“Impact of intellectual capital on profitability: Evidence from software development companies in the Slovak Republic”

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IMPACT OF INTELLECTUAL CAPITAL ON PROFITABILITY: EVIDENCE FROM SOFTWARE DEVELOPMENT COMPANIES IN THE SLOVAK REPUBLIC

Abstract

Intellectual capital is the total value of all entity's intangible resources (organizational, human, and customer). Effective management of intellectual capital in high-tech industries needs determination of its role in ensuring profitability and clarifying the direction of managerial and investment policy in intangible resources. The aim of this study is to investigate the impact of intellectual capital on the profitability of Slovak software development companies. Panel data regression analysis was used as the main research method to analyze the data of 16 Slovak software development companies for 2015–2019. The study designed and analyzed four panel data regression models with different dependent variables (Return on Assets, Net Profit Margin, Gross Profit Margin, Earnings Before Interest and Taxes Margin) and similar independent variables (Capitalized Development Costs, Software, Acquired Intangible Fixed Assets, Personnel Costs, Social Security Costs, Social Costs, and Total Costs of Economic Activity). The analysis of these models was carried out based on the fixed effects method. It was found that intellectual capital reflected in the financial statements of software development companies does not meet the information needs of stakeholders and does not have a significant direct impact on profitability. Only Acquired Intangible Fixed Assets had a direct positive impact on the profitability of software development companies in all four analyzed models, and some independent variables had a negative impact. It is proposed to expand the structure of financial reporting items that characterize the intellectual capital and improve the method of recognizing costs of various types as intangibles.

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INTRODUCTION

The formation of the knowledge economy in a world is characterized by changing the priority of resources used by enterprises to ensure profitability. This has led to special attention to intellectual capital management as a significant factor in value creation. The role of intellectual capital in ensuring profitability is obvious for innovative enterprises, which are the main driving force of economic development. Many countries around the world support the development of innovative sectors of the economy, in particular, software development companies.

The shift in management's focus from tangible to intangible capital when considering the 'value creation' processes within firms (Abeysekera, 2008) also raised a number of important questions among scientists regarding the need to improve the theoretical and methodological foundations of intangible assets management. The current financial statements of innovative enterprises do not fully meet the needs of management in the operation of intellectual capital. From the standpoint of representatives of the theory of post-industrial society and the knowledge economy (Adams & Oleksak, 2010; Haskel & Westlake, 2018; Kabir, 2019; Ullberg et al., 2021), primarily the innovative enterprises must have the strongest link between their intellectual capital or intangibles and the level of their profitability. Therefore, the imperfection of the current financial reporting primarily also has negative consequences for the management of software development companies and their capital suppliers due to the inability to provide relevant information about intellectual capital.

This study tests whether the profitability of innovative enterprises not significantly depends on the available intellectual capital reflected in financial statements. Therefore, it can serve as empirical evidence for the improvement of managerial and investment policy of software development companies in intangible resources. In addition, it highlights the necessity of improving current information provision of intellectual capital management, taking into account the sectoral characteristics of enterprises and the specifics of the use of intangibles.

1. LITERATURE REVIEW

The growth of profitability is the defining goal of any enterprise, so the analysis of factors influencing profitability is the research focus of many scholars. Analyzed papers in this area in the context of this study can be divided into two main groups. The first group presents studies that conduct a general analysis of the impact of various factors of intangible nature (intangible assets, intellectual capital, intellectual resources, investment in intangible assets, etc.) on profitability. The second group includes impact analysis of intellectual capital directly on the profitability of high-tech companies (IT companies, software developers).

1.1. Impact of intangible factors on the profitability management

The influence of intangible factors on profitability was considered both directly and within the frame of their impact on financial performance because profitability is one of its components. This allowed obtaining a number of important results that explain the role of various types of intangible factors in ensuring the profitability of companies in different sectors of the economy.

From a theoretical point of view, intellectual capital should positively affect the profitability of enterprises and should play a decisive role among all other factors. For instance, Sedláček (2010) investigated the role of intangible assets that have not been included in the balance sheet of the Slovak and Czech companies' market value. It was found that such assets represent the main item of the estimated market value of companies, ensuring their profitability. Yuan and Rizki (2020) continued the development of the idea of taking into account the unrepresented part of intellectual capital in analyzing its impact on profitability. They pointed out that intangible assets as unexplained value have a significant and positive effect on the financial performance of manufacturing companies listed on the Indonesia Stock Exchange (IDX) 2010–2014.

Wang (2011) explored the relationship between intellectual capital and financial performance using the data about companies from the capital market in Taiwan. He found a positive relationship between value-added intellectual capital indicator and return on assets in both fixed and random effects.

Ranani and Bijani (2014) investigated the influence of intellectual capital on the financial performance of listed companies on Tehran Stock Exchange. They found that it has a significant effect on the rate of return on assets. These findings were also confirmed by Arianpoor (2021), who noted that unrecorded and recorded intangible assets positively affect firm profitability (return on assets, profit margin). Finally, Seo and Kim (2020) analyzed Korean enterprises and found out that three intangible resources (human capital, advertising, and R&D) have a positive effect on a firm's profitability.

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Okoye et al. (2019) examined the effect of intangible assets on the performance of quoted companies in Nigeria during 2008–2017. They found that intangible assets research and development cost and goodwill have a significant effect. On the contrary, employee benefit expenses have no significant effect on return on profitability.

