Quantification of the Systematic Risk in Industries[1]

*Helena MAJDÚCHOVÁ – Bernadeta SIVÁKOVÁ – Daniela RYBÁROVÁ – Slavka ŠAGÁTOVÁ**

Abstract

The aim of this paper is to verify systematic risk possibility in an alternative way using the accounting data. The verification is based on the Brimble-Hodgson accounting model, which we tested on a sample of EU-15 companies within ten years in total and separately for each concerned industry. We developed our own model using accounting data due to the more general model applicability, and tested the model on the same sample of a company. We obtained data for the analysis from the Datastream database. The Brimble-Hodgson accounting model could explain 28 – 77% of the variability of systematic risk, and our accounting model explained 21 – 75% of the variability of systematic risk, depending on the sector. The result is to identify determinants affecting systematic risk to individual industries, and formulation of industry-based accounting models, which can be applied in practice.

Keywords: *Capital Asset Pricing Model, beta coefficient, systematic risk, accounting model*

JEL Classification: G30, G33, M20

Introduction

Risk is a vital part of all business activities, which becomes an important factor in decision-making processes in enterprises. It is highly subjective to determine the level of risk due to low data rates in non-financial corporations. To use expert estimates to determine the level of risk solely can lead to mistakes and wrong decisions. Searching for exact methods of risk quantification has resonated in the professional and scientific community for quite a long time. The theory

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offers a range of risk quantification models, of which only a few have been applied in practice. One of the most widely used models, despite its considerable restrictions, is the Capital Asset Pricing Model (CAPM), where the rate of risk is the market premium and beta coefficient, as a degree of the systematic risk of a stock or business entity. The value size of the beta coefficient in the CAPM is dependent on the historical volatility of a given asset, and on the historical correlation of the shifts in the price of the given asset, and the shifts in the benchmark value (Brown and Walter, 2013). The model assumes that there is an existing relationship between the beta coefficient, and the asset return rates. However, after having performed empirical tests, it has been demonstrated that this relationship is not as significant as expected, and rather a combination of multiple factors helps to record volatility in the yields of securities. In the paper, we outline selected alternative approaches how to set beta coefficient considering more relevant risk factors.

From these alternative approaches, we initially test the Brimble-Hodgson model for selected about 800 business entities from EU-15 countries within a ten-year period of 2005 – 2014. Based on the results of the Brimble-Hodgson model test, we propose our own accounting model and apply it on the same sample of enterprises. The main difference between the Brimble-Hodgson accounting model and our accounting model is the exclusion of market value indicators and the design of new indicators due to the wider use of the model for business units with shares that are not traded on the market. The presented results are the outputs of larger research, which has set two main hypotheses: (1) There is a statistically significant relationship between the systematic risk and the accounting variables, and (2) The sector is a significant factor in quantifying the systematic risk. We briefly present the methods and process for verifying the hypotheses, along with the statistical results obtained. At the end of the paper, we provide the final accounting models for all industries and compare the impacts of selected indicators on the systematic risk in the Brimble-Hodgson model and in our own proposed industry-specific accounting model.

The aim of the paper is to shift scientific knowledge in the field, and using an alternative approach based on accounting variables to offer scientists and professionals a model of systematic risk quantification respecting the industry. The model can be applied at various business entities.

1. Literature Review

The systematic risk of non-marketable companies cannot be shown using shifts in the prices marketed on the stock market. That is why other approaches of recording the beta coefficient have been developed and used in practice.

The research in the area suggests that systematic risk reflects both external and internal factors. If taken into account in the beta coefficient quantification, these factors enable alternative approaches. One of them is to use accounting data that reflects all events and decisions that have been taken in the company. However, the accounting data includes both systematic and specific risk. Therefore, it is probable that the accounting data will not exhibit a perfect correlation with the beta coefficient. That said we hold that this data can be considered one of the most suitable ways of recording company risk with regard to time-related fluctuation.

