UNVEILING THE HIDDEN VALUE: CRITICAL DETERMINANTS OF CORPORATE INTANGIBLE ASSETS

[a]DARYA DANCAKOVÁ

[a]*Technical University of Košice, Faculty of Economics, Department of Banking and Invesment, B. Němcovej 32, 040 01 Košice, Slovak Republic*
email: [a]darya.dancakova@tuke.sk

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Abstract: This paper examines the key determinants of corporate intangible assets by analysing financial data from 250 publicly traded companies in Germany, France, and Switzerland over a ten-year period (2009-2018). Through panel regression analysis, we identify significant relationships between intangible asset intensity and various firm-specific characteristics. The findings reveal that while firm size positively correlates with intangible assets, higher levels of tangible assets and cash reserves are associated with a decrease in intangible asset intensity. Surprisingly, R&D expenditures and patents do not show a statistically significant impact on intangible asset value, suggesting potential limitations in how financial statements capture innovative activities.

Keywords: R&D, patents and trademarks, intangible assets intensity, panel regression, determinants of intangible assets.

1 Introduction

The rise of the knowledge economy, coupled with rapid advancements in scientific and technological progress, has necessitated a reassessment of the importance of traditional sources of economic value creation at both macroeconomic and microeconomic levels (Dosso & Vezani, 2019). As a result, over the past decades, there has been a consistent increase in investments in intangible assets and research and development initiatives (Andersson & Saiz, 2018). This trend has been marked by a rising share of intangible assets in the market capitalization of global stock indices. The global annual study Brand Finance (2023) illustrates this shift, showing that the share of intangible assets in the market value of the S&P 500 index soared to over 90% in 2023, up from just 17% in 1975. The 2023 study results reveal significant global trends in intangible asset investments, with the United States, Ireland, Denmark, the United Kingdom, and France leading in this domain. American companies like Apple, with a 74% increase in brand value to $517 billion in 2023, and NVIDIA, with a 163% increase to $44.5 billion, are taking the lead. European telecom giant Deutsche Telekom has also seen a 17% rise in brand value to $73.3 billion in the same year. The key factor for these companies is their successful and intensive implementation of digital transformation initiatives in their business models, which boosts the value of their intangible assets. At the corporate level, this growth in intangible assets has become a crucial source of shareholder wealth (Masulis et al., 2023). These intangibles are crucial because they significantly enhance the companies' brand value and competitive edge in the market. This fact leads us to the following question: What are the crucial determinants of this hidden value behind intangible assets?

2 Literature review

The available literature on intellectual capital and intangible assets highlights several factors that can influence a company's motivation to invest in new knowledge. A key determinant of the value of intangible assets at the company level is the industry in which it operates. Industry characteristics shape strategic decisions about accumulating intangible assets and developing intellectual capital. In general, companies operating in technology-intensive industries tend to invest more in intangible assets and focus heavily on their intellectual capital. This is achieved through the development of human capital, the adaptation of organizational structures to new business models, and often the creation of entirely new products. Additionally, industry-specific characteristics determine how companies acquire new knowledge and expand their existing base of intangible assets. Uppenberg & Strauss (2010) highlighted differences in how knowledge acquisition occurs between the manufacturing sector and the services sector. While companies in industrial manufacturing obtain intangible assets primarily through funding research and development (R&D) activities, firms in the services sector tend to acquire new knowledge more through direct interactions with customers, business partners, or potential competitors, rather than through financial investments in R&D.

The value of intangible assets is significantly determined by the level of industry concentration. This relationship underscores the critical role of industry dynamics in shaping companies' competitive strategies and market positioning. According to Crouzet and Eberly (2019), as industry concentration increases, there is a corresponding rise in the value of intangible assets within individual firms and across industries. Leading firms within an industry play a pivotal role in creating new intangible assets, leveraging their bargaining power to increase market share and thereby influencing industry concentration levels.

