick ratio (liquidity), Net working capital / Current assets. In both countries the idiosyncratic effect is also high. This indicates that the enterprises' individual and time changes are significant. This clearly draws attention to the fact that in case of investigated companies the uncertainty is relatively high.

In case of financial leverage ratio, according to Hausman test, the random effect of panel regression was consistent, one-way variant for Romanian enterprises and two-way for Hungarian enterprises. Based on values of correlation coefficient, it can be concluded that in case of Romanian SMEs there is much stronger correlation between financial leverage and selected financial ratios than in case of Hungarian companies. In the case of Romania, the DFL could be explained with four financial ratios: Net income / Operating profit, Return on equity, Net working capital / Current assets and Debt ratio. Surprisingly the Debt ratio has

negative impact on financial risk. All other variables have positive effect on DFL. In this case, the idiosyncratic effect is also significant, which means that the enterprises' individual and time changes are significant. In case of Hungarian SMEs the two ways random effect of panel regression provided better solution for DFL. The advantage of it is that besides the individual effect may be able to detect separately the time effect. Two of the investigated variables, have positive effect on the financial risk (Debt / Equity, Debt ratio), while in the case of other two (Return on Equity, Net working capital / Current assets) negative correlation could be experienced. The time effects play a decisive role on Hungarian companies because it represents 98.70% of all variance. It could be stated that both countries' panel regression models include as explanatory variables: Return on equity, Debt ratio, and Net working capital / Current assets. Based on the above mentioned, this hypothesis is well confirmed.

4. The main results of dissertation

1. I determined the general statistical characteristics and the heterogeneity graphs of the ten financial ratios of the investigated Romanian and Hungarian enterprises for four years. These led me to conclude that annual dispersion of ratios is different and in most of the cases it is very significant. Based on the investigations carried out, I compared the data of two countries. I found that the investigated Hungarian companies are generally more risky than the Romanian companies.

2. Due to the high heterogeneity of the data, I carried out a grouping using k-means cluster analysis. I evaluated the obtained results, during which I created the Mean Deviation to Mean Ratio (MDMR) and the distribution of ranking to mean. There was a relatively high level of synchrony between the created MDMR indicator and the leverage ratios, which means that we can create indicators derived from financial ratios. This ratios can adequately support risk ratios. The above indicators enabled a complex approach to risk analysis.

3. Using multilevel regression I examined the effect of clustering in the case of the two countries. In each of the investigated years, the effect of clustering was more and less highlighted. For the other two indicators, the examined period can be divided into two parts. In the first half of investigated period (2009-2010), in the case of Romanian and Hungarian enterprises the variance of leverage ratios exceeded the value of error. In 2011, in case of DCL in Romania, in 2012, in case of DOL and DCL the value of error was greater than the value of variance.

4. In order to ensure the homogeneity of the data in terms of analysed indicators, I divided the population into deciles in each year. This made possible performing the panel analysis of the relationship between the selected financial ratios and the two leverage ratios. The obtained high values of correlation coefficient confirmed the strong correlation between operational / financial leverage ratios and each financial ratio.

5. Summary

Risk is one of the determinative elements of economic environment that managers have to face with during their work. Most companies' leaders are aware that in short term achieving the necessary profit and in long-term capital maximization could be realized only by risk-taking. Considering all these, in the literature review of present dissertation I considered important to deal with the common definition of risk and with the difference between risk and uncertainty. By the way it is a theme disputed by several authors. Since my secondary research is based on two neighbouring counties' (Bihor and Hajdú-Bihar) enterprise data, I considered it is essential to deal with specific risks of companies, basically with the economic and financial risks. Besides the individual and company specific risks, there are some other independent risk factors against which companies have to defend. These include the effect of whole economy, the changes of economic competition's rules and the unpredictable and less favourable changes of laws, effects of globalization. Regarding to the consequences of 2008 financial and economic crisis I considered also important to overview the macroeconomic factors which affect companies. I think that one of the great lessons learned from crisis is that a company as an organizational unit cannot isolate himself from the country's economy and from the international effects that influence economy. Changes in macroeconomic factors affect in some way a company's functioning and its performance, which from the aspect of risk is very important.

