INTELLECTUAL CAPITAL AND ITS IMPACTS ON SMEs PROFITABILITY DURING COVID-19 PANDEMIC

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ABSTRACT

This study aims to examine the relationship between intellectual capital and profitability in the pre-COVID-19 period and its change during the pandemic, focusing on Slovak small and medium enterprises (SMEs). The novelty of this study is the analyses of the crisis period conducted on a sector level via linear mixed-effects models in a Central and Eastern European country. The data sample consisted of 24,351 Slovak small and medium enterprises. This study assumes a positive relationship between profitability and company size, age, capital employed efficiency, and structural and human capital efficiency during the pre-COVID-19 year. Companies with higher value-added intellectual coefficient (VAIC) scores achieved higher values of profitability in both return on assets (ROA) and return on equity (ROE). The results also show that structured capital and capital employed efficiencies negatively impacted company profitability during 2020. On a sector level, the pandemic hit the following sectors the most: tourism and gastronomy and gambling due to various restrictions and closures.

Keywords: COVID-19, intellectual capital, human capital, profitability, SME, CEE

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INTRODUCTION

Companies are constantly pushed to innovate due to globalization, changing technologies and increased competition. Companies create value and obtain a competitive advantage through their intellectual capital (IC) and knowledge. (Ren and Song, 2021) These market changes happened even faster during the COVID-19 pandemic, spreading in early 2020. Movement restrictions and compulsory home offices contributed to the faster digital transformation of private companies and government institutions. IC allowed companies to adapt faster to the continuous changes and challenges caused by pandemic restrictions. These changes might be even more significant for small and medium enterprises (SMEs) which have fewer resources (i.e., financial, personal). The correct allocation of existing resources, then, might lead to a higher level of innovation, optimization of internal processes, increased quality, and increased profitability.

Most studies (Chen et al., 2005; Clarke et al., 2011; Firer and William, 2003; Nadeem et al., 2019) mainly have concluded that IC contributes to improved performance of companies. Opinions differ, however, as to how IC impacts company performance during an economic crisis. The Morariu (2014) study showed that the

relationship between IC and profitability became weaker during the 2008 financial crisis in 2008. According to Nadeem et al. (2019), the IC of companies did not change during the financial crisis, which helped companies overcome the economic turmoil. On the other hand, Kehelwalatenna (2016) claimed that IC increased the productivity of companies during an economic crisis such as the one in 2008 and 2009. This disunity of opinion is caused by fewer existing studies dealing with this topic. The impact of intellectual capital during a crisis has not been properly studied before, and if it was, those studies did not provide specific results. (Kehelwalatenna, 2016; Morariu, 2014; Nadeem et al., 2019). This study, therefore, aims to examine the relationship between IC and company performance in the pre-COVID-19 period and its change during the pandemic in 2020. The novelty of this study is that this relationship has been analyzed during the crisis period. Moreover, this relationship was investigated on a sector level via a linear mixed-effects model, which has not been studied before. Existing studies (Kamath, 2008; Ovechkin et al., 2021, Vishnu and Gupta, 2014; Xu and Li, 2020) focused on analyzing one or two industrial sectors and did not conduct broader cross-industrial comparisons within one economy. Unlike this study, those studies did not contribute to the development of global models describing the impact of IC on company performance across all industrial sectors. This study is structured as follows: the first part provides a literature review, while the second describes data sample details and the research methodology. The third section explains the achieved results. The last part includes a discussion and concluding remarks.

LITERATURE REVIEW

The relationship between IC and company performance during a crisis, as mentioned in the introduction, has been studied only by a few researchers so far (Kehelwalatenna, 2016; Morariu, 2014; Nadeem et al., 2019). Therefore, the literature review in this paper focuses on the relationship between IC and profitability and provides an overview of data samples based on the industrial sector and regional representation.