Kaymaz et al. (2019) due to difficulties to measure intangible factors (because they are not recognized as assets) investigated the impact of the calculated indicators "Calculated Value of Intangible factors (CVIF)" and "Calculated Value of Intangible Factors/Total Assets (CVIFTA)" on profitability indicators of corporations traded at Muscat securities market in Oman. After analysis of selected regression models, it was confirmed that intangibles have a significant and a positive effect on corporate financial performance, except when CVIFTA rather than CVIF regresses ROA.

Xu and Liu (2020) investigated the impact of intellectual capital on profitability for Chinese manufacturing listed companies and found a positive relationship between such indicators. Dogan and Kevser (2020) also confirmed a statistically significant and positive relationship between the intellectual capital coefficient and profitability rates (ROA, ROE) for companies operating in the Borsa Istanbul Industrial Index for the period of 2015–2019. Finally, Tumpach et al. (2020) analyzed the possibility of Slovak companies bankrupting by means of neural networks using SMOTE methodology.

Myroshnychenko et al. (2019) researched the influence of corporate socially responsible activities on the net profit in 63 manufacturing enterprises in Ukraine, proving a sound relationship between them. Plastun et al. (2018) explored financial data in the Ukrainian stock market in terms of persistence using R/S analysis. Zavalii et al. (2022) examined the correlation between marketing-related intangible assets as the main element of customer capital and net income of 100 U.S. stock market leaders. They found that marketing costs (expenses) have a significant impact on net income.

The analyzed papers allowed determining the positive impact of different types of intangible factors on the profitability of enterprises in different sectors of the economy worldwide (Brazil, China, Czech Republic, Iran, Korea, Nigeria, Oman, Taiwan, Turkey, USA, Slovak Republic, Ukraine, etc.).

1.2. Impact of intellectual capital and its elements (human capital) on the profitability of IT companies and software developers

Some scholars have focused on the role of intellectual capital in ensuring the profitability of high-tech enterprises operating in the IT sector. Thus, Gan and Saleh (2008) examined the relationship between Intellectual Capital and the profitability of technology-intensive companies listed on Bursa Malaysia. They found that technology-intensive firms still depend on physical rather than intellectual capital efficiency. Therefore, physical capital efficiency is the most significant variable related to the profitability of the companies.

Chiarello et al. (2014) analyzed the relationship between financial performance and intangible assets disclosure using the data from Brazilian and Chilean IT companies. They found that companies with a more developed level of intellectual capital have more opportunities to increase their value.

Li and Wang (2014) investigated the relationship between intangible assets and profitability indicators of technology firms listed on the Hong Kong Stock Exchange. They found that R&D expenditure and sales training positively correlate to ROA. Sundaresan et al. (2021) investigated the relationship between intangible assets and financial performance and financial policies of 33 listed technology firms in Thailand from 2015 to 2019. They noted that intangible assets had a significant positive relationship with the profitability of such companies.

Radonić et al. (2021) analyzed the impact of different elements of intellectual capital (human, relational, structural, and innovation) on the profitability of South-East European IT companies. They also confirmed a positive effect of intellectual capital on profitability. Thus, innovation capital has the strongest impact on profitability compared to previous studies in which human capital was considered the main factor.

In addition to researching the impact of intellectual capital on the profitability of IT enterprises in different countries (Brazil, Chile, Hong Kong, Malaysia, and Thailand), some scientists study the features of such an impact on enterprises on a global scale. The conclusions obtained confirm the positive influence of intellectual capital on profitability (Qureshi & Siddiqui, 2020), and a negative one (Lopes & Ferreira, 2021).

Summing up, based on previous research on the impact of intangible factors on company profitability and the impact of intellectual capital on the profitability of software developers, the study found that intellectual capital, intangible assets, and other intangible factors mainly increase firm profitability. However, such an increase varies depending on the industry in which the company operates. Moreover, it depends on the structure of intangible factors, the impact of which was studied.

Intellectual capital and profitability are mainly studied based on the listed companies in Asian and Latin Americas emerging countries, except for Radonić et al. (2021) and Zavalii et al. (2022). The related studies conducted in the Europe information technology industry are very few. Therefore, this study conducted in the software development industry fills this missing gap. Considering the above, the purpose of this study is to investigate the impact of intellectual capital on the profitability of Slovak software development companies.

2. DATA AND METHODOLOGY

To test the assumptions highlighted in the paper, the activities of 16 Slovak companies' software developers were analyzed (Appendix A) for the period 2015–2019. These are innovative high-tech companies whose activities largely depend on the efficient use of intellectual capital. Selected profitability indicators of such companies were calculated based on their annual financial reporting for the period 2015–2019. Among 16 analyzed software development companies, 14 are the companies with limited liabilities, and 2 are joint-stock companies, which all, according to the classification of SK NACE, belong to group 58290. The observed population has such structure by the type of ownership of software development companies: private domestic – 75%; international with a predominant private sector – 6%; and foreign – 19%.