Many questions may arise about how we can measure / determine the enterprise's risk and how much risk the enterprise should overtake. Thanks to my studies and calculations, I realised that the measurement of corporate risk and the determination of influential factors are relatively complicated tasks. In corporate finance literature, the most commonly mentioned risk measurements are variance, its root square standard deviation and the coefficient of variance. The research made me think about these risk measures, whether they provide an adequate solution for enterprise's risk quantifying or not. Due to the rapid and often unpredictable changes in the economic environment, I think risk quantification requires a more composite and complex approach. That is the reason why besides the traditional dispersion measures, I used the leverage ratios. By these elasticity ratios, the risk gets slightly different interpretation, because based on this, the risk express the impact of percentage changes in economic variables (e.g. revenue, operating profit) on results.

Risk quantification and the proper estimation of obtained results are important but not always sufficient steps to minimize the risk. Risk management can assure the balance between the growth goals and risk governance. From the '90s, the risk management, which is a multi-task and holistic approach process, appears as a separate area in the financial literature. During my study, I found that the definition of specific risk management measure vary from author to author. According to most approaches, the subtask of complex risk management includes risk mapping, risk quantification and developing of risk minimizing strategies.

In the empirical research, I was dealing with the operational and financial risks of the SMEs from Romanian and Hungarian counties (Bihor- Hajdu Bihar). For my calculations I used the financial statements of investigated enterprises registered in the two mentioned counties. I also considered important to present the main features of enterprise sectors from these neighbouring counties. Based on the four-year (2009-2012) financial statements of enterprises I calculated the degree of operational and financial leverage ratios. Besides these, I also calculated some financial ratios considered important regarding to present research: Current ratio (liquidity), Debt ratio, Assets turnover ratio, Profitability ratios.

During the investigation of statistical characteristics of each year, we can see that in Romania only 8 indicators from 10 had coefficient of variance < 100%, so 80% of indicators the coefficient of variance had values greater than 100%. In the case of Hungarian enterprises, the coefficient of variance shows worse values than in Romanian. In the case of 36 indicators from 40, or 90% of calculated indicators the coefficient of variance was greater than 100%. Based on these, it became clear to me, that the examined population is strongly heterogeneous in term of two leverage ratios (DOL, DFL) and selected financial ratios.

The extremely high values of dispersion measures drew attention that in case of two enterprise's samples, the indicators' mean values are not proper measurements for sample characterizing. In order to get a homogeneous sample, I decided to group the sample. The grouping was carried out with k-means cluster analysis, where I used as grouping features the DOL and DFL. Although appeared clusters with different element numbers, I analysed in details only those that contained more than 10 elements. Besides the degree of leverage ratios I calculated the degree of combined leverage ratio (DCL). In the analysis, I considered important to determine the Sales / Sales in break-even point related to DOL and the Interest coverage ratios strongly related to DFL. In reference to financial ratios, I performed the raking of ratios. Based on the average values of created clusters, I found out how many

percent of financial ratios reach each ranking number into the given cluster. Due to the extent limit, I could not deal with detailed analysis of financial ratios. Therefore, in the interpretation and analysis of financial ratios I tried to approximate it by the deviation from mean of each financial ratios divided to mean. Accordingly, I created the MDMR (**M**ean **D**eviation to **M**ean **R**atio) which made the risk position of each cluster more suggestive in term of financial ratios. In addition, it also helped me in determination of clusters' ranking. The colour scale that I used also supported the ranking and the comparability of different risk measurements and features.

In the analysis of risk, I also considered important to express enterprise risk with other measures. For this purpose, I presented the corporate through the dispersion measures of DOL, DFL and DCL (standard deviation, semi-deviation, mean absolute deviation, median absolute deviation). During the cluster analysis, I calculated the mentioned four dispersion measures only for clusters including more than 10 companies. In order of a better illustration of similarities and differences between the examined groups, I also visualized the clusters in two-dimensional coordinate system. I performed this by using multidimensional scaling. For metric scaling I used the three leverage ratios' dispersion measures and the average of financial ratios (AFR). In metric scaling, the similarities and differences between displayed objects are indicated by distances. Besides the comparison of each cluster, the representation in the coordinate system made possible to compare the results obtained by applying different risk measures. The investigation revealed that in most of the cases, the degree of leverage ratios and the dispersion measures of its do not indicate the same risks. I also examined the effect of clustering by multilevel regression.