In addition to industry characteristics, the value of intangible assets is directly and indirectly influenced by the individual attributes of a given company. Policies implemented by the company's governance bodies (shareholders, board of directors, management) affect corporate decisions regarding the disclosure of information related to intangible components of intellectual capital. Consequently, these policies determine the reported value of intangible assets in the company's financial statements (Li et al., 2008; Hidalgo et al., 2011). Moreover, by capturing and disclosing more comprehensive non-financial information about intangible assets, companies can reduce information asymmetry between themselves and third parties, including potential investors and analysts. This improved transparency can lead to more favourable financing conditions, as stakeholders gain a better understanding of the company's risk profile. In this context, research has shown that compensation structures can influence executives' investment decisions in fixed intangible assets. Specifically, cash bonuses are associated with increased investment in these assets, while stock bonuses tend to have a negative impact, with effects varying based on factors such as firm growth, internal cash flow, and leverage (Adu-Ameyaw et al., 2022). Additionally, Lemmon and Lins (2003) highlighted that a company's ownership structure also plays a critical role in determining its overall value, including the value of its intangible assets. This is influenced by the decisions of majority shareholders regarding the allocation of financial resources to investment projects.

Moreover, investments in research and development are a crucial way for companies to acquire new knowledge and expand their existing base of intangible capital. This can lead to future cash flows and positively impact the company's market value (Griliches, 1981; Elsten and Hill, 2017). Given that the disclosure of information on corporate investments in R&D and the resulting creation of intangible assets is not mandatory, the value of R&D expenditures reported in company accounts provides only a partial picture of a company's innovative activities. Nevertheless, Grandi et al. (2009) emphasize that investors tend to consider the reported value of R&D expenditures when making investment decisions, indicating that the reported value of R&D investments can potentially determine a company's market value.

In discussing the impact of company characteristics on the value of its intangible assets, the growth rate of sales is often considered a proxy variable that reflects the growth opportunities utilized by a company. Continuous sales growth indicates that the company is effectively capitalizing on market opportunities to increase its overall revenues, thereby enhancing its overall value (Tsai et al., 2012). Furthermore, the past utilization of growth potential serves as an indicator of positive future growth

prospects, which in turn influences the increase in the share of intangible assets in the company's market value (Rao et al., 2004). Besides the growth rate of sales, corporate profitability also plays a crucial role in the value of intangible assets. According to Lu et al. (2010) and Rao et al. (2004), corporate profitability has a significantly positive impact on the value of intangible assets and the associated growth in market value. Investors on financial markets tend to positively evaluate companies with higher profitability, anticipating potentially higher future cash flows. For instance, Omoye & Ibadin (2013) note that achieving higher profitability motivates companies to disclose information about intangible assets in their financial statements. This increases the reported value of intangible assets, thereby encouraging potential investors to make investment decisions in favour of the company.

The company characteristics such as company size, age, and debt levels are factors that can profoundly influence the value of reported intangible assets and shape the intensity of R&D and innovation activities. According to Min and Smyth (2015), larger company size tends to positively correlate with higher levels of R&D expenditures. Conversely, high levels of debt negatively impact the relationship between R&D intensity and the company's growth opportunities. Given the fact that investments in research and development are considered risky with high uncertainty about future benefits, companies whose business models do not hinge on creating new knowledge and added value may lack sufficient motivation to allocate more funds to R&D activities and professional training for employees. Many member countries of the European Union utilize their tax systems to stimulate investments in R&D and adequate training related to R&D project execution (European Commission, 2016a). According to a study conducted by the European Commission (2016b), most EU member states employ targeted tax incentives or direct subsidies to support R&D. Becker (2015) highlighted that public sector investments in R&D can stimulate R&D intensity in the private sector at the firm level. The author underscores that enhancing the connection between science and economic practice, supporting investments in university research, and fostering highly skilled human capital can encourage companies to allocate larger financial resources to R&D.

3 Methodology and data

In this study, we analyse a dataset of financial information from publicly traded companies across various industries in selected European countries. The main goal of this study is to evaluate how different factors influence the intensity of intangible assets in companies. To achieve this, we developed a set of variables, presented in Table 1, which were then analysed using panel regression in the statistical software R.