The methods used are Descriptive Statistics Analysis; Selection of Estimate Panel Data Parameter; Classical Assumption Test analysis; Panel Data Regression Model Analysis. The panel data regression models include four dependent variables – ROA (Return on Assets), NPM (Net Profit Margin), GPM (Gross Profit Margin), EBITM (Earnings Before Interest and Taxes Margin). The choice of ROA, EBITM, NPM, and GPM indicators as a characteristic of the enterprise profitability is justified because they are used to measure the company's ability to obtain profits and manage its assets effectively. Selection of the indicators to analyze the impact of intellectual capital on the profitability of enterprises panel data regression analysis is based on previous research (Wang, 2011; Ranani & Bijani, 2014; Kaymaz et al., 2019; Yuan & Rizki, 2020; Dogan & Kevser, 2020). The panel set of data allows presenting a spatial sample of intellectual capital components of Slovak software developers. This provides a set of observations on each element of intellectual capital and allows to reduce the problem of multicollinearity based on the use of individual differences of intellectual capital indicators.

Table 1 summarizes approaches to different types of indicators characterizing the profitability of the enterprise, and using them as a dependent variable in establishing the relationship with the intellectual capital of the enterprise.

Table 1. Approaches to profitability indicators influencing intellectual capital

Source: Compelled by authors.

Profitability indicators	References
ROA	Gan and Saleh (2008), Wang (2011), Ranani and Bijani (2014), Li and Wang (2014), Kaymaz et al. (2019); Xu and Liu (2020); Yuan and Rizki (2020); Dogan and Kevser (2020); Qureshi and Siddiqui (2020); Arianpoor (2021); Sundaresan et al. (2021), Lopes and Ferreira (2021); Radonić et al. (2021)
EBITM	Kaymaz et al. (2019); Xu and Liu (2020)
NPM	Kaymaz et al. (2019); Xu and Liu (2020); Qureshi and Siddiqui (2020); Arianpoor (2021); Radonić et al. (2021)

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Based on the evolutionarily formed structure of intellectual capital, it includes organizational, relational, and human capital (Ullberg et al., 2021). According to Li and Wang (2014), Seo and Kim (2019), and Lopes and Ferreira (2021), the analysis of the impact of organizational capital on profitability as independent variables must choose such indicators as capitalized development costs, software and acquired intangible fixed assets. According to Li and Wang (2014) and Okoye et al. (2019), the analysis of the impact of human capital on profitability is based on the personnel costs, social security costs, and social costs. Confirmation of the relevance of these indicators is that as a result of capitalization of such costs social intangible assets may be incurred (Ievdokymov et al., 2020a). To analyze the impact of relational capital on profitability, total costs of economic activity was chosen as an indicator. The last one is relevant because intangible assets do not include trademarks, as the capitalization of costs for their creation is prohibited by accounting legislation, as well as there are no other objects of accounting that characterize relational capital.

However, according to Slovak legislation, costs for training and seminars, marketing and similar studies, market research, consulting, expertise, acquisition of standards and certifications such as ISO standards, preparation and commissioning, advertising, product marketing, restructuring and reorganization of the business, as well as other costs of a similar nature, are not accounted for as intangible fixed assets, but are accounted for as expenses for economic activities (Ministerstvo financií Slovenskej republiky, 2002). Therefore, the total costs of economic activity reflect the uncapitalized efforts of the enterprise aimed at increasing the relative capital of software development companies.

To control for a significant effect of additional variables except for main independent variables (intellectual capital indicators), this study gathered data on the company's size. Based on Ievdokymov et al. (2020b), company size was calculated as the natural log of total assets to control economies of scale.

For examining the relationships between the indicators that characterize the profitability of Slovak software development companies (ROA, EBITM, NPM, GPM – dependent variables), for indicators that characterize their intellectual capital (independent variables), and for control variables the paper must calculate the values of such indicators from the financial reporting. To fulfill this purpose and taking into account the features of accounting and financial reporting regulations in the Slovak Republic, a set of indicators and formulas for their calculation were used (Appendix B).

To investigate the relationship between intellectual capital and profitability indicators, this study examined the following models:

Model 1

$$ROA_{it} = \alpha + \beta_1 CDC_{it} + \beta_2 S_{it} + \beta_3 AIFA_{it} + \beta_4 PC_{it} + \beta_5 SDC_{it} + \beta_6 SC_{it} + \beta_7 TEA_{it} + \beta_8 l\_CS_{it} + \varepsilon_{it}. \quad (1)$$

Model 2

$$NPM_{it} = \alpha + \beta_1 CDC_{it} + \beta_2 S_{it} + \beta_3 AIFA_{it} + \beta_4 PC_{it} + \beta_5 SDC_{it} + \beta_6 SC_{it} + \beta_7 TEA_{it} + \beta_8 l\_CS_{it} + \varepsilon_{it}. \quad (2)$$

Model 3

$$GPM_{it} = \alpha + \beta_1 CDC_{it} + \beta_2 S_{it} + \beta_3 AIFA_{it} + \beta_4 PC_{it} + \beta_5 SDC_{it} + \beta_6 SC_{it} + \beta_7 TEA_{it} + \beta_8 l\_CS_{it} + \varepsilon_{it}. \quad (3)$$

Model 4

$$EBITM_{it} = \alpha + \beta_1 CDC_{it} + \beta_2 S_{it} + \beta_3 AIFA_{it} + \beta_4 PC_{it} + \beta_5 SDC_{it} + \beta_6 SC_{it} + \beta_7 TEA_{it} + \beta_8 l\_CS_{it} + \varepsilon_{it}. \quad (4)$$

where *ROA*, *NPM*, *GPM*, *EBITM* – dependent variables, where i = entity and t = time; α – Identifier; β – Regression coefficient; *CDC*, *S*, *AIFA*, *PC*, *SDC*, *SC*, *TEA*, *l_CS* – independent variables, where i = entity and t = time; ε_{it} – error term.