Existing studies have mostly confirmed a positive relationship between the profitability of a company and its IC. Studies applying the value-added intellectual coefficient (VAIC) model or its components (Chen et al., 2005; Clarke et al., 2011; Nadeem et al., 2019), and studies applying different features describing IC (Guo et al., 2012; Ren and Song, 2021), have shown that companies with a certain level of IC achieve higher values of return on assets (ROA) or return on equity (ROE). However, few studies assume no relationship between IC and ROA or ROE. (Firer and William, 2003, Morariu, 2014) On the contrary, Clarke et al. (2011) and Joshi et al. (2013) showed using data samples of Australian companies that high levels of human and structural capital might lead to higher profitability. Additionally, Li et al. (2020), in a sample of 264 Chinese SMEs, showed that human capital directly increases SMEs' efficiency. Similarly, the studies of Ge and Xu (2020) and Ovechkin et al. (2021) indicated that structural capital and physical capital are significantly related to company performance on a single-sector data sample. Xu and Li (2020) assumed that profitability is impacted by physical, human, structural and relational capital based on a study of 953 manufacturing companies. On the other hand, Tran and Vo (2018) showed that human capital efficiency marginally reduces banks' profitability. In summary, most of the authors identified the impact of IC or its parts on the profitability of companies.

Existing studies have focused on IC's impact on company performance within one or two economic sectors. These sectors can be mainly considered as sectors with high added value such as healthcare (Ali, 2020; Ge and Xu, 2020; Kamath, 2008; Vishnu and Gupta, 2014; Parast et al. 2013; Zhang et al. 2021), IT (Dženopoljac et al., 2016), the financial sector (Joshi et al., 2013; Tran and Vo, 2018; Zhang et al., 2021) and the petrochemical sector (Parast et al., 2013). Several studies have also analyzed the impact of IC within sectors with lower added value such as agriculture (Ovechkin et al., 2021; Xu and Wang, 2019) and the manufacturing sector (Xu and Li, 2020; Xu and Liu, 2020). In addition, Zhang et al. (2021) conducted a study including a cross-sector comparison and has shown that different elements of IC have a different impact on company performance in the financial and pharmaceutical industries. For example, these findings point out that the impact of human capital efficiency is higher in the companies from the pharmaceutical sector. However, the limitation of existing studies (Joshi et al., 2013;

Ge and Xu, 2020; Zhang et al., 2021) is their primary focus on a single industrial sector with its subsectors and, therefore, the expansion of the data set with other sectors is indeed required. Also, other studies (Zéghal and Maaloul, 2010, Nadeem et al., 2016) suggested expanding the analysis of IC across all industrial sectors and not focusing on single sectors with expected lower or higher levels of value added.

From a geographical point of view, many studies have analyzed the impact of IC on profitability, mainly in developing economies like China (Ge and Xu, 2020; Li et al., 2020; Xu and Li, 2020; Xu and Liu, 2020; Xu and Wang, 2019) and India (Ali, 2020; Kamath, 2008; Vishnu and Gupta, 2014). Additionally, many studies focusing on IC or human capital research were conducted in Central and Eastern Europe (CEE) countries such as Slovakia (Hamad and Tarnoczi, 2021; Pílková, 2013), the Czech republic (Hamad and Tarnoczi, 2021; Yousaf, 2021), Poland (Kozera-Kowalska and Baum, 2018; Hamad and Tarnoczi, 2021), Hungary (Hamad and Tarnoczi, 2021), Ukraine (Rodchenko et al., 2021), Romania (Morariu, 2014) and Serbia (Dženopoljac et al., 2016), or Central Asia such as Azerbaijan (Ismayilzade et al., 2021) or Russia (Ovechkin et al., 2021). However, these studies, when compared to studies done in developed countries (e.g., Australia - Clarke et al., 2011; Joshi et al., 2013) or the UK (Nadeem et al., 2016)) do not provide any essential findings on the impact of IC on profitability which would point to any cultural differences or other country specifics. Nevertheless, most studies have confirmed a positive relationship between IC (and its elements) and profitability.