The data, sourced from the "Orbis" database, have been cleaned to remove any missing observations. The dataset initially included 4687 European companies with available data on R&D and intangible assets expenditures over the ten-year period. After removing inaccurate and missing data, the final dataset consists of 250 companies, organized into a long, balanced panel with 2500 observations, covering the ten-year period from 2009 to 2018. Our dataset includes small, medium-sized, and large companies operating in various industries across three countries, namely: Germany, France, and Switzerland. The descriptive statistics of the data is presented in Table 2.

To examine how various variables affect the intensity of intangible assets, we initially employed a basic regression model, which was later adjusted to account for the panel data structure. Green (2002) highlights that panel models are characterized by the presence of heterogeneity among individual cross-sectional units. In this context, the basic panel data model is represented by the following equation:

$$y_{it} = \boldsymbol{x}'_{it}\boldsymbol{\beta} + \boldsymbol{z}'_{it}\boldsymbol{\alpha} + \varepsilon_{it}$$

where $\boldsymbol{x}'_{it}$ denotes a vector of explanatory variables containing K regressors without a constant term. Heterogeneity and individual effects are captured by the term $\boldsymbol{z}'_{it}\boldsymbol{\alpha}$, where $\boldsymbol{z}'$ includes a constant component and a set of individual or group-specific variables that may be either observable (e.g., geographical location) or unobservable (e.g., specific skills and individual heterogeneity), but are assumed to be constant over time. If the variable $\boldsymbol{z}'$ is observable for all individual entities in the dataset, the entire panel data model can be estimated using Ordinary Least Squares (OLS). However, if $\boldsymbol{z}'$is unobservable, which is common in real-world economic data, OLS does not provide consistent estimates of the regression coefficients.

Table 1 Variables used in analysis

Dependent Variables	
IA/BV	Intangible assets intensity = book value of intangible assets/book value of total assets.
Independent Variables	
TA/BV	Tangible assets intensity = book value of tangible assets/book value of total assets.
Cash/BV	Cash holdings intensity = book value of cash holdings/book value of total assets.
EBITDA/BV	Profitability = EBITDA/book value of total assets.
SALES/BV	Sales intensity = book value of sales/book value of total assets.
Control Variables	
LEV	Leverage = long term debt/ book value of total assets.
SIZE	Firm size = natural logarithm of number of employees.
AGE	Firm age measured by the number of years since the company's incorporation.
Dummy Variables	
R&D	A dummy variable that takes a value of 0 or 1, indicating the absence (0) or presence (1) of R&D expenditures for the given year.
PATRADE	A dummy variable that takes a value of 0 or 1, indicating the absence (0) or presence (1) of patents and trademarks for the given year.

Source: own elaboration

We analysed the relationship between variables using three distinct modelling approaches: the pooled regression model, the random effects model, and the fixed effects model. To assess whether a panel model with fixed or random effects is more appropriate than the pooled regression model, we applied the F-test (pFtest) and the Honda test (Lagrange Multiplier Test). The results of the pFtest ($F = 77.481$, $df1 = 248$, $df2 = 2242$, p-value < 0.000) and the Honda test (normal = 93.445, p-value < 0.000) confirmed that the panel regression model with fixed or random effects is more suitable than the pooled regression model.

Following the Hausman test, we determined that the fixed effects model—whether time-fixed or individual-fixed—is more appropriate than the random effects model. The Hausman test ($\chi 2 = 13.039$, $df = 8$, p-value < 0.000) indicated that the fixed effects model provides a better fit for the data, as it accounts for unobserved heterogeneity that could bias the estimates in the random effects model. Applying the F-test (pFtest) for individual effects ($F = 1.0023$, $df1 = 8$, $df2 = 2234$, p-value < 0.000) led us to conclude that a time-fixed effects model is preferred for analysing the relationships between variables in our study.

$$Y = \alpha + \beta_1 TA/BV + \beta_2 Cash/BV + \beta_3 EBITDA/BV + \beta_4 SALES/BV + \beta_5 LEV + \beta_6 SIZE + \beta_7 AGE + \beta_8 R\&D + \beta_9 PATRADE + \varepsilon$$

where Y represents the dependent variable, specifically indicating the intensity of intangible assets. The $\beta_1 \ldots \beta_9$ in the model denote the effects of tangible assets, cash, EBITDA, sales, leverage, firm size, age, R&D expenditure, and patent activity on the dependent variable Y.