Figure 1 shows the conceptual framework of the study.

Source: Authors' elaboration.

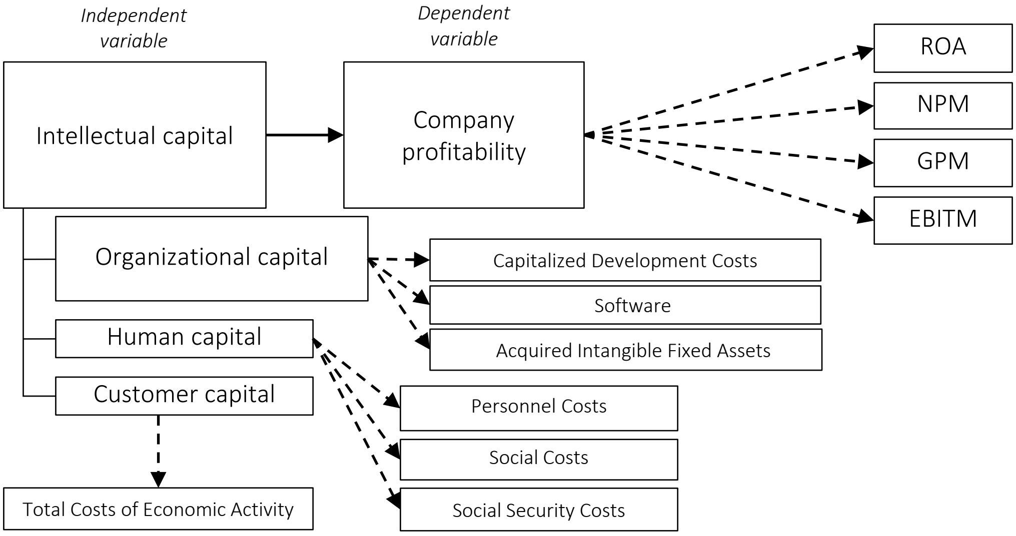

Figure 1. Conceptual framework

3. RESULTS

3.1. Dynamics of profitability indicators of Slovak software developers

The development of four indicators that characterize the profitability of software developers in the Slovak Republic (ROA, NPM, GPM, EBITM) for the period 2015–2019 can be seen in Figure 2.

Figure 2 provides a comparative description of changes in the profitability of software developers in Slovak Republic for the period 2015–2019. All indicators decline in their values from 2017 to 2018 and growth from 2018 to 2019. During the period 2015–2016, an increase in the values of ROA, EBITM, and NPM against the background of falling GPM values can be seen. During 2016–2017, only an increase in NPM was detected, other indicators (ROA, EBITM, and GPM) have decreased.

To calculate the impact of intellectual capital on the profitability of Slovak software developers, the study uses information from the financial statements of intangible assets of such enterprises, as well as the costs

Source: Authors' elaboration.

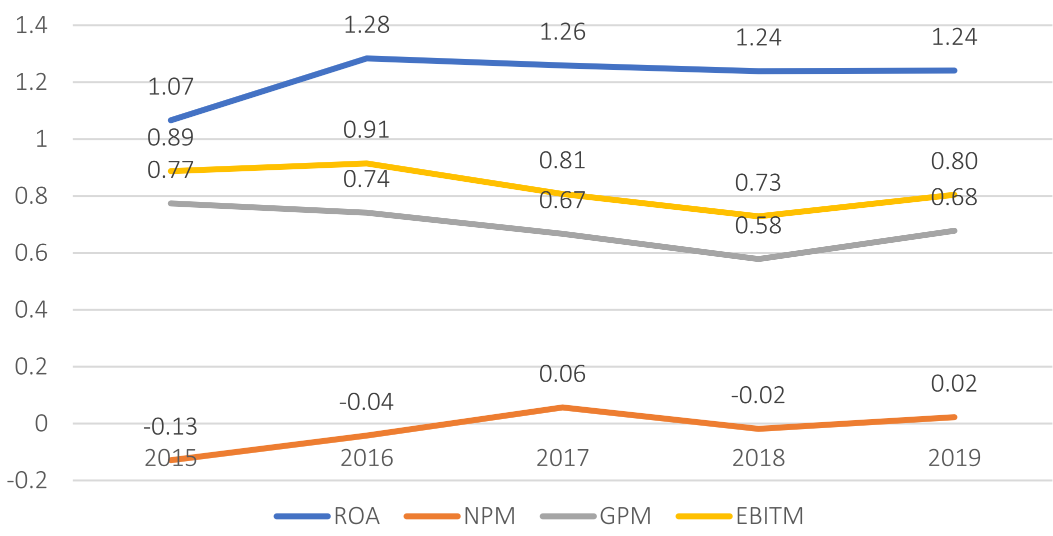

Figure 2. Dynamics of profitability indicators of Slovak software developers for the 2015–2019 period

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Table 2. Numerical characteristics, based on observations 1:1-16:5

Source: Calculated via Gretl software package.