Attempts to verify this approach have been made by several experts (Ou and Penman, 1989; Lev and Thiagarajan, 1993; Nissim and Penman, 2001; Konchitchki, 2011; Patatoukas, 2014). Their studies were based on financial analysis carried out on a corporate level. The analysis of the systematic risk in relation to the accounting data has been studied using a combination of market and accounting-based approaches. In fact, the market-based approach to the identification of systematic risk is its portrayal by means of the CAPM model. The accounting-based approach to risk identification is based on individual financial indicators or non-financial indicators, respectively. The idea of using accounting information to quantify the systematic risk relies heavily on the fact that this type of data can be used to predict future cash flows. Thus also enables the evaluation of the risk of individual stocks. This accounting data reflects the financial and economic situation in the company throughout the time and is a point of reference when choosing the most suitable portfolio for the investor. Numerous economists have been seeking a way of beta coefficient quantification using other means than market data.

Ball and Brown (1969) have pioneered this particular area in their studies of the intensity with which accounting data reacts to the business risk in the company. Beaver, Kettler and Scholes (1970) studied the relationship between the beta coefficient and 7 financial indicators: the pay-out of dividends, asset growth, the ratio of own and outside equity, asset size, profit variability and the so-called "accounting beta". In addition, an in-depth analysis has been carried out by Rosenberg and Guy (1976) and Hamada (1972), which discovered the fact that a beta coefficient of an indebted company should have a higher value than the beta of a debt-free company for a given amount of own equity. At the same time, higher company debt also causes an increase in the size of the financial lever, leading to an increase of risk for shareholders. Rosenberg and McKibben (1973) elaborated upon the outcomes of the research produced by Beaver, Kettler and Scholes (1970), confirming that the use of financial variables ultimately leads to more accurate results than in the cases when only the historical coefficient is used. Beaver and Manegold (1975) examined the relationship between the market beta coefficient and financial indicators on a sample of 254 companies between 1951 and 1969. Thompson (1976) analysed 43 variables. Gahlon and Gentry (1982) created a model that offers an explanation of the influence of the financial and operational levers on the company cash flow, its systematic risk and its return rate. Ro, Zavgren and Hsieh (1992) studied the development of the beta coefficient healthy companies and companies that faced the risk of default. St-Pierre and Bahri (2006) have carried out a study aiming to evaluate the association between the historical beta financial indicators. Anderson and Brooks (2006) studied 4 indicators that have an impact on the P/E ratio. Amorim, Lima and Murcia (2012) tested the relationship between the systematic risk based on the market and accounting principles on the Brazilian market. The models often test several explanatory variables at the same time. However, a combination of variables has both its advantages and disadvantages when tested. On one hand, the advantage lies in the increased strength of the model, i.e. the model can explain a higher change the percentage of the dependent variable. On the other hand, the problem of multi-collinearity arises. The probability of its appearance grows along with the growth of the independent variables.

The Brimble-Hodgson accounting model (Brimble and Hodgson, 2007) has become the basis of the analysis. In their study, the authors analysed the relationship between the systematic risk and accounting variables. Their model analysed 12 accounting variables: accounting beta, variability of the returns, cash flow, operational lever, liquidity, interest coverage, dividend pay-out, financial lever, and market-to-book ratio. The results indicated a strong relationship between the accounting variables and the beta coefficient, with the determining coefficient reaching the value of 67%. This model was applied to a sample of 129 marketable companies in Australia between 1991 and 2000. This paper presents its own model based on the accounting model of Brimble and Hodgson. The main difference between their accounting model, and the model presented in this paper is in the fact that the accounting model suggested by this paper does not include the indicators of market value so that it enables its use in the environment of a less developed equity market. A sample of companies from 15 European countries was used for testing. First, the Brimble-Hodgson accounting model was used (previously applied only to marketable Australian companies) both for the whole sample and for the separate market segments. Then, the testing continued using the accounting model presented by this paper, which has been created so that it could possibly be applied in the conditions specific for the country of Slovakia.