Table 2 Descriptive statistics of the variables used in analysis

Variable	Mean	SD	Min	1Q	Median	3Q	Max
IA/BV	0.220	0.170	0.000	0.082	0.190	0.326	0.830
TA/BV	0.180	0.170	0.000	0.051	0.130	0.267	0.940
Cash/BV	0.130	0.110	0.000	0.063	0.100	0.172	0.840
EBITDA/BV	0.100	0.080	-0.860	0.064	0.100	0.135	0.470
SALES/BV	0.950	0.530	0.000	0.610	0.880	1.188	4.630
LEV	0.140	0.120	0.000	0.040	0.120	0.215	0.620
SIZE	7.880	2.180	0.690	6.240	7.670	9.140	13.700
AGE	46.420	27.330	13.000	28.000	40.000	61.000	201.000

Source: own elaboration

The final model, which incorporates fixed time effects, was subsequently subjected to a series of diagnostic tests. The Breusch-Godfrey/Wooldridge test ($\chi 2$ = 1851, df = 10, p-value< 0.000) identified the presence of serial correlation in the idiosyncratic errors, while the Breusch-Pagan LM test for cross-sectional dependence in panels also confirmed serial correlation within these errors test ($\chi 2$ =6 5524, df = 31125, p-value< 0.000).

According to Wooldridge (2009), serial correlation in idiosyncratic errors ε_{it} is a common issue in panel data analysis. A recommended solution in such cases is to recalculate the standard errors using the robust variance-covariance matrix method proposed by Arellano (Arellano, 1987; Croissant & Millo, 2008). This method was applied in the estimation of the final model parameters in our study.

4 Results

The results of our analysis reveal several key trends in the relationships between intangible asset intensity and various dependent variables. Below, in Table 3, we present the key findings of our panel data analysis, which demonstrate statistically significant relationships between several independent variables and the size of firms' intangible assets.

One of the most notable findings is the strong negative relationship between the ratio of tangible assets to book value of total assets (TA/BV) and the dependent variable, with an estimate of -0.514 that is highly significant at the 0.001 level. This suggests that as a firm's tangible assets increase, there may be a corresponding decrease in its intangible assets. Similarly, the cash holdings (Cash/BV) also exhibit a significant negative relationship, with an estimate of -0.464. This indicates that firms with higher cash reserves tend to have lower levels of intangible assets.

Table 3 Results of panel regression model with time-fixed effects[1]

Independent variable	Estimate	Robust Std. Error
TA/BV	-0.514***	0.055
Cash/BV	-0.464***	0.060
EBITDA/BV	0.104	0.085
SALES/BV	-0.074***	0.016
LEV	0.106	0.092
SIZE	0.017***	0.004
AGE	-0.000*	0.000
R&D	-0.014	0.026
PATRADE	-0.002	0.016
R-Squared:	**0.372**	
Adj. R-Squared:	**0.367**	

Source: own elaboration

On the other hand, the company's profitability (EBITDA/BV) does not show a significant relationship with intangible assets, as evidenced by an estimate of 0.104. However, our analysis does reveal a small but statistically significant negative effect of the higher sales (SALES/BV), with an estimate of -0.074, suggesting that higher sales intensity may be associated with a slight decrease in intangible assets.

In contrast to these findings, firm size (SIZE) shows a positive and significant relationship with intangible assets, with an estimate of 0.017. This indicates that larger firms tend to have a more substantial base of intangible assets, which is closely linked to the value of human capital represented by their employees.

Surprisingly, variables directly related to firms' innovative activities, such as the presence of R&D expenditures (expressed as the dummy variable R&D) and the presence of trademarks and patents (indicated by the dummy variable PATRADE), did not show a statistically significant relationship with the intensity of intangible assets in our dataset.

5 Discussion

The results of our analysis contribute to the broader understanding of how various factors influence the value of intangible assets within firms, complementing existing research in the field. Our findings particularly resonate with the established literature on the role of company-specific characteristics, and R&D investments in shaping intangible asset values.