Variables	Mean	Median	St. Dev.	Minimum	Maximum
ROA	1.22	1.01	1.00	0.000	4.49
NPM	–0.0221	0.0256	0.335	–1.75	0.347
GPM	0.687	0.472	0.593	–0.182	3.79
EBITM	0.828	0.721	0.528	0.000	3.79
CDC	1.26e+004	0.000	4.52e+004	0.000	2.43e+005
S	5.61e+004	1.06e+003	1.58e+005	0.000	7.91e+005
AIFA	2.08e+004	0.000	7.49e+004	0.000	4.92e+005
PC	2.90e+005	0.000	6.29e+005	0.000	2.62e+006
SDC	7.63e+004	5.75e+003	1.53e+005	0.000	6.53e+005
SC	3.90e+004	1.29e+004	5.79e+004	0.000	2.26e+005
TEA	8.82e+005	2.11e+004	1.69e+006	125.0	9.68e+006
l_CS	12.1	12.1	1.86	9.02	15.9

incurred by enterprises, which characterize other structural elements of intellectual capital.

3.2. Descriptive test result

The descriptive statistics extracted from 16 Slovak software development companies from 2015 to 2019 provided a total of 80 observations, as tabulated in Table 2.

For all variables (dependent and independent) used to build the four proposed models, the basic numerical characteristics (mean, median, standard deviation, minimum, maximum) were calculated. The analysis of such characteristics allowed one to establish the following defining trends: for individual variables (ROA, GPM, EBITM, S, SDC, TEA, and l_CS) the mean value is greater than the standard deviation; thus, the data in these variables have small distribution. For all independent variables, except the control variable, there are significant gaps between the minimum and maximum values. As a result of their comparison with the corresponding median value, the paper encourages the use of robust statistics.

3.3. Selection of estimate panel data parameter (choice between fixed effects method (FEM) and random effects method (REM))

First, it is necessary to determine which method is more suitable for each model used in this study – FEM or REM. To do this, the Hausman test was used for the four models identified above and found that for each of them the null hypothesis can be rejected. That is why the fixed effects model is more appropriate to use than random effects for all models. For example, the application of the Hausman test for Model 2 revealed that for the value of chi-square (8) (17.8791), the p-value (0.0221516) of the asymptotic statistic test is less than 0.05, which does not confirm the null hypothesis regarding that Random-effects (GLS) model estimates are consistent.

Based on the fixed effects model, individual effects correlate with regressors, for each object $i = 1,\dots N$ the individual effect α1 remains constant during all periods (2015–2019). Thus, in models of this type α_1, $i = 1, \dots N$ are unknown parameters that need to be estimated.

3.4. Classical assumption test

To confirm the compliance of the constructed FEM data, determine its adequacy, as well as to find ways to further improve the constructed model, it is necessary to diagnose it using a series of tests. Regression testing of panel data based on the Normality test, Autocorrelation test, and Heteroscedasticity test allows this paper to verify theoretical assumptions.

The results of testing the normal distribution of residues of all four models via Gretl software package revealed that the errors in them are abnormally distributed. For example, in Model 1, the value of Chi-square (2) = 11.896, p-value = 0.00261101, which is less than 0.05. It does not confirm the null hypothesis of a normal distribution of residues.

Autocorrelation testing should be performed to verify the relationship between one residue and another. To do this, the Wooldridge test was used for autocorrelation in panel data. It confirmed the presence of first-order autocorrelation for Models 1 and 3, and autocorrelation absence for Models 2 and 4. For example, for Model 2, the obtained p-value is higher than 0.05, confirming the null hypothesis of no first-order autocorrelation.

To determine the fact that there is an inequality of variants of the remains of one observation to another in the regression model, it must be analyzed for heteroskedasticity. Its absence is evidence of its better adequacy to the data used. To determine the level of heteroskedasticity for all four models, a nonparametric Wald test was used to establish its presence for all four models.

To improve the suggested models, it is also proposed to use robust estimators. It will prevent autocorrelation and correlation between units and variance problems in panel data regression models, detecting emissions, reducing their impact, or excluding them from the statistical sample altogether. This practice is now widely used, particularly among scientists engaged in research in determining the role of intellectual capital in ensuring the profitability of enterprises (Dogan & Kevser, 2020).

3.5. Panel data regression model analysis

3.5.1. *Model 1 (ROA)*

Tables 3-10 show the analysis performed using the FEM. It demonstrates the extent to which the independent variable will affect the dependent variable, given the non-measurable individual differences of objects, allowing one to get rid of the influence of an unobserved variable (constant in time) and get unbiased parameter estimates.

Model 1 can be demonstrated through the following equation:

$$\begin{aligned}\hat{y} &= 2,67510 - 1,30939e - 06x_1 - 2,11958e - \\ &- 06x_2 + 4,79790e - 07x_3 + 4,68582e - \\ &- 07x_4 - 1,03991e - 06x_5 - 1,16692e - \\ &- 06x_6 + 7,73519e - 08x_7 - 0,116580x_8.\end{aligned} \tag{5}$$