2. Proposed Accounting Model for the Quantification of the Systematic Risk

During the creation of the model presented in the paper, dependent and independent variables have been defined together with their expected impact on the systematic risk. The model was prepared using the multiple regression model, which contains several independent variables. The dependent variable has been defined as the systematic risk expressing the dependency of the return rate of the asset from the return rate of the market, known also as the beta coefficient. The choice of independent variables has been influenced by their availability in the financial statements. Market indicators, included only in the financial statements of publically traded joint stock companies, have not been included. Indicators of expenses on research and development and foreign revenue have also been excluded and can be seen under the line in Table 1.

Table 1

The Independent Variables of the Proposed Accounting Model

Formula	Description	Influence
$AG_{it} = ln\frac{total\ assets}{total\ assets_{n-1}}$	Growth calculated as the natural logarithm of the ratio of total assets in a given year and the total assets in the year before (n – 1).	+
$Ibeta_{it} = \frac{operational\ profit}{total\ assets}$	The operational beta coefficient calculated as the ratio of the operational profit and total assets.	–
$IInten_{it} = \frac{CAPEX}{assets}$	The investment intensity calculated as the ratio of capital expenses and total assets.	–
$Flev_{it} = \frac{total\ obligations}{total\ assets}$	The financial lever.	+
$DOZ_{it} = ln\left(\frac{stock}{revenue}\right)$	The natural logarithm of the stock turnover time.	+
$DUebit_{it}$ **(Mark of profit before tax deduction and interest)**	The mark of earns before taxes and interest – an artificial *(dummy)* variable. If negative, it has the value of zero, otherwise 1.	+/–
$ROA_{it} = \frac{ebitda}{total\ assets}$	The return on assets calculated as the ratio of the earnings before interest, taxes, depreciation and amortization (***EBITDA)*** indicator and the total assets.	–
$sdebit_{it} = \sqrt{\frac{(EBIT - \overline{EBIT})^2}{n}}$	The standard deviation of the earnings before interest and taxes (***EBIT)*** indicator where ***EBIT*** is the indicator value in the year *i* and ***EBIT*** is the average value of the indicator during the 5 previous years including the year *i* for the company *j*.	
$totdebttoequity_{it} = \frac{D}{E}$	Calculated as the ratio of debt and equity.	+
$Size_{it} = ln(total\ assets)$	Size calculated as the natural logarithm of total assets.	–
$RD_{it} = \frac{r\ \&\ d\ expenditure}{revenue}$	The research and development expenditure.	
$Int_{it} = \frac{foreign\ revenue}{total\ revenue}$	The rate of internationalisation is expressed as the ratio of foreign and total revenue.	+/–

Source: Own composition.

Although a relationship between these indicators and the systematic risk has been identified, only a limited number of companies made the data required for their calculation publically available. The analysis has not been carried out only on the panel data, but also separately for each segment. Therefore, every variable in a non-logarithmic form has been expressed in a logarithmic form and these forms have been exchanged as needed during the model testing. Apart from the description of the independent variables, Table 1 also includes the expected influence of the variable on the systematic risk. The plus sign expresses a positive relationship, whilst the minus sign expresses a negative relationship between the dependent and independent variables.

The model used in this research takes the following form:

$$\begin{aligned} \boldsymbol{beta}_{it} &= \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \times \boldsymbol{AG}_{it} + \boldsymbol{\beta}_2 \times \boldsymbol{Ibeta}_{it} + \boldsymbol{\beta}_3 \times \boldsymbol{IInten}_{it} + \boldsymbol{\beta}_4 \times \boldsymbol{Flev}_{it} + \\ &+ \boldsymbol{\beta}_5 \times \boldsymbol{DOZ}_{it} + \boldsymbol{\beta}_6 \times \boldsymbol{DUebit}_{it} + \boldsymbol{\beta}_7 \times \boldsymbol{ROA}_{it} + \boldsymbol{\beta}_8 \times \boldsymbol{sdebit}_{it} + \\ &+ \boldsymbol{\beta}_9 \times \boldsymbol{totdebttoequity}_{it} + \boldsymbol{\beta}_{10} \times \boldsymbol{Size}_{it} + \boldsymbol{\varepsilon}_{it} \end{aligned} \tag{1}$$

Where $beta_{it}$ is the market beta coefficient for the company „*i*“(*i* = 1,…,1965) in the year „*t*“ *(t* = 2005,…,2014*)*. The model has been applied to business entities in 15 countries of the EU.