I examined the effect of clustering using multilevel regression model. In each of the investigated years, in case of DFL, the effect of clustering could be more and less pointed. In the first two analysed years, both in Romanian and Hungarian enterprises the variance of three degree of leverage ratios exceeded the value of error. Not the same situation could be seen in the next two years. In 2011, in case of DCL in Romania, in the 2012, in case of DOL and DCL in Hungary, the value of error exceeded the value of variance. The values of leverage and its dispersion measures, except in some cases, show different and in many cases contradictory results. At the same time, I experienced significant synchrony between MDMR and the three degree of leverage ratios. In the cluster analysis of Romanian and Hungarian companies, in many cases, in companies with high operational and financial risks the MDMR values were also unfavourable. Therefore, I considered that it is important to examine the

relationship between degree of operational/financial leverage and financial ratios. I did not find proper correlation between the two risk measures (DOL and DFL) and financial ratios calculated from the basic data. Therefore, I divided the population into deciles. In this way, more homogenous groups were created, which made possible the panel analysis of relationship between degree of leverage and some financial ratios.

In the first three years of analysis, the Hungarian companies were more risky than the Romanians, in terms of DOL. In 2012, the DOL's absolute values of cluster averages are much higher. This indicates much higher operational risk in case of Romanian companies. The DFL calculated by the average values of Romanian clusters show greater financial risk, excepting year 2009. During the panel regression analysis based on decimals of two leverage ratios and financial ratios, it became obvious, that the two risk measures used as dependent variables could be determined by financial ratios. I calculated the random effect and fixed effect panel regression and I used Hausman's test to compare the obtained results. For DOL, in case of both countries, the one-way random effect panel regression considered consistent. The high values of coefficients of determination in Romanian and Hungarian SMEs confirmed the fact of strong relationship between operational leverage ratio and financial ratios. In order to avoid multicollinearity between the explanatory variables I calculated the variance inflation factor (VIF) for each regression function. I included in the final panel regression models only the variables, of which VIF values were less than 10.

In the case of Romanian SMEs, the operating leverage as dependent variable could be explained through five financial ratios: Inventory turnover ratio, Net working capital / Current assets, Sales / Employee expenses, Receivables turnover ratio and Quick ratio (liquidity). The first three have positive effect and the last two have negative impact on operating leverage. On the score of Hungarian SMEs, operating leverage could also be determined by five financial indicators. Excepting one, (Current assets/Total assets) each financial ratio has positive effect on DOL. The explanatory variables of DOL panel regression model are the following: Receivables turnover ratio, Operating profit / Total expenses, Quick ratio (liquidity), Net working capital / Current assets, Current assets / Total assets. Consequently, we can see that there are differences and similarities in term of explanatory variables in two countries' SMEs. The coefficients of the panel regression model of both countries include: Receivables turnover ratio, Net working capital / Current assets, Quick ratio (liquidity). So three of the five indicators are the same and two are different. The idiosyncratic effect is also

high that indicates that the enterprises' individual and time changes are significant. This highlights that in the case of investigated companies the uncertainty is relatively high.

In this case of financial leverage ratio, the random effect of panel regression was consistent: one-way variant in case of Romanian enterprises and two-way in case of Hungarian enterprises. I observed that in Romanian SMEs there is a much stronger correlation between financial leverage and selected financial ratios than in case of Hungarian companies. In case of Romanian SMEs, four of the investigated financial indicators had adequate explanatory power. With one exception (Debt ratio), I found positive correlation between the financial ratios included in final model and the degree of leverage ratios. In the case of Romanian SMEs, the DFL could be correlated with Net income / Operating profit, Return on equity, Net working capital / Current assets and Debt ratio. Surprisingly the Debt ratio and financial risk are negative correlated, which disproves the information that we can read in the financial literature. In this case, the idiosyncratic effect is also significant, which means that the enterprises' individual and time changes are significant.

In the case of Hungarian SMEs the two ways random effect of panel regression provided better solution for DFL. The advantage of it is essential; besides the individual effect it is able to present separately the time effect. Two of the investigated variables, have positive effect on the financial risk (Debt / Equity, Debt ratio), while in the case of the other two (Return on Equity, Net working capital / Current assets) I experienced negative correlation. It could be stated that both countries' panel regression models include as explanatory variables: Return on equity, Debt ratio, and Net working capital / Current assets. The time effect plays a decisive role on Hungarian companies because it represents 98.70% of all variance.

The analysis reflects that the two countries' enterprises cannot always manage operational and financial risk. This is basically supported by significant deviations of each cluster's DOL and DFL. Probably this causes difficulties in determination of an adequate correlation between leverage and financial ratios, as well.

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7. The candidate's publication list

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List of publications related to the dissertation

Articles, studies (13)

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32

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33