Table 3. Model 1 (ROA). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Variable	Coefficient	Standard error	*T*–statistics	*P*–value	Significance by *t*–statistics
const	2.67510	0.650498	4.112	<0.0001	***
CDC	–1.30939e–06	5.85181e–07	–2.238	0.0252	**
S	–2.11958e–06	4.26713e–07	–4.967	<0.0001	***
AIFA	4.79790e–07	9.77980e–07	0.4906	0.6237	
PC	4.68582e–07	1.46115e–07	3.207	0.0013	***
SDC	–1.03991e–06	3.70252e–07	–2.809	0.0050	***
SC	–1.16692e–06	1.52572e–06	–0.7648	0.4444	
TEA	7.73519e–08	8.05406e–08	0.9604	0.3368	
l_CS	–0.116580	0.0559346	–2.084	0.0371	**

Note: * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 4. Model 1 (ROA). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Indicator	Value	Indicator	Value
Mean dependent var.	1.217595	S.D. dependent var.	1.004082
Sum squared resid.	52.96029	S.E. of regression	0.972481
LSDV R–squared	0.335056	Within R–squared	0.199997
Log–likelihood	–97.01571	Akaike criterion	242.0314
Schwarz criterion	299.2001	Hannan–Quinn	264.9520
RHO parameter	–0.099123	Durbin–Watson statistic	1.645336

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where: $\hat{y}$ – ROA, x_1 – CDC, x_2 – S, x_3 – AIFA, x_4 – PC, x_5 – SDC, x_6 – SC, x_7 – TEA, x_8 – l_CS.

In addition to the variables AIFA, SC, and TEA, all other selected independent variables for Model 1 are statistically significant. The most significant parameters are Const (P-value = < 0.0001), S (P-value = < 0.0001), PC (P-value = 0.0013), SDC (P-value = 0.0050), i.e., these indicators are the most influential on the dependent variable (ROA). The absence of corresponding asterisks in Table 3 indicates the insignificance of the intellectual capital indicator.

Equation of the Model 1 shows that part of the proposed parameters (const, AIFA, TEA, and PC) has a direct effect on ROA, and other parameters (CDC, S, SDC, SC, and l_CS) have an inverse effect.

Table 4 indicates that the coefficient of determination (LSDV R-squared) of Model 1 is 0.33. This means that 33.5% of the variation of the dependent variable (ROA) can be explained by the variation of the selected independent variables (const, CDC, S, AIFA, PC, SDC, SC, TEA, and l_CS). At the same time, the rest is the impact of other variables that are not examined in this study.

3.5.2. *Model 2 (NPM)*

Model 2 can be demonstrated through the following equation:

$$\begin{aligned}\hat{y} &= 0,177759 - 2,88079e-06x_1 - \\ &- 8,64310e-07x_2 + 1,29516e-06x_3 - \\ &- 2,18580e-08x_4 - 2,94978e-07x_5 - \\ &- 7,60005e-07x_6 - 3,45661e-09x_7 - \\ &- 0,00663920x_8.\end{aligned} \tag{6}$$

where: $\hat{y}$ – NPM; x_1-x_8 – the same as in Model 1.

Unlike the previous model, in Model 2, only two parameters are statistically significant – S and AIFA (Table 5). The most significant parameter is S (P-value = 0.0075), i.e., this indicator is the most influential on the dependent variable (NPM). Equation of the Model 2 shows that most independent variables (CDC, S, PC, SDC, SC, TEA, and l_CS) have an inverse effect on NPM, and only two variables (const and AIFA) have a direct effect.

Table 6 indicates that the LSDV R-squared of Model 2 is 0.39. This means that 39.1% of the variation of the NPM can be explained by the variation of the selected independent variables.

Table 5. Model 2 (NPM). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Variable	Coefficient	Standard error	T–statistics	P–value	Significance by t–statistics
const	0.177759	0.200407	0.8870	0.3751	
CDC	−2.88079e−06	2.33190e−06	−1.235	0.2167	
S	−8.64310e−07	3.23132e−07	−2.675	0.0075	***
AIFA	1.29516e−06	5.28917e−07	2.449	0.0143	**
PC	−2.18580e−08	2.62149e−08	−0.8338	0.4044	
SDC	−2.94978e−07	3.09845e−07	−0.9520	0.3411	
SC	−7.60005e−07	7.35223e−07	−1.034	0.3013	
TEA	−3.45661e−09	2.14859e−08	−0.1609	0.8722	
l_CS	−0.00663920	0.0165787	−0.4005	0.6888	

Note: * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 6. Model 2 (NPM). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Indicator	Value	Indicator	Value
Mean dependent var.	−0.022144	S.D. dependent var.	0.335471
Sum squared resid.	5.414176	S.E. of regression	0.310937
LSDV R-squared	0.391030	Within R-squared	0.277757
Log-likelihood	−5.794845	Akaike criterion	59.58969
Schwarz criterion	116.7583	Hannan-Quinn	82.51023
RHO parameter	−0.422208	Durbin–Watson statistic	2.209445

3.5.3. Model 3 (GPM)

Model 3 can be demonstrated through the following equation:

$$\begin{aligned}\hat{y} = &-0,231498 + 8,32534e-06x_1 + \\ &+1,22627e-07x_2 + 7,86528e-07x_3 + \\ &+1,06723e-07x_4 + 2,66162e-07x_5 - \\ &-9,00023e-08x_6 + 1,13668e-08x_7 + \\ &+0,0605301x_8.\end{aligned} \tag{7}$$

where: $\hat{y}$ – GPM; x_1-x_8 – the same as in Model 1.