Let us assume that the segment is a significant factor with an impact on the achieved economic results and the company risk. The companies found in the same segment have common features, be it when reaching the values of their financial indicators or the access to financial opportunities (Kalusová, 2015). It is expected that the division of the analysed sample into 8 segment categories can improve the quality of the models that are to be analysed and help achieve a higher determination coefficient. The assessed business units from EU-15 countries have been categorised according to their segment (Table 2) and the dependency of the market beta coefficient from the accounting variables has been analysed separately for each segment.

T a b l e 2

The Number of Observations in the Individual Segments

Total number of observations and observations categorised according to the SIC categories with their SK NACE pairings		
Standard Industrial Classification	**SK NACE**	**No. of observations**
SIC A	SECTION A	52
SIC B	SECTION B	216
SIC C	SECTION F	426
SIC D	SECTION C	3 948
SIC E	SECTION H, D, E	956
SIC F	SECTION G	302
SIC G		505
SIC I	SECTION J, I , M, P, R, S, T, U	1 314
Model total		**7 530**

Source: Own composition.

Table 2 shows the total number of observations for the models without any regard for the segments and a number of observations distributed according to the segments (Majdúchová and Siváková, 2015). Given that the data for the analysis has been acquired in the foreign DataStream database, the companies have been categorised according to the SIC – *Standard Industrial Classification.* This classification is used in the United States of America, and is not completely equivalent to the Slovak classification system SK NACE. Therefore, for the purposes of the research, the individual SK NACE categories have been paired with their SIC counterparts, so that the model could be applied to the particular segment in Slovakia.

3. Data and Methodology

When studying the issue of the accounting model and its use when quantifying the systematic risk, we have formulated a hypothesis that there is a statistically significant relationship between the systematic risk and accounting variables and that the segment is a significant factor in systematic risk quantification. We assume that the companies operating in the same segment have common features, be it when reaching the values of their financial indicators or the access to financial opportunities.

During the testing of the proposed accounting model, the panel data method and the multiple linear regression model have been used within a ten-year period of 2005 – 2014. These methods allowed for acquiring an insight into the structure and the dynamics of the analysed economic phenomena.

The basic sample consisted of 1 865 companies. After cleaning it from missing data and extreme values, the number of the companies decreased (762). After having cleaned the sample, we have created artificial variables for the individual segments. In total, we have created 8 segment categories and using the Stata software, 7 530 observations have been made on 762 companies.

The comparison has been made with the following models: the model with fixed effects, the model with random effects, and the model with random effects and artificial variables. In the fixed-effect model, we have found 7 statistically significant indicators at the significance level $\alpha = 0.05$. In the random-effect model, we have found 5 statistically significant independent variables at the significance level $\alpha = 0.05$. The model with random effects and artificial segment variables also had 5 statistically significant independent variables at the significance level $\alpha = 0.05$ and almost all segment variables excluding the SIC_B segment (Mining and quarrying). The SIC_I segment has been excluded from the analysis purposefully, so that a multi-collinearity check could be performed. In each model, 7 171 observations have been analysed.

When analysing the panel data, both the fixed-effect and random-effect model had to be tested for the possibility whether a model better than the joint regression model does not exist. To check whether the fixed occurs in the tested panel data, the LM (Langrange Multiplier) test has been used. The panel data demonstrated the presence of random effects, and so using the joint regression model has proven to be unsuitable.

In order to discover, which of the effects (fixed or random) are more relevant and are also significant for the suggested model, the Hausman test has been used. It has been identified that compared to the random-effect model, the fixed-effect model has proven to be more suitable. Based on the Hausman test results, we further worked with the fixed effects during the analysis of the accounting model proposed in this paper. It has a disadvantage in the fact that it is not possible to identify the individual effect of the artificial variables on the dependent variable, i.e. the market beta coefficient.