The advantage of small economies in CEE is that they can quickly become knowledge-based due to their size. Zelinská et al. (2020) defined a knowledge-based economy as high-quality and continuous education, economic incentives, institutional arrangements, and an effective innovation system including information infrastructure. Therefore, the importance of IC and its elements is growing in the CEE region. Also, it is possible to develop broad data samples, which might represent most of the economy (e.g., the number of SMEs in Slovakia was approximately 260,000 in the year 2020 and data in this study was approxivately 25,000). Such a data sample is representative enough and includes various components, which fills an existing literature gap on IC and its impact on company performance at a cross-industrial level. Findings developed on such data samples might be applied to various emerging countries and developed economies.

DATA AND METHODOLOGY

This study has measured the intellectual ability of a company via the VAIC model and its variables. This model measures new value created in a company per each invested money unit in each resource. (Pulic, 2004) Some studies have extended the original VAIC model primarily by attributes considering research and development expenses and other variables derived from them. (Vishnu and Gupta, 2014; Chen et al. 2005; Nadeem et al. 2019). Application of the extended model was not possible in this study, however; only 0.5% of the companies from the data sample reported some values for research and development expenses in their financial statements. Due to this limitation, Pulic's original VAIC was applied in this study. Its variables and their formulas are listed in Table 1.

Table 1. VAIC model variables

Ratio	Long	Formula
SCE_IC	Structural capital efficiency	Structural capital for the company / (Operating profit + Employee costs + Depreciation + Amortization)
HCE_IC	Human capital efficiency	(Operating profit + Employee costs + Depreciation + Amortization) / Total salaries and wage paid
ICE_IC	Intellectual capital efficiency	Human capital efficiency + Structural capital efficiency
CEE_IC	Capital employed efficiency	(Operating profit + Employee costs + Depreciation + Amortization) / Book value of the net assets of company
VAIC	Value added intellectual capital	Intellectual capital efficiency + Capital employed efficiency

Source: author's work based on Pulic (2004)

The data sample consisted of 24,351 Slovak companies for 2019 and 2020. The data source was the Finstat database, which contains the financial statements of companies operating in Slovakia. The data sample contained companies classified as SMEs. The classification for an SME is as follows: a) less than 250 employees: b) annual sales turnover below 50 million Euro; or c) total asset value below 43 million Euro. The distribution of the data sample per sector and its average VAIC values in both years are in Table 2. Sectors with the lowest values of VAIC in the pre-pandemic period were tourism and gastronomy, sales and maintenance of vehicles, wood and paper, and the automotive industry. Sectors with the highest values of VAIC were IT, law, energy and mining, real estate, and finance. Provided values correspond with expectations when high-added-value sectors such as IT, law or finance also achieve higher values of VAIC.

Table 2. Sample – industrial sectors distribution and average VAIC values

Industrial sector	Nb.	% of total	VAIC 2019	VAIC 2020	K-W test (p-value)
Advertising	366	1.50	3.58	3.57	0.966
Agriculture and forestry	1,081	4.44	3.28	3.23	0.208
Automobile industry	85	0.35	3.16	3.10	0.583
Clothing and footwear	194	0.80	3.28	3.44	0.228
Construction	3,030	12.44	3.56	3.38	0.000***
Development and civil engineering	747	3.07	3.96	3.75	0.039*
Education	186	0.76	3.72	3.33	0.019*
Electrical engineering	295	1.21	3.21	3.06	0.065
Energy and mining	249	1.02	4.36	4.26	0.673
Engineering	474	1.95	3.24	3.10	0.024*
Finance	333	1.37	4.59	4.67	0.774
Food processing industry	386	1.59	3.27	3.24	0.67
Gambling	54	0.22	3.60	2.03	0.000***
Health care	2,195	9.01	3.72	3.63	0.029*
Chemistry and plastics	307	1.26	3.19	3.17	0.76
Information technology (IT)	1,006	4.13	4.04	4.10	0.417
Intermediary activity	571	2.34	3.91	3.74	0.157
Law, consulting and accounting	1,309	5.38	4.09	4.10	0.875
Media, publishing and culture	301	1.24	3.57	3.44	0.272
Metalworking and metallurgy	966	3.97	3.47	3.30	0.001***
Production - other	111	0.46	3.74	3.21	0.006**
Real estate	1,258	5.17	4.48	4.46	0.903
Research and development	312	1.28	3.83	3.68	0.181
Retail	1,365	5.61	3.19	3.27	0.062
Sales and maintenance of vehicles	585	2.40	3.07	3.00	0.304
Service	1,048	4.30	3.61	3.67	0.395
Telecommunications	67	0.28	3.87	3.95	0.772
Tourism and gastronomy	1,262	5.18	3.02	2.41	0.000***
Transportation and logistics	1,385	5.69	3.65	3.76	0.026*
Waste management	182	0.75	3.50	3.58	0.487
Wholesale	2,256	9.26	3.41	3.42	0.756
Wood and paper	385	1.58	3.09	3.00	0.181