In Model 3, only three parameters are statistically significant – CDC, PC, and l_CS (Table 7). The most significant parameter is CDC (P-value = 0.0018), i.e., this indicator is the most influential on the dependent variable (GPM). Equation Model 3 shows that most independent variables (CDC, S, AIFA, PC, SDC, TEA, and l_CS) have a direct effect, and only two variables (const and SC) have an inverse effect on GPM.

Table 8 indicates that the LSDV R-squared of Model 3 is 0.67, which is quite high compared to other models considered but not quite enough to talk about the significant role of intellectual capital in ensuring the profitability of enterprises. This means that 67.29% of the variation of the GPM can be explained by the variation of the selected independent variables.

3.5.4. Model 4 (EBITM)

Model 4 can be demonstrated through the following equation:

$$\begin{aligned}\hat{y} = &-0,333604 + 7,14963e-06x_1 + \\ &+2,59160e-07x_2 + 3,32742e-07x_3 - \\ &-2,98984e-08x_4 + 2,18542e-07x_5 + \\ &+4,99247e-07x_6 + 1,25647e-09x_7 + \\ &+0,0843714x_8.\end{aligned} \tag{8}$$

where: $\hat{y}$ – EBITM; x_1-x_8 – the same as in Model 1.

In Model 4, only two parameters are statistically significant – CDC and l_CS (Table 9). The most significant parameter, as in Model 3, is the parameter CDC (P-value = < 0.0001), i.e., this indicator is the most influential on the dependent variable (EBITM). Equation of the Model 4 shows that most independent variables (CDC, S, AIFA, SDC, SC, TEA, l_CS) have a direct effect, and only two variables (const, PC) have an inverse effect on EBITM.

Table 10 indicates that the LSDV R-squared of Model 4 is 0.66. This means that 66.44% of the variation of the EBITM can be explained by the variation of the selected independent variables.

Table 7. Model 3 (GPM). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Variable	Coefficient	Standard error	T–statistics	P–value	Significance by t–statistics
const	–0.231498	0.361276	–0.6408	0.5217	
CDC	8.32534e–06	2.66079e–06	3.129	0.0018	***
S	1.22627e–07	2.49976e–07	0.4906	0.6237	
AIFA	7.86528e–07	6.13609e–07	1.282	0.1999	
PC	1.06723e–07	5.49503e–08	1.942	0.0521	*
SDC	2.66162e–07	2.39385e–07	1.112	0.2662	
SC	–9.00023e–08	8.56441e–07	–0.1051	0.9163	
TEA	1.13668e–08	2.86609e–08	0.3966	0.6917	
l_CS	0.0605301	0.0328266	1.844	0.0652	*

Note: * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 8. Model 3 (GPM). FEM (Robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Indicator	Value	Indicator	Value
Mean dependent var.	0.687412	S.D. dependent var.	0.593361
Sum squared resid.	9.097846	S.E. of regression	0.403065
LSDV R–squared	0.672905	Within R–squared	0.526536
Log–likelihood	–26.55552	Akaike criterion	101.1110
Schwarz criterion	158.2797	Hannan–Quinn	124.0316
RHO parameter	–0.164845	Durbin–Watson statistic	1.960965

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Table 9. Model 4 (EBITM). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Variable	Coefficient	Standard error	T-statistics	P-value	Significance by t-statistics
const	–0.333604	0.458203	–0.7281	0.4696	
CDC	7.14963e-06	1.03938e-06	6.879	<0.0001	***
S	2.59160e-07	4.47770e-07	0.5788	0.5651	
AIFA	3.32742e-07	9.44131e-07	0.3524	0.7258	
PC	–2.98984e-08	1.16182e-07	–0.2573	0.7979	
SDC	2.18542e-07	3.10996e-07	0.7027	0.4851	
SC	4.99247e-07	8.50417e-07	0.5871	0.5595	
TEA	1.25647e-09	5.01737e-08	0.02504	0.9801	
l_CS	0.0843714	0.0403276	2.092	0.0410	**

Note: * significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 10. Model 4 (EBITM). FEM (robust standard errors), using the observations 1-80

Source: Calculated via Gretl software package.

Indicator	Value	Indicator	Value
Mean dependent var.	0.828133	S.D. dependent var.	0.528073
Sum squared resid.	7.391736	S.E. of regression	0.363312
LSDV R-squared	0.664470	Within R-squared	0.530967
Log-likelihood	4.821753	Akaike criterion	7.85e-07
Schwarz criterion	–18.24852	Hannan-Quinn	84.49705
RHO parameter	141.6657	Durbin–Watson statistic	107.4176

CONCLUSION AND STUDY IMPLICATIONS

Obtained results partially confirm the previous studies on the positive impact of intellectual capital on the profitability of enterprises, as well as clarify which of its elements have the greatest impact on profitability indicators. Thus, the only independent variable that had a direct positive impact on the profitability of software development companies in all four analyzed models is Acquired Intangible Fixed Assets.

This study has some limitations. Firstly, future research aimed at confirming the hypothesis should cover not only the activities of software developers, as representatives of innovative enterprises, but also other economic entities belonging to this group of enterprises. Applying a more integrated approach will provide a comprehensive understanding of the role of intellectual capital in ensuring the profitability of innovative enterprises, as well as a comparison between enterprises in different industries, which will determine how to improve the policy of investing in intellectual capital depending on the industry.