The model variables were checked for the presence of multicollinearity. The results indicate that there is heteroscedasticity present in the model. Apart from the heteroscedasticity, the accounting model has been tested for the presence of auto-correlation. The presence of a first-grade autocorrelation has been rejected on the $\alpha = 0.05$ significance level. Based on the outcome, the proposed accounting model has been treated to account for heteroscedasticity, and autocorrelation using cluster analysis. Due to having used the cluster in the model, the number of statistically significant variables at $\alpha = 0.05$ decreased to 4: the natural logarithm of the financial lever, the natural logarithm of the standard deviation of EBIT, the natural logarithm of the investment intensity and the natural logarithm of the return on assets.

T a b l e 3

The Correct Value of the Determination Coefficient for the Panel Data

Linear regression, absorbing indicators	
Number of observations	7 652
F (4, 6837)	193.14
Prob > F	0.0000
R-squared	0.7438
Adjusted R-squared	0.7133
Root MSE	0.1535

Source: Own composition in program Stata.

According to the results in Table 3, it can be concluded that the adjusted determination coefficient *(Adjusted R-squared)* has reached the value of 0.7133, which means that this model is capable of explaining 71.33% of variability in the systematic risk.

Table 4

Cluster Analysis for the Model with Fixed Effects

Random – effects GLS regression Group variable: id				Number of observations = 7 652 Number of groups = 811		
R-sq: within = 0.0984 between = 0.3309 overall = 0.2692				Obs per group: min = 2 avg = 9.4 max = 10		
				Wald chi 2 (4) = 558.25		
corr (u_i, X) = 0 (assumed)				Prob > chi 2 = 0.0000		
(Std. Err . adjusted for 811 clusters in id)						
beta	Coef.	Robust Std. Err	z	P > [z]	[95% Conf. Interval]	
lnFlew	–0.0351114	0.0151976	–2.31	0.021	–0.0648982	–0.0053246
lnsdebit	0.068314	0.0036287	18.83	0.000	0.0612019	0.0754261
lnIInten	–0.0333257	0.0042909	–7.77	0.000	–0.0417358	–0.0249157
lnROA	–0.0485814	0.0065319	–7.44	0.000	–0.0613837	–0.0357791
_cons	–0.373614	0.0440232	–8.49	0.000	–0.459898	–0.28733
sigma_u	0.18531347					
sigma_e	0.15353598					
rho	0.59296297 (fraction of variance due to u_i)					

Source: Own composition in program Stata.

Accounting model was treated for heteroscedasticity and autocorrelation. We used cluster analysis. Due to the use of the cluster in the model, the number of statistically significant variables was reduced to 4. There are statistically significant the natural logarithm of the financial leverage, the natural logarithm of the standard deviation of the EBIT indicator, the natural logarithm of the net working capital and the natural logarithm of the return on assets on the significance level $\alpha = 0.05$.

4. Results and Relevant Discussion

The determination coefficient of the proposed accounting model has reached values between 0.3 and 0.42. It has been confirmed that the segment is an important determining factor in the process of systematic risk estimation. During the testing for individual segments, the proposed accounting model has proven to be problematic with regard to specification and normal distribution. Therefore, it can be assumed that the market value indicators, which have not been included among the independent variables, also play an important role when estimating the systematic risk.

The final form of the proposed accounting model is as follows:

$$\widehat{\boldsymbol{beta}}_i = -0.373614 - 0.0351114 \times ln\left(\boldsymbol{Flev}\right)_i + 0.068314 \times \times \mathbf{ln}(\boldsymbol{sdebit})_i - 0.0333257 \times \mathbf{IInten}_i - 0.0485814 \times \mathbf{ln}(\boldsymbol{ROA})_i \qquad (2)$$

The model shows that the systematic risk has a negative correlation with the natural logarithm of the financial lever, the natural logarithm of the investment intensity and the natural logarithm of the return on assets, while having a positive correlation with the he natural logarithm of the standard deviation of EBIT.