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: author's work based on FinStat database

The main aim of this study is to examine the relationship between IC and company performance in the pre-COVID-19 period and its change during the pandemic. Based on this, the following hypotheses were defined:

Hypothesis 1: There is a positive relationship between IC and company performance in the pre-pandemic year.

Hypothesis 2: There is a positive relationship between IC and company performance during the COVID-19 period.

Hypothesis 3: There is a positive relationship between IC of sectors and company performance.

All three hypotheses were tested by linear mixed-effects models. A linear mixed-effects model is a model that uses random-effects and fixed-effects. and is useful when the measurement is done on groups of related statistical units. (Obenchain and Lilly, 1993) Therefore, linear mixed-effects model (1) was tested in the following vector form:

$$Y = \beta_1 VAIC + \beta_2 SCE\_IC + \beta_3 ICE\_IC + \beta_4 CEE\_IC + \beta_5 HCE\_IC + \beta_6 \ln(AGE) + \beta_7 \ln(SIZE) + \delta_{1,i} Q_{1,i} + \cdots + \delta_{4,i} Q_{4,i} + \gamma_1 S_1 + \cdots + \gamma_i S_i + \varepsilon \quad (1)$$

where Y is a dependent variable representing one of the profitability ratios (*ROA* or *ROE*) for year 2019 (Hypothesis 1) or its annual absolute change (*ROA* year-over-year difference or ROE year-over-year difference) between years 2019 and 2020 (Hypothesis 2). Both ratios were used by Dženopoljac et al. (2016), Ge and Xu (2020), Nadeem et al. (2019) and Xu and Li (2020). Variables *VAIC, SCE_IC, ICE_IC, CEE_IC* and *HCE_IC* are the original VAIC model variables which were calculated based on Table 2. *Ln(AGE)* represents the natural logarithm based on company age, and *ln(SIZE)* represents the natural logarithm of total assets. Variables β_1 up to β_7 represent coefficients of the regression line (fixed-effects) for the respective independent variable. Variables $Q_{1,i}$ up to $Q_{4,i}$ are a dummy binary variable expressing their reference to a particular VAIC quartile. Variables $\delta_{1,i}$ up to $\delta_{4,i}$ are coefficient of random-effects factors for dummy variable VAIC quartiles and a particular industrial sector *i*. Variables S_1 up to S_i are dummy binary variables expressing their reference to a particular industrial sector *i*. Variables γ_1 up to γ_i is coefficients of random-effects factor for dummy variable industrial sector (Hypothesis 3). The last variable ε represents the value of the corresponding residual component of a linear regression model with mixed-effects. Coefficient's estimation has been conducted in R-Studio version 1.3.959.

RESULTS OF ANALYSIS

Table 3 shows the results of the linear mixed-effects regression for the pre-pandemic year 2019. These results show a positive relationship between ROA and ROE during the pre-pandemic period and HCE_IC, SCE_IC, CEE_IC, and company age and size.