The most striking finding from our analysis is the significant negative relationship between the tangible assets' intensity and the intensity of intangible assets. A negative estimate of -0.514 indicates that as the proportion of tangible assets increases, the share of intangible assets within a firm's total asset base tends to decrease. This suggests that companies with a higher concentration of tangible assets may deprioritize the development and maintenance of intangible assets like intellectual property, brand value, or human capital.

Furthermore, the significant negative relationship between cash reserves and intangible assets in our results supports the idea that companies with larger cash reserves may be more conservative, potentially underinvesting in the creation of intangible assets. This observation is consistent with the findings of Li et al. (2008) and Hidalgo et al. (2011), who emphasize that corporate governance policies influence how firms report intangible assets, impacting their overall valuation. Firms with substantial cash reserves may prioritize financial stability over aggressive intangible asset development, leading to lower reported values of such assets.

Interestingly, while our analysis shows that the corporate profitability (EBITDA/BV) does not significantly influence intangible assets, it contrasts with studies like those of Lu et al. (2010) and Rao et al. (2004), which highlight the positive impact of corporate profitability on intangible asset value. This discrepancy may be attributed to differences in sample characteristics or industry-specific dynamics that were not fully captured in our dataset.

Additionally, our finding that sales growth has a small but significant negative effect on intangible assets contrasts with the work of Tsai et al. (2012) and Rao et al. (2004), who suggest that sales growth reflects a company's ability to capitalize on market opportunities and enhance its intangible asset base. The negative relationship in our analysis might indicate that firms experiencing rapid sales growth are focusing more on scaling

1 Note: Model represents aggregated results for the entire dataset spanning 250 companies over a 10-years period. The stars denote level of significance. If p-value is less than 0.05 (*); if a p-value is less than 0.01 (**); and if a p-value is less than 0.001 (***).

operations and tangible asset expansion rather than on developing their intangible assets.

The positive relationship between firm size and intangible assets found in our study is in line with the findings of Min and Smyth (2015), who suggest that larger firms are more likely to invest in R&D and innovation, thereby increasing their intangible asset base. Larger firms often have more resources to allocate toward intangible asset creation, which is reflected in our results showing that size is a significant determinant of intangible asset value.

Our results also reveal that variables directly linked to innovative activities, such as R&D expenditures and the presence of patents or trademarks, did not show a statistically significant impact on the value of intangible assets. This is surprising given the extensive literature highlighting the role of R&D in enhancing firm value. For example, Griliches (1981) and Grandi et al. (2009) emphasize that R&D investments are essential for acquiring new knowledge and expanding intangible capital, which ultimately boosts future cash flows and market value. The lack of significance in our findings might indicate that financial statements do not fully reflect the breadth of innovative activities within firms or that the influence of R&D on intangible assets is more complex and mediated by other unaccounted factors. Furthermore, our analysis suggests that firm-specific characteristics have minimal impact on the intensity of intangible assets. This points to a potential issue with how companies disclose information about intangible assets in their financial statements, particularly concerning R&D expenditures and innovation activities. The findings highlight a broader challenge related to the transparency and completeness of reporting on intangible assets.

6 Conclusion

This study analyzed financial data from 250 publicly traded companies in Germany, France, and Switzerland over a ten-year period (2009–2018) to assess factors influencing the intensity of intangible assets. Panel regression analysis explored the relationship between intangible asset intensity and variables such as tangible asset intensity, sales growth, profitability, firm size, leverage, cash reserves, and R&D activities. Our findings contribute to existing literature by revealing the complex interplay between firm-specific characteristics and intangible assets, suggesting that these relationships may be more nuanced than previously understood.

A key limitation is the study's focus on three European countries, which may affect the generalizability of the results. Additionally, the sample size was limited by the exclusion of companies with incomplete or inaccurate data, impacting the analysis of R&D expenditures. Future research should expand the geographic scope to include a broader range of countries and investigate policies that encourage companies to disclose more comprehensive information about intangible assets, enhancing transparency and understanding of these critical value drivers.

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