Table 5 shows the final forms of the accounting models according to the individual segments:

T a b l e 5

The Accounting Model According to the Segments

Segment	Formula	Description
Segment SIC A – Agriculture, Forestry and Fishing	$\widehat{beta}_i = -1.560214 - 0.1582027 \times ln(\boldsymbol{Flev})_i + 0.1379775 \times \boldsymbol{Size}_i - (2.46\boldsymbol{e} - 06) \times \boldsymbol{sdebit}_i$	*The beta coefficient is negatively correlated to the natural logarithm of the financial lever and the standard deviation of EBIT indicator. It is positively correlated to the company size.*
Segment SIC B – Mining and quarrying.	$\widehat{beta}_i = -0.6256705 - 0.3054851 \times \boldsymbol{Flev}_i - 0.647629 \times \boldsymbol{Ibeta}_i + 0.1373683 \times \mathbf{ln}(\boldsymbol{sdebit})_i$	*The beta coefficient is negatively correlated to financial lever and the operational beta coefficient. It is positively correlated to the natural logarithm of the standard deviation of EBIT. Based on theoretical knowledge, the financial lever should be positively correlated to the market beta coefficient.*
Segment SIC C – Construction	$\widehat{beta}_i = -0.8967428 - 0.9891287 \times \boldsymbol{ROA}_i - 0.7728439 \times \boldsymbol{IInten}_i + 0.1588095 \times ln(\boldsymbol{sdebit})_i + 0.0836927 \times ln(\boldsymbol{Flev})_i - (2.59\boldsymbol{e} - 07) \times \boldsymbol{sdebit}$	*The beta coefficient is negatively correlated to the return of assets, the investment intensity and the standard deviation of EBIT. It is positively correlated to the natural logarithm of the standard deviation of EBIT, and the financial lever. Based on theoretical knowledge, the standard deviation of EBIT should be positively correlated to the market beta coefficient.*
Segment SIC D – Industry	$\widehat{beta}_i = -0.8967428 - 0.9891287 \times \boldsymbol{ROA}_i - 0.7728439 \times \boldsymbol{IInten}_i + 0.1588095 \times ln(\boldsymbol{sdebit})_i + 0.0836927 \times ln(\boldsymbol{Flev})_i - (2.59\boldsymbol{e} - 07) \times \boldsymbol{sdebit}$	*The beta coefficient is negatively correlated to the natural logarithm of the operational and financial levers, and the artificial EBIT variable. It is positively correlated to the company size.*
Segment SIC E – Transport, Communication, Utilities	$\widehat{beta}_i = 0.0944028 + 0.0790653 \times ln(\boldsymbol{Flev})_i + 0.0790653 \times \boldsymbol{DOZ}_i - 0.688234 \times \boldsymbol{IInten}_i + 0.0485418 \times \boldsymbol{Size}_i + 0.2676489 \times \boldsymbol{ROA}_i - 0.1244495 \times \boldsymbol{DUebit}_i$	*The beta coefficient is positively correlated to the stock turnover time, the asset size and their return. It is negatively correlated to the investment intensity and the artificial EBIT variable.*
Segment SIC F – Wholesale	$\widehat{beta}_i = -2.683578 + 0.2069681 \times \mathbf{ln}(\boldsymbol{sdebit})_i + 5.921462 \times \boldsymbol{Ibeta}_i - 5.568182 \times \boldsymbol{ROA}_i$	*The beta coefficient is positively correlated to the natural logarithm of the standard deviation of EBIT. It is negatively correlated to the operational beta coefficient and the return of assets.*

Segment	Formula	Description
Segment SIC G – Retail	$\widehat{\boldsymbol{beta}}_i = -0.5986321 + 0.0703902 \times ln(\boldsymbol{sdebit})_i - 0.0918048 \times ln(\boldsymbol{IInten})_i - 0.0442111 \times \boldsymbol{DOZ}_i$	*The beta coefficient is positively correlated to the natural logarithm of the standard deviation of EBIT. It is negatively correlated to the natural logarithm of the net working capital and the stock turnover time.*
Segment SIC I – Services	$\widehat{\boldsymbol{beta}}_i = -0.1954539 + 0.0610448 \times ln(\boldsymbol{sdebit})_i + 0.0225202 \times \boldsymbol{Size}_i - 0.0759927 \times \boldsymbol{DUebit}_i + 0.0120981 \times \mathbf{ln}(\boldsymbol{IInten})_i$	*The beta coefficient is positively correlated to the natural logarithm of the standard deviation of EBIT, size, and the natural logarithm of the investment intensity. It is negatively correlated to the artificial EBIT variable.*

Source: Own composition.