Table 3. Liner mixed-effects regression models – pre-COVID-19 profitability

Fixed-effects	ROA			ROE		
	Coeff.	Stand. error	t value	Coeff.	Stand. error	t value
VAIC	0.000	0.001	0.706	0.005	0.002	0.052
SCE_IC	0.101	0.004	0.000***	0.201	0.008	0.000***
ICE_IC	0.002	0.001	0.080	-0.005	0.002	0.044*
CEE_IC	0.114	0.003	0.000***	0.206	0.006	0.000***
HCE_IC	0.002	0.001	0.021*	0.009	0.002	0.000***
AGE	0.001	0.000	0.007**	0.004	0.001	0.000***
SIZE	0.001	0.000	0.000***	0.006	0.001	0.000***
Random-effects						
First quartile	-0.055			-0.051		
Second quartile	-0.066			-0.086		
Third quartile	-0.082			-0.127		
Fourth quartile	-0.107			-0.143		
R squared adjusted	0.570			0.365		
Wald chi-square	4,945.200			3,472.500		

Table 3. Continued

p-value	0.000	***	0.000	***
AIC	-55,569.000		-17,593.000	
BIC	-55,488.000		-17,512.000	

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: own calculation in R-Studio based on financial statements

This finding indicates that larger, well-established companies achieved higher levels of profitability because the combination of their capital (both physical and financial) with skills, experience, productivity, knowledge, strategy, and organizational networks was on a higher level. The random-effects analysis also achieved similar results – penalization of companies in the first quartile for VAIC was two times lower for ROA and three times lower for ROE than the values for companies in the fourth quartile.

Different results were achieved by the linear mixed-effects regression model analyzing the difference in profitability between pre-pandemic and pandemic years as shown in Table 4. This model indicates a negative relationship between profitability and SCE_IC and CEE_IC (for ROA and ROE), company age and ICE_IC (for ROA) and company size (for ROE). Companies with higher levels of structural, physical, and financial capital achieved worse profitability results than companies with lower investments in capital. Moreover, the random-effects analysis shows that companies in the first quartile of VAIC achieved lower performance than companies in other quartiles. These results indicate that expenses associated with maintenance of different capital components (structural or employed) might cause temporarily weaker performance during crisis periods.

Table 4. Linear mixed-effects regression models – COVID-19 profitability (delta)

Fixed-effects	Delta ROA			Delta ROE		
	Coeff.	Stand. error	t value	Coeff.	Stand. error	t value
VAIC	0.001	0.002	0.373	0.002	0.003	0.630
SCE_IC	-0.060	0.005	0.000***	-0.174	0.011	0.000***
ICE_IC	-0.003	0.002	0.047*	0.001	0.003	0.706
CEE_IC	-0.029	0.004	0.000***	-0.106	0.008	0.000***
HCE_IC	-0.002	0.001	0.104	0.000	0.003	0.936
AGE	-0.001	0.000	0.005**	-0.001	0.001	0.326
SIZE	0.000	0.000	0.760	-0.009	0.001	0.000***
Random-effects						
First quartile	0.038			0.193		
Second quartile	0.041			0.217		
Third quartile	0.048			0.239		
Fourth quartile	0.058			0.239		
R squared adjusted	0.200			0.479		
Wald chi-square	851.860			577.050		
p-value	0.000	***		0.000	***	
AIC	-38,488.000			-674.620		
BIC	-38,407.000			-593.620		

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: own calculation in R-Studio based on financial statements

Figure 1 shows coefficients for random-effects for the dummy variable industrial sector. Random effects from parts a) and b) show that sectors with high profitability (blue lines) during the pre-pandemic period are the IT, healthcare, finance, electrical engineering, research and development, and law, consulting, and accounting sectors. These sectors can be considered as sectors with the highest ability of IC as per the descriptive analysis. Therefore, their

VAIC values were the highest. Random-effects from parts c) and d) show the difference in the profitability of these sectors during the COVID-19 year. Sectors with the lowest ROA or ROE are tourism and gastronomy, and gambling. These sectors were hit the most during 2020 due to restrictions and closures, restriction of movement, and cancellation of sporting events. All of the COVID-19 restrictions negatively impacted the profitability of companies from these sectors. Based on confidence interval analysis, it can be assumed that random-effects for models with ROE are more robust (confidence interval has lower variability) than random-effects for models with ROA.