Secondly, the study depends on the published financial data of Slovak software developers, so it is subject to all limitations that are inherent in the published financial statements of such companies. In addition, some companies that were not included in the study object either did not disclose financial statements for specific periods or had a limited period of existence (recently established or liquidated during the period under study). Therefore, they did not enter the panel data on which regression models were built.

The main theoretical assumption of this study that profitability of innovative enterprises depends to a small extent on the available intellectual capital, which is reflected in the financial statements, was justified by testing four panel data regression models.

The obtained results empirically confirm the conclusions of scientists on the unsuitability of conventional information provision in the treatment of intangible values and the need to expand the criteria for recognizing intangible assets. Therefore, to increase the relevance of information on the intellectual capital of high-tech enterprises, it is recommended to expand the structure of financial reporting. Moreover, it is vital to improve the method of recognizing costs of various types (research and development costs, advertising and marketing costs, personnel costs, etc.) as intangible assets to increase management information requests.

The implementation of such proposals will help address the following important issues in the field of intellectual capital management: 1) Clearer identification of intellectual capital components in the financial statements of enterprises and ensuring unimpeded access to such information by different stakeholders; 2) Building a more effective system of internal control of intellectual capital, based on its new expanded structure; 3) Construction of a system of cost-oriented management of intellectual capital, based on an improved system of its accounting evaluation; 4) Development of a system for evaluating the effectiveness of the enterprise based on not only the material and financial, but also the intellectual capital; 5) Transformation of the management system of intellectual capital from tactical to strategic, based on the ability to obtain accounting information about the internal and external components of the intellectual capital in fair estimates.

AUTHOR CONTRIBUTIONS

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APPENDIX A

Table A1. Reporting data of 16 Slovak software development companies

No	Company	No	Company
1	3WINGS, s. r. o.	9	MzdyServis, s.r.o.
2	COLOSSEUM INVEST s.r.o.	10	PREFIS a. s.
3	DenciSoft s.r.o.	11	QICS Slovensko s. r. o.
4	DIASTONE s.r.o.	12	Streamstar, a. s.
5	ENERGO CONTROL s.r.o.	13	UTILIS, spol. s r.o.
6	Epicor Software Slovakia, s.r.o.	14	Výskumný ústav stavebnej informatiky, s.r.o., v skratke: VÚSI, spol. s r.o.
7	Goodwind, s. r. o.	15	ICP Integrated Computer Programs, s.r.o.
8	iInvoices s.r.o.	16	SPZA s.r.o.

APPENDIX B

Table B1. Characteristics of dependent and independent variables for analysis of the relation between profitability and intellectual capital

Source: Compelled by authors.

Variable		Definition	Formula	Data type from financial reporting of Slovak companies
Dependent Variables (Profitability indicators)				
ROA	Return on Assets	ROA shows how profitable a company is in relation to its total assets	$ROA = \frac{Net\ Profit}{Total\ Assets}$	Net turnover item (V1), Total assets item (S1)
NPM	Net Profit Margin	NPM shows the extent to which the company earns money, i.e., how many cents of net profit was received for each euro of sale	$NPM = \frac{Net\ Profit}{Total\ Sales}$	Income for the accounting period after tax (S100), Sales of goods (V3), Sales of own products (V4), Sales of services (V5), Sales of intangible fixed assets, tangible fixed assets and materials (V8)
GPM	Gross Profit Margin	NPM shows the extent to which the company earns money, i.e. how many cents of gross profit (profit before subtraction selling, general, and administrative costs) was received for each euro of sale	$GPM = \frac{TIEA - COGS}{Total\ Sales}$	Total income from economic activity (V2), Cost of goods sold (V11)
EBITM	Earnings Before Interest and Taxes Margin	EBITM characterizes profitability margin before paying interests and taxes	$EBITM = \frac{EBIT}{Total\ Sales}$	Total income from economic activity (V2)
Independent Variables (Intellectual capital indicators)				
CDC	Capitalized Development Costs	Development costs related to the results of research or design of new and improved materials, etc.	–	Capitalized Development Costs item (S4)
S	Software	Copyrighted or not copyrighted software, purchased separately or self–created	–	Software item (S5)
AIFA	Acquired Intangible Fixed Assets	Acquired intangible assets prior to their commissioning, including costs associated with their acquisition	–	Acquired Intangible Fixed Assets (S9)
PC	Personnel Costs	Wages, income of partners and members from dependent activities, as well as remuneration of members of the management bodies of societies and cooperatives	–	Personnel Costs (V15)

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Table B1 (cont.). Characteristics of dependent and independent variables for analysis of the relation between profitability and intellectual capital

Variable		Definition	Formula	Data type from financial reporting of Slovak companies
SDC	Social Security Costs	Expenses for compulsory social insurance	–	Social Security Costs (V18)
SC	Social Costs	Mandatory social expenses under a special provision	–	Social Costs (V19)
TEA	Total Costs of Economic Activity	Costs of training and seminars, marketing and similar studies, market research, etc.	–	Total Costs of Economic Activity (V10)
Independent Variables (Control variables)				
l_CS	Company Size	l_CS calculates as a logarithm of Total Asset at the end of reporting period and shows a size of a company	$l\_CS = Ln(Total\ Assets)$	Total assets item (S1)

Note: * indicates the elements of the financial statements from which the data for the calculation of dependent and independent variables of four models were taken.