T a b l e 6

The Summary of the Influences of Selected Indicators on the Systematic Risk for the Brimble-Hodgson Accounting Model

Sample	**EU-15**								
Determinant	**Total**	**SIC A**	**SIC B**	**SIC C**	**SIC D**	**SIC E**	**SIC F**	**SIC G**	**SICI**
Accbeta	+				+				+
sdebit	+				–				
DUebit					–				
CF2								–	
Pay-out ratio			+			–			
OPL	–				–			+	
Liquidity	+				+				
Fin. lever	+	+	–		+				
Inter. covg.		+	–		–	–			
Growth									
Size	+			+	+	+	+	+	
MB									
lnsdebit		+	+						+
lnMB	–		–	–	–	–	–	–	–
lnOPL				–		–	–		–
lnDPR							+		
lnLiq							+		+
lnFlev				+			+	+	
lnCF	–								
lnGrowth	–		–	–	–			–	
R2	**0.7698**	**0.6323**	**0.5042**	**0.401**	**0.3382**	**0.2761**	**0.6272**	**0.3761**	**0.285**

Source: Own composition.

To compare the achieved results, we have provided Table 6 with cumulative results from the testing of the Brimble-Hodgson accounting model that constituted the basis for creating our own model. The testing was performed on the same sample of companies. The cumulative results from the testing of the proposed accounting model can be found in Table 7.

The fields for the individual variables in both tables are marked with a plus or minus sign with light- or dark-grey background. The sign shows the influence of the variable on the systematic risk, whilst the coloured background indicates whether this influence coincides with the expectations. It can be seen that the influence of some variables on the systematic risk changes according to the segment. This phenomenon is obvious in the variables of pay-out ratio, financial lever, operational lever and interest coverage. The rest of the variables have preserved the same type of influence in all segments. The agriculture, forestry and fishing segment *(SIC A)* has the lowest number of statistically significant variables: financial lever, interest coverage, and the natural logarithm of the standard deviation of EBIT. On the other hand, the industry segment *(SIC D)* has 10 statistically significant variables.

T a b l e 7

The Summary of the Influences of Selected Indicators on the Systematic Risk for the Proposed Accounting Model

Sample	**EU-15**								
Determinant	**Total**	**SIC A**	**SIC B**	**SIC C**	**SIC D**	**SIC E**	**SIC F**	**SIC G**	**SIC I**
Growth									
Oper. beta			–				+		
ln(oper.beta)					–				
IInten				–		–		–	
ln(IInten)	–								+
Fin. lever			–						
ln(fin. lever)	–	–		+	–	+			
DOZ (STT)						+		–	
DUebit					–	–			–
ROA				–		+	–		
ln(ROA)	–								
sdebit		–		–					
D/E ratio									
Size		+			+	+			+
Lnsdebit	+		+	+			+	+	+
R2	**0.7438**	**0.3797**	**0.4289**	**0.3937**	**0.2671**	**0.2092**	**0.3945**	**0.345**	**0.2177**

Source: Own composition.