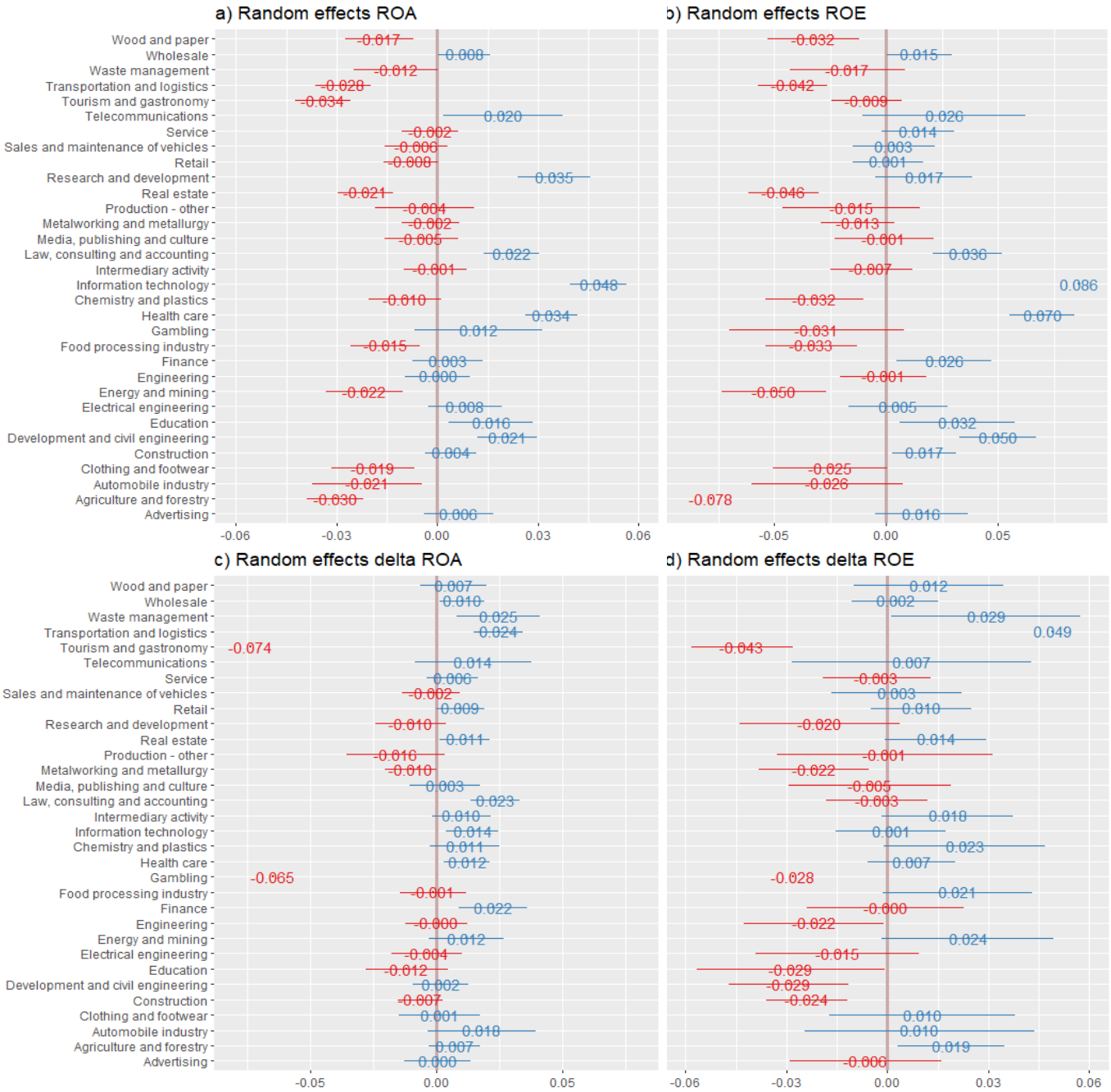

Figure 1. Random effects from linear mixed effects model

Source: own calculation in R-Studio based on financial statements

DISCUSSION AND CONCLUSION

The main aim of this study has been to examine the relationship between IC and company performance in the pre-COVID-19 period and its change during the pandemic. The analysis was conducted on 24,351 Slovak companies for 2019 and 2020, and the results indicate the following findings.

First, the results of this study show a positive relationship between company profitability and its size, age, CEE_IC, SCE_IC and HCE_IC. This finding does not reject Hypothesis 1. The positive relationship is in line with existing studies of Li et al. (2020), Ge and Xu (2020), Nadeem et a. (2019), Ovechkin et al. (2021) and Xu and Li (2020). Physical and financial capital are still crucial in companies and companies' business success in post-communist countries like Slovakia, which does not depend only on intangible resources. The transformation to the knowledge economy of post-communist countries in the CEE region might bring companies sustainable competitive advantage via endogenous growth out of a middle-income trap.

Second, during the COVID-19 year, ICE_IC, SCE_IC and CEE_IC had a negative impact on company profitability. Companies in the highest VAIC quartile achieved worse profitability results than companies in the lower quartiles. Therefore, based on the second finding, Hypothesis 2 is rejected. Moreover, the second finding indicates that different components of IC temporarily decreased company profit during the crisis. Higher expenses can cause this profit decrease to maintain IC and relatively limited options on decreasing these expenses over a short period. In Slovakia, like in other CEE countries, the cost to maintain IC during the crisis when there are low levels of liquidity in the market exceeded the benefits of having IC in a company. This can be explained by underestimating IC importance or relatively inefficient crisis management in companies in times of a crisis. These findings align with Morariu (2014), who pointed out that the relationship between IC and profitability weakens during a crisis. However, these findings are still opposed to studies of Kehelwalatenna (2016) and Nadeem et al. (2019).

Third, sectors achieving the highest values of VAIC (e.g., IT, healthcare, finance or electrical engineering) also achieved above-average performance of ROA and ROE parameters in the pre-COVID-19 period; this aligns with the expectation of Hypothesis 3, which is neither rejected. Similar results were provided by Zhang et al. (2021), who also showed the different impacts of IC on company performance for sectors in their data sample. However, contrary to Zhang's study, our study assumes a higher impact of IC on the financial sector instead of healthcare. Then, during the COVID-19 pandemic, the performance of these companies worsened even though the IC ability measured via VAIC remained almost unchanged. The sectors hit by the decreased profitability were mainly tourism and gastronomy or gambling. These sectors were hit during the second COVID-19 wave due to restrictive measures.

A possible limitation of this study is that the analysis was conducted only for two periods (pre-COVID-19 and COVID-19 year). Even though IC might seem like a burden in the COVID-19 crisis, all the skills, experience, productivity, knowledge, strategy, or structure would provide a competitive advantage for companies once the crisis is over. These companies can, as a result, subsequently grow faster. Therefore, future studies should focus on analyzing the post-COVID-19 period and the development of IC. Another limitation of this study is the inability to apply the extended VAIC model as only a minimum number of companies in the data sample reported research and development expenses in their financial statements. Application of the extended model therefore is currently impossible in the Slovak environment. Regardless of these limitations, this study is the first to apply the VAIC model in Slovakia and estimate its coefficients via a linear mixed-effects model, and as a result it has contributed to the extension of the literature dealing with IC by providing new empirical evidence from the CEE region during negative events – economic crisis.

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