From the analysis of the structure of the models, it can be stated that the size of the property has been mostly occurring as statistically significant. However, it did not reach the desired significance in none of the cases. It is true that with the growing size of the company property, the systematic risk decreases. In the models for the segments SIC C, SIC D, SIC E, SIC F, and SIC G, the influence of the size on the systematic risk was positive. The knowledge of positive influence of the size on the systematic risk is not new: the same influence of the indicator has been proven by Bergesen and Ward (1996). During their analysis of South African companies, and by Castagna and Maltocsy (1978) when analysing Australian companies. Castagna and Maltocsy suggested that the positive relationship between the systematic risk and the size might be the result of the relativity of the size and the willingness to undertake risks. Size relativity means that a company that could be considered small in smaller markets such as in Australia and South Africa may actually be a large company. The other factor, i.e. the willingness to undertake risks, shows that larger companies on smaller markets are usually more active in higher-risk areas than smaller companies. This is also proven be the correct relationship of the indicator to the systematic risk when testing companies in the United States (Kachecha and Stydom, 2011) and (Castagna and Matolcsy, 1978). In the case of an incorrect model specification, we have replaced the size indicator by the natural logarithm of the standard deviation of EBIT. This was the case of the segments of agriculture, forestry and fishing *(SIC A),* and mining and quarrying *(SIC B)*. In this case, we have achieved the correct influence of the indicator on the systematic risk. Another major determinant of the systematic risk is the natural logarithm of the market-to-book ratio. Apart from the SIC A segment, it has reached positive influence in all segments. The expected influence on the systematic risk can be seen in the case of the financial lever indicator. When analysing all of the segments both together and separately, we have confirmed a statistically significant and positive relationship with the systematic risk. The influence of the financial lever was only statistically insignificant in the segment of services (SIC I) and wholesale (SIC E). In wholesale and retail segments, the variable was significant in the logarithmic form and also had a positive influence on the systematic risk. By comparing the determination coefficients according to the segments in the Brimble-Hodgson accounting model and the proposed accounting model, we have identified that the values in the proposed accounting model are lower. It is presumably caused by the fact that the proposed model does not include market indicators such as market-to-book ratio, cash flow and pay-out ratio. It can be suggested that the accounting models that include market indicators are more suitable for explaining the variability in the systematic risk. Due to the fact, that our aim was to test a model that would be applicable in companies that are not publicly traded, the market indicators have not been included into the proposed accounting model.

During the assessment of the influence of the variables, we focused on their stability among the segments, i.e. the fact whether their influence changed from segment to segment. Table 7 indicates that the investment intensity, standard deviation of EBIT, size, natural logarithm of the EBIT standard deviation, and artificial EBIT variables had the same influence on the systematic risk in each segment. On the other hand, the influence of the operational beta, natural logarithm of the investment intensity, natural logarithm of the financial lever and return of assets changed in the individual segments. This implies that some of the variables are unstable. This fact can be considered one of the major deficiencies in accounting models. With expectations, we recorded the opposite effect on systematic risk compared to enterprise size indicators and the natural logarithm of the financial leverage. In the case of size, this opposite effect was also achieved in other tests (Kachecha and Strydom, 2011). The explanation is that large corporations behave like small companies in small capital markets, and therefore, when analysing the determinants of systematic risk in small markets, this indicator may achieve this opposite effect in relation to the systematic risk. The opposite effect of the financial leverage can be attributed to both the construction of the indicator using only the accounting data that are affected by the different accounting standards as well as by the natural logarithm of the number lower than zero.

Conclusion

Despite the negativity mentioned above, it can be suggested that there is a statistically significant relationship between systematic risk and accounting variables. Currently, the estimates of beta coefficients are based on the data published online by several financial institutions (Kardoš, 2005). The beta coefficient determined this way is then adjusted according to the specific features of a given company using penalties that mostly reflect financial and business risks (Mařík and Maříková, 2008). The value of these penalties is often determined by estimation according to the subjective opinion of the valuator. With the confirmation of the hypothesis stating that there is a statistically significant relationship between the systematic risk and the accounting variables, it is possible to choose accounting variables with regard to the specific features of the company during the calculation of the beta coefficient.

The most important factors seem to be the size of the company property, the financial and operational levers, the market-to-book ratio indicator and interest coverage. These indicators have exhibited stability and demonstrated a statistically significant relationship with the systematic risk in almost all of the segments. The artificial variable of EBIT is also considered important. Although, this indicator was only significant in some of the segments, it exhibited a negative influence in all of the measurements. It was only statistically significant in the segments of industrial services, construction and wholesale. The selection of the determinants and the proposal of the models were based on the data over a ten-year period, which creates stability assumptions for the model to a certain extent.

We have previously determined the most important determinants of the systematic risk. However, we have not considered the size of the penalties according to which the average beta coefficient should be adjusted. Given the fact that this is a process, which requires long-term experience in the valuation process, this question is suitable for further study or can serve as a catalyst for further research in the